



National Report

# LEAD IN THAILAND'S NEW ENAMEL HOUSEHOLD PAINTS

October 2013



Ecological Alert and Recovery-Thailand (EARTH)



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**This** report presents new data on the lead content in enamel household paints for sale on the Thai market. It examines the level of lead contamination in these paints and advocates for sufficient measures to control the use of lead in household paints and to guarantee consumer safety.

The report also reviews national policy frameworks that are in place to ban or restrict the national manufacture, import, sale and use of leaded household paints.

It presents background information on why the use of household paints with high lead content is a source of serious concern, especially to children's health. It proposes recommendations for taking action to protect children and others from lead in paint.

The report was prepared by Ecological Alert and Recovery - Thailand (EARTH) with support and assistance from the Asian Lead Paint Elimination Project. The Asian Lead Paint Elimination Project has been established to eliminate lead in paint and raise widespread awareness among business entrepreneurs and consumers about the adverse human health impacts of lead-based decorative paints, particularly on the health of children under six years old.

The Asian Lead Paint Elimination Project is being implemented by IPEN over a period of three years in seven countries (Bangladesh, India, Indonesia, Nepal, Philippines, Sri Lanka, and Thailand) with funding from the European Union (EU) totaling EUR €1.4 million. While this publication has been produced with the assistance of the European Union, the contents of the publication are the sole responsibility of EARTH and can in no way be taken to reflect the views of the European Union. In addition, this document was produced with financial contributions from the Swedish Environment Protection Agency, Swedish public development co-operation aid through the Swedish Society for Nature Conservation (SSNC). The views herein shall not necessarily be taken to reflect the official opinion of any of these donors, including SSNC or its donors.

EARTH is an independent non-profit organization striving for social and environmental sustainability and justice in Thai society. EARTH serves as a watchdog monitoring the Thai government's industrialization policy, industrial pollution and unsustainable consumption patterns. EARTH promotes climate justice, good governance and accountability of governmental and international agencies. EARTH focuses on the impacts of hazardous substances on ecosystems, local communities and workers' health.

IPEN is an international NGO network of health and environmental organizations from all regions of the world in which EARTH participates. IPEN is a leading global organization working to establish and implement safe chemicals policies and practices to protect human health and the environment. Its mission is a toxics-free future for all. IPEN helps build the capacity of its member organizations to implement on-the-ground activities, learn from each other's work, and work at the international level to set priorities and achieve new policies.

The European Union is made up of 28 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development, while maintaining cultural diversity, tolerance and individual freedom. The European Union is committed to sharing its achievements and its values with countries and people beyond its borders.



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# Executive Summary

## The Study

In February 2013, the Thai NGO EARTH purchased 120 cans of oil-based (enamel) house paints from stores across Bangkok and nearby provinces in central and eastern Thailand, following a survey of paint brands commonly sold in different regions of the country. The availability of these paints in retail establishments suggests that they are intended to be used within home environments. Excluded were automotive and industrial paints that are not typically used for domestic housing applications or to paint toys.

EARTH sent samples of the paints to be analyzed for lead content by a laboratory in Italy accredited by ACCREDIA - the Italian Accreditation System. The lab participates in the Environmental Lead Proficiency Analytical Testing (ELPAT) program. Paints from 68 paint brands manufactured by 42 companies were analyzed.

## Summary of results of paint lead levels in Thailand

Table 1: Paint analysis results from 2013 sampling study

	No. of paints analyzed	% paints with lead levels less than or equal to 100 ppm*	% paints with lead levels over 100 ppm	% paints with lead levels over 10,000ppm	Highest level detected (ppm)
Year 2013	120	21	79	40	95,000
- Bright color (mainly yellow)	68	7	93	71	95,000
- White color	52	38	62	0	9,500

**The majority of household paints were found to contain high lead levels.** Out of 120 oil-based household paints, 79 percent contained lead over 100 ppm. Of the 68 bright color paints, 93 percent contained lead over 100 ppm. Of the 52 white paints, 62 percent contained lead over 100 ppm.

**The majority of bright color paints contained extremely high levels of lead.** Seventy percent of bright color paints contained lead levels over 10,000 ppm. The highest level of lead detected among bright colors of paint was 95,000 ppm, while the highest level of lead in white paints was 9,500 ppm.

**A majority of paint manufacturers produced paint with high lead levels.** Forty-two manufacturers produced the 120 paint samples collected for this study. Only 15 of these manufacturers produced enamel paint products with a lead concentration within 100 ppm.

**Paints labeled “lead-free” often are not.** Twenty-nine out of 120 paints were sold with lead-free labeling, e.g. “No Added Lead,” “Lead Free”, and “100% Lead Free” However, over half of these samples, or 17 out of 29 paints, contained lead levels over 100 ppm.

\* Thai voluntary standards for lead in enamel paints was recently reduced from 600 to 100 parts per million (ppm) maximum lead content, as of 2010. Paints with no intentionally added lead will consistently contain low lead levels below 90 ppm. In contrast, lead paints, or paints containing lead compounds as an intentionally added ingredient, contain lead levels far above 90 or 100 ppm. The trace amount of lead is due to unintentional contamination from the production process.

## Conclusions and Recommendations

Lead paints continue to be sold widely on the Thai market. The majority of enamel paints, analyzed in the year of 2010 and 2013, still contained lead at levels exceeding the Thai Industrial Standard Institute (TISI) voluntary standards. Based on the manufacturing dates of all analyzed samples, between 2007 and 2013, the use of lead compounds in paint products is widespread. Voluntary standards, therefore, appear to be insufficient for lead paint control. In addition, consumers have no way to distinguish safe from unsafe products. Knowledge of lead content in paints is an essential first step for consumers to exert market pressure for product improvement.

EARTH recommends:

1. **Mandatory standards** for lead content in enamel household paints not exceeding 0.06% or 600 ppm which should take effect by 2014 as an immediate measure, and stricter mandatory standards of 0.01% or 100 ppm in the future to ensure consumer safety
2. **Required warning labels** to indicate the health risks of lead, lead dust hazards, and the lead content in household paints which should take effect by 2014 enabling consumers to make informed choices
3. **Government assistance to small and medium enterprises (SMEs)** to ensure that all paint manufacturers will have equal opportunity to market high quality paints with little or no lead content.
4. **Regular monitoring of the household paint market** by relevant government agencies, to evaluate the level of compliance and to guarantee consumer safety
5. **Increased public awareness of the health and environmental danger of lead paint**, with continued communication from the government, manufacturers and civil society. In the beginning, public awareness campaigns may target major consumers of paint, such as child-care centers, schools, hospitals and large-scale residential buildings.

# Introduction and Background

## to the Lead Paint Issue

**Lead** is a toxic metal, which can be found in paints when a paint manufacturer intentionally adds one or more lead compound to the paint for some purpose. The lead compounds most commonly added to paint are pigments that give the paint its color. Lead compounds commonly used as paint pigments include: lead chromates, lead oxides, lead molybdates, and lead sulfates. These are added to produce bright colors such as yellow, red and green. Lead compounds may also be added to paint to serve as drying agents and catalysts in oil-based paints. These make the paint dry faster and more evenly. Lead-based corrosion resistance agents are sometimes added to paints that are used on metal surfaces in order to inhibit rust and corrosion. The most common of these is lead tetroxide, sometimes called red lead or minium.

Good, cost-effective substitutes for all the lead compounds that are used in making household paints have been widely available since the 1980's and before. Any paint manufacturer that currently produces household paints with added lead compounds could easily reformulate its paints using these substitutes with very little (if any) impact on the characteristics of the paints they produce or on the price. There is no good reason for a paint manufacturer to continue producing paints with added lead compounds, especially since the childhood health hazards associated with lead paint are very serious and well-documented.

When a paint manufacturer does not intentionally add lead compounds in the formulation of its paints, the lead content of the paint will be very low - almost always less than 90 parts per million (total lead, dry weight). If a paint manufacturer is careful in selecting ingredients that do not contain lead as a contaminant, the lead content of the paint will often be as low as 10 parts per million or less.

EARTH and IPEN recommend 90 or 100 ppm as an achievable and protective goal for lead in paint worldwide. International health organizations generally believe that no level of lead exposure is safe, and 30 countries worldwide have phased out the use of lead paint. Meanwhile, 90 ppm is the current standard for household paints in the US and Canada, and 100 ppm is the current voluntary standard for household paints in Thailand.

In almost all cases where recent studies has been made, water-based paints (sometimes called latex or acrylic paints) do not contain added lead. On the other hand, in most developing countries and countries with economies in transition where paints have recently been analyzed for their lead content, many of the oil-based paints (sometimes called *enamel paints*) contain high lead content. For this reason, the current study, *Lead in Thailand's New Enamel Household Paints*, selected to only analyze oil-based paints for lead content.

## *Lead Exposure to Children and its Health Effects*

Children are not generally exposed to lead from paint while the paint is still in the can or even when the paint is being newly applied to a previously unpainted or uncoated surface. Rather, the lead exposure generally occurs after the lead paint has already dried on the wall or on the article that has been painted.

Painted surfaces age, weather, and chip with time. Any lead that is in the paint then enters indoor and outdoor dusts and soils in and around the painted home or building. Children have an innate curiosity to explore their world and engage in developmentally appropriate hand-to-mouth behavior. When playing in lead contaminated environments, the dust and soil that they ingest will carry lead. This is especially true for children in the six years and under age group, the group most easily harmed by exposure to lead. For example, a typical one to six year old child ingests approximately 100 milligrams of house dust and soil each day.<sup>1</sup>

Paint chips can be especially harmful since their lead content can be much higher than what is typically found in dust and soils. In some cases, children may pick up paint chips and put them into their mouth. In addition, when toys or other articles are painted with lead paint, children may chew on them and directly ingest the lead-contaminated dried paint. However, the most common way in which children ingest lead is thought to be through lead-containing dust.

Children and workers are especially at risk when surfaces that were previously painted with lead paint are repainted or disturbed by construction or other activities. Workmen may sand, dry scrape, grind, or in other ways disturb the old painted surface and produce large quantities of dust with very high lead content.

Exposure to lead is much more harmful to children than adults, and the health effects are generally irreversible and can have a lifelong impact.<sup>2</sup> The younger the child, the more harmful lead can be. The human fetus is the most vulnerable and a pregnant woman can transfer lead that has accumulated in her body to that of her developing child. That means that lead can poison several generations, and not only one person during active exposure.

Children are more biologically susceptible to lead than adults for several reasons including:

- A child's brain undergoes very rapid growth, development and differentiation and lead interferes with this process. Brain damage caused by chronic, low-level exposure to lead during early years is irreversible and untreatable.
- Exposure to lead early in life can re-program genes, which can lead to altered gene expression and an associated increased risk of disease later in life.
- Gastrointestinal absorption of lead is enhanced in childhood. Up to 50 percent of ingested lead is absorbed by children, as compared with 10 percent in adults. (Pregnant women may also absorb more ingested lead than other adults). In those children who suffer from nutritional deficiencies, ingested lead is absorbed at an even more increased rate.

Evidence of reduced intelligence caused by childhood exposure to lead has led the World Health Organization to list "lead caused mental retardation" as a recognized disease, which WHO lists as one of the top ten diseases caused by preventable environmental factors.<sup>3</sup>

The World Health Organization also stated that there is no level of lead safe for human health.<sup>4</sup> Chronic, low-level exposure to lead during early years of child development causes brain damage that is irreversible and untreatable. Lead-caused mental retardation affects more than 600,000 children each year, mostly in middle-income and low-income countries.<sup>5</sup>

In the 1990s, most countries worldwide, including Thailand, eliminated a major source of childhood lead exposure by banning the use of leaded gasoline.<sup>6</sup> Today, lead in paint has become a major source of childhood lead poisoning. Lead in paint enters the home and school environment in the form of lead dust, invisible to the naked eye.

In recent years, medical researchers have been documenting significant health impacts on children from lower and lower lead exposures.<sup>7</sup> In response, the U.S. Center for Disease Control and Prevention (CDC) and other authorities have concluded that there is no known acceptable lead exposure level for children.<sup>8</sup>

### *Global Lead Paint Elimination Efforts*

The use of lead in household paints is a matter of global concern. At an International Conference on Chemicals Management (ICCM) held in 2009, lead paints were identified by consensus to be international priority issues of concern. Representatives of the Government of Thailand participated in this conference and its decisions.

In response to the ICCM decision, the United Nations Environmental Programme (UNEP) and the World Health Organization (WHO) jointly initiated a global partnership to eliminate the use of lead compounds in paints in order to protect public health and the environment. This partnership is called the Global Alliance to Eliminate Lead Paint (GAELP), and its overall goal is to prevent children's exposure to lead via paints containing lead and to minimize occupational exposures to lead in paint. GAELP's broad objective is to phase out the manufacture and sale of paints containing lead and, eventually, to eliminate the risks from such paint

In 2012, the third meeting of the ICCM was held. A representative of the Government of Thailand also participated in this meeting. The Conference agreed by consensus to call upon governments, civil society organizations, and the private sector to contribute to GAELP in various ways including by:

- Raising awareness about the toxicity to human health from lead in paint including for young children, paint users, and the workers in paint production facilities;
- Filling information gaps by analyzing paints for their lead content in countries where little or no data is available;
- Promoting national regulatory frameworks, as appropriate, to stop the manufacture, import, export, sale and use of lead paints and products coated with lead paints;
- Encouraging paint manufacturing companies to substitute lead compounds added to paint with safer alternatives; and
- Establishing prevention programs to reduce exposure in and around housing, childcare facilities, schools and other buildings where lead paint has been used in the past.



# Thai Policy and Legal Framework

## for Eliminating Lead Paint

**Most** highly industrial countries enacted laws, regulations or mandatory standards to protect the health of their people in the 1970's and 1980's. These laws generally prohibit the manufacture, import, sale or use of lead paint for interiors or exteriors of homes, schools and commercial buildings. In recent years, these regulations have become increasingly stringent. The standard adopted by the United States imposes an upper limit of 90 parts per million (ppm) on total lead (dry weight) for household paints and many other paint categories. Other countries have adopted mandatory limits in the range of 90 to 600 ppm total lead (dry weight). NGOs associated with the IPEN network generally promote the 90-ppm standard as one that is fully achievable and maximally protective.

For decades, household paints that are produced for sale in highly industrial countries have not used added lead compounds as pigments, drying agents or for other purposes. Most paint manufacturers that produce paints for sale in the developing world know the reason why. It is unfortunate that lead paints for household use are still being produced, sold and used. This practice must now end.

Thailand issued voluntary standards for lead in household paint as early as 1978, beginning with water-based (emulsion) paints.<sup>9</sup> Today, the voluntary standard for lead in emulsion paints is 100 ppm for many different types of paints: general use, weather-resistant, fire-resistant, solar heat reducing, and glossy emulsion paints.<sup>10</sup> In 2010, the voluntary standard for lead in enamel paints was reduced from 600 ppm to 100 ppm for glossy and matte enamel paints.<sup>11</sup> Thai paint manufacturers have begun to produce lead-free paint as early as 1977.<sup>12</sup> Today, a number of companies advertise paint products as having no added lead, but rely mostly on a self-certification system.

Recent efforts by various national government institutions suggest that Thailand is moving towards a mandatory standard on lead in household paint. In November 2012, the Thai National Assembly's Industry Committee, an advisory arm of Thailand's main legislative body, recommended the Prime Minister that existing standards for all types of paint products be converted to mandatory standards, and that the level of allowable lead be determined with human safety in mind.<sup>13</sup> The Industry Committee also recommended that public schools, child-care centers and government offices purchase only paint products that meet industrial product standards. The Office of Prime Minister heeded the recommendations and ordered the relevant ministries and agencies to follow the recommendations. In December 2012, the Ministry of Interior, for instance, issued the same recommendations to all provincial governors and local government authorities.<sup>14</sup> In January 2013, the Thai Industrial Standards Institute invited all paint manufacturers to a forum about producing paints in compliance with industrial product standards.<sup>15</sup>

Beginning in February 2013, some local governments began to issue legally-binding municipal notices requiring that publicly-funded child-care centers purchase only paints that meet industrial standards for lead content.<sup>16</sup> In March 2013, the National Economic and Social Advisory Council submitted a set of recommendations to the Prime Minister entitled "Lead in Household Paints: a Preventable Danger."<sup>17</sup> In August 2013, the Thai Cabinet issued a cabinet resolution to implement the recommendations which include that voluntary industrial standards for lead content in oil-based (enamel) household paints become mandatory standards by the end of 2013. In addition, the Cabinet Resolution advised public schools to require the use of paint with lead levels below 90 ppm and advised the Office of Consumer Protection to require warning labels on the lead content in household paints by the end of 2013.<sup>18</sup>

To date, the Thai paint industry has remained largely self-regulated. According to Thai Paint Manufacturers Association (TPMA) estimates in January 2013, there are approximately 200 paint manufacturers nationwide. Only 63 percent of all paint manufacturers (126 companies) are legally registered, and only 18 percent (36 companies) are members of the association.<sup>19</sup>

Nonetheless, the TPMA has expressed support for a future ban of leaded paint. TPMA conducted an industry survey in May 2012 and presented its findings at the Second Meeting of the Global Alliance to Eliminate Lead Paint in July 2012, indicating that Thai paint companies are willing to transition away from the use of lead compounds.<sup>20</sup> TPMA is supportive of either mandatory standards or a future ban on leaded paint, but requested that the government provide sufficient time and support measures for implementation.<sup>21</sup>

There is a lack of financial disclosure in the Thai paint market due to the fact that 99 percent of paint manufacturers are not public companies. Factory registration data at the Thai Department of Industrial Works (DIW) as of October 11, 2013 indicates that there are 307 facilities employing a total of 10,168 employees producing products for painting, spraying or coating surfaces - categorized as DIW factory class 45(1). Only 2 factories (1 percent) are registered as public companies. Thirty-eight factories (12 percent) are family businesses registered to individuals or as limited partnerships. Two hundred and sixty-seven factories (87 percent) are registered as limited companies, which are not required to disclose financial information to the public.<sup>22</sup>

As a result, estimates on the value of Thailand's paint industry vary widely, and are mostly based on speculations by paint manufacturers themselves. The total value of Thailand's paint market in 2012 ranges from 12 to 19 billion baht (283 to 448 million Euros) according to estimates by Jotun Thailand (12 billion), Akzo-Nobel Paint (Thailand) (14 billion), Beger (15-17 billion), Nippon (16 billion), TPMA (18.2 billion) and TOA (19 billion).<sup>23</sup> Despite the broad range of statistics, it is certain that the Thai paint market has continued to grow over the past several years, with annual growth estimates ranging from 5 percent (Kasikorn Bank Research Center 2010) to 12 percent (TOA 2012).<sup>24</sup>

The share of the decorative paint market ranges from 49 percent<sup>25</sup> to 65 percent<sup>26</sup> of the entire paint market in Thailand. Market share estimates are projected by paint manufacturers themselves for decorative and industrial paint markets combined, and do not add up to one hundred percent. It is widely accepted that TOA Paint (Thailand) holds the largest market share in Thailand's paint market, ranging from 40 percent<sup>27</sup> to 54 percent.<sup>28</sup> Other dominant paint manufacturers include Akzo-Nobel Paint (Thailand) with 15 percent market share,<sup>29</sup> Nippon Paint (Thailand) with 10-14 percent market share,<sup>30</sup> Thai Kansai Paint with 13 percent market share,<sup>31</sup> Jotun Thailand with 9-12 percent market share,<sup>32</sup> and Beger with 10 percent market share.<sup>33</sup> Of these six dominant paint manufacturers, three are subsidiaries of foreign companies (Akzo-Nobel, Nippon and Jotun based in the Netherlands, Japan and Norway, respectively), two are Thai companies (TOA and Beger) and one is a joint venture between Japanese and Thai businesses (Thai Kansai Paint).

All of the six major paint manufacturers are included in this sampling study, represented by the following brands: 4 Seasons, Homecote, Kobe, Mandarin Duck Super Matex, TOA and TOA Glipton manufactured by TOA; ICI Supercote manufactured by Akzo-Nobel Paint (Thailand); Bodelac and Nippon ShieldPro manufactured by Nippon Paint (Thailand) and its affiliate company Nippon Paint Decorative Coating (Thailand); Ftalit manufactured by Thai Kansai Paint; Jotun Gardex and Jotagloss manufactured by Jotun Thailand; Beger Delight Titanium, Beger Shield and Ben-Tone manufactured by Beger's paint factory registered as B. N. Brother Limited Partnership.

Of the 42 total paint manufacturers included in this sampling study, 31 percent (13 manufacturers) are small enterprises, 33 percent (14 manufacturers) are medium enterprises and 19 percent are large enterprises (8 manufacturers) according to the criteria issued by the Small and Medium Enterprise Development Bank of Thailand (SME Bank).<sup>34</sup> The remaining sample includes 7 percent (3 manufacturers) of legally-registered factories with no manufacturing capacity information and 10 percent (4 manufacturers) which are not legally registered.

In February and March 2013, Thai NGO, Ecological Alert and Recovery - Thailand (EARTH) with assistance and support from the international NGO network IPEN, purchased 120 cans of oil-based (enamel) house paints from stores across Bangkok and five nearby provinces in central and eastern Thailand, namely, Nonthaburi, Samut Prakarn, Patum Thani, Ayudhya and Chachoengsao. The purchase of house paints followed a paint market survey, which identified paint brands commonly available to consumers in three different types of retail stores: large franchise stores found throughout the country, medium-sized stores favored by contractors selling both wholesale and retail products, and small neighborhood stores. The paint market survey was conducted in collaboration with a non-profit consumer rights organization, the Foundation for Consumers, in four sample locations across Thailand: Chiang Mai city and nearby suburbs in northern Thailand, Khon Kaen city and nearby suburbs in northeastern Thailand, Chachoengsao city and nearby suburbs in eastern Thailand and the Bangkok metropolitan area and nearby suburbs in central Thailand.

Paint purchases covered 68 different brands, consisting of 68 paints of bright colors (mostly yellow, but including orange, red, green or blue when yellow was not available) and 52 white paints from the same brands whenever possible. The availability of these paints in retail establishments suggested that they were intended to be used within home environments. Excluded were automotive and industrial paints that are not typically used for domestic housing applications or to paint toys.

Paint sample preparation kits containing individually numbered, untreated wood pieces, single-use brushes and stirring utensils made from untreated wood sticks were assembled and shipped to EARTH by staff of the IPEN partner NGO, Arnika, in the Czech Republic. Each paint was thoroughly stirred in the can and applied by a separate unused single-use brush to duplicate, individual, numbered, unused, wood pieces by staff of EARTH.

Each stirring utensil and paintbrush was used only once, and care was taken to avoid cross contamination. After drying, the wood pieces were placed in individual plastic bags and shipped for analysis of lead content to Certottica laboratory in Italy.

Certottica is accredited by ACCREDIA - the Italian Accreditation System, which is the Italian National Accreditation Body appointed by the State. This laboratory participates in the Environmental Lead Proficiency Analytical Testing (ELPAT) program operated by the American Industrial Hygiene Association under a program established by the US Environmental Protection Agency.

The laboratory scraped paint off the wood pieces they received. The paint was then weighed into a hot block digestion tube and the paint chips digested according to method CPSC-CH-E1003-09.1. A quantity of paint was removed from the sample by abrasion. The paint was placed in a beaker of borosilicate, in which were added 3 mL of HNO<sub>3</sub> and 1 mL of 30% H<sub>2</sub>O<sub>2</sub>. The beaker was first covered with a glass and then was heated on a hotplate (surface temperature of approximately 140° C, from 85 initially to 100° C) until most of the acid evaporated. This treatment was repeated twice more. The beaker containing the sample was removed from the plate and let cool to room temperature. The cover glass was rinsed with a quantity of HNO<sub>3</sub> 10% from 3 to 5 mL and the solution was left to evaporate slowly and let cool to room temperature. Finally, 1 mL of HNO<sub>3</sub> was added to the residue, which was agitated to dissolve the soluble species. The walls of the beaker and the bottom of the cover glass were rinsed and the whole was transferred into a flask and brought to volume with deionized water.

Lead in the digestates was analyzed by an Atomic emission spectrophotometer (ICP-AES), Thermo Scientific iCAP 6000 Series, using yttrium (2 mg/L) as internal standard.

The laboratory's lower limit of detection for the lead concentration in the paint samples is dependent on the amount of paint the samples. Generally, for 100 mg of paint scraped off the wood pieces the lowest detection limit is 8 ppm, but for a smaller amount of paint the detection limit increases. Therefore, the lead content in four of the samples is reported as below 9 ppm.

## Results and Discussion

A total of 120 cans of new enamel decorative paint from 68 brands were purchased in Thailand and analyzed for total lead content. The details of the paints are listed in *Appendix 1*, and a summary is presented in Table 2, along with results of an earlier sampling conducted by EARTH in 2010. The results are expressed as parts per million (ppm) total lead, based on the dry weight of the paint sample.

### *Lead Content in Enamel Household Paints*

Analysis of lead content in samples from all 120 enamel paints (representing 68 brands) showed:

- 79 percent of paints (95 paints from 63 brands) contained lead above 100 ppm
- 40 percent of paints (48 paints from 47 brands) contained high levels of lead, above 10,000 ppm
- The average concentration of lead in paints was 19,101 ppm
- The highest level of lead for paints detected was 95,000 ppm, and the lowest level detected was less than 9 ppm.

**Table 2: Lead Content in Enamel Household Paint Samples**

Types of Paint	Number of Samples	Paints with Lead Level ≤ 100 ppm*	Paint with Lead Level >100 ppm*	Lowest Level of Lead Detected (ppm)	Highest Level of Lead Detected (ppm)
<b>Enamel (2013)</b>	120	21% (25 samples)	79% (95 samples)	< 9	95,000
• <b>Bright colors</b>	68	7% (5 samples)	93% (63 samples)	26	95,000
• <b>White colors</b>	52	38% (20 samples)	62% (32 samples)	< 9	9,500
<b>Enamel (2010)**</b> • <b>Mainly yellow</b>	31	16% (5 samples)	84% 26 samples	< 3	34,442

\* Voluntary industrial product standards require that gloss and matte enamel paints contain lead levels no more than 100 ppm (TIS 327-2553 for gloss enamel and TIS 1406-2553 for matte enamel)

\*\* 2010 samples were analyzed by Intertek Testing Services (Thailand), a private laboratory accredited by the Thai Industrial Standards Institute (TISI) and the US Consumer Product Safety Commission (CPSIA)

## *Lead Content in Bright Colors*

Results from the analysis of lead content in samples from the 68 bright color enamel household paints (representing 64 brands) are shown in Figure 1, with details in *Appendix 2*.

Analysis of lead content in the samples from paints with bright colors showed:

- 93 percent of bright color paints (63 samples from 60 brands) contained lead content above the voluntary standard of 100 ppm
- 70 percent of bright color paints (48 samples from 47 brands) contained extremely high levels of lead, above 10,000 ppm
- The average concentration of lead in bright paints was 32,301 ppm
- The highest level of lead detected in bright color paints was 95,000 ppm, and the lowest level detected was 26 ppm.

## *Lead Content in White Color*

Results from the analysis of lead content in samples from the 52 white enamel household paints (representing 51 brands) are shown in Figure 2, with details in *Appendix 3*.

Analysis of lead content in samples from the white paints showed:

- 61 percent of white paints (32 paints from 32 brands) contained lead content above the voluntary standard of 100 ppm
- The average concentration of lead in white paints was 1,840 ppm
- The highest level of lead detected in white paints was 9,500 ppm, and the lowest level detected was less than 9 ppm.



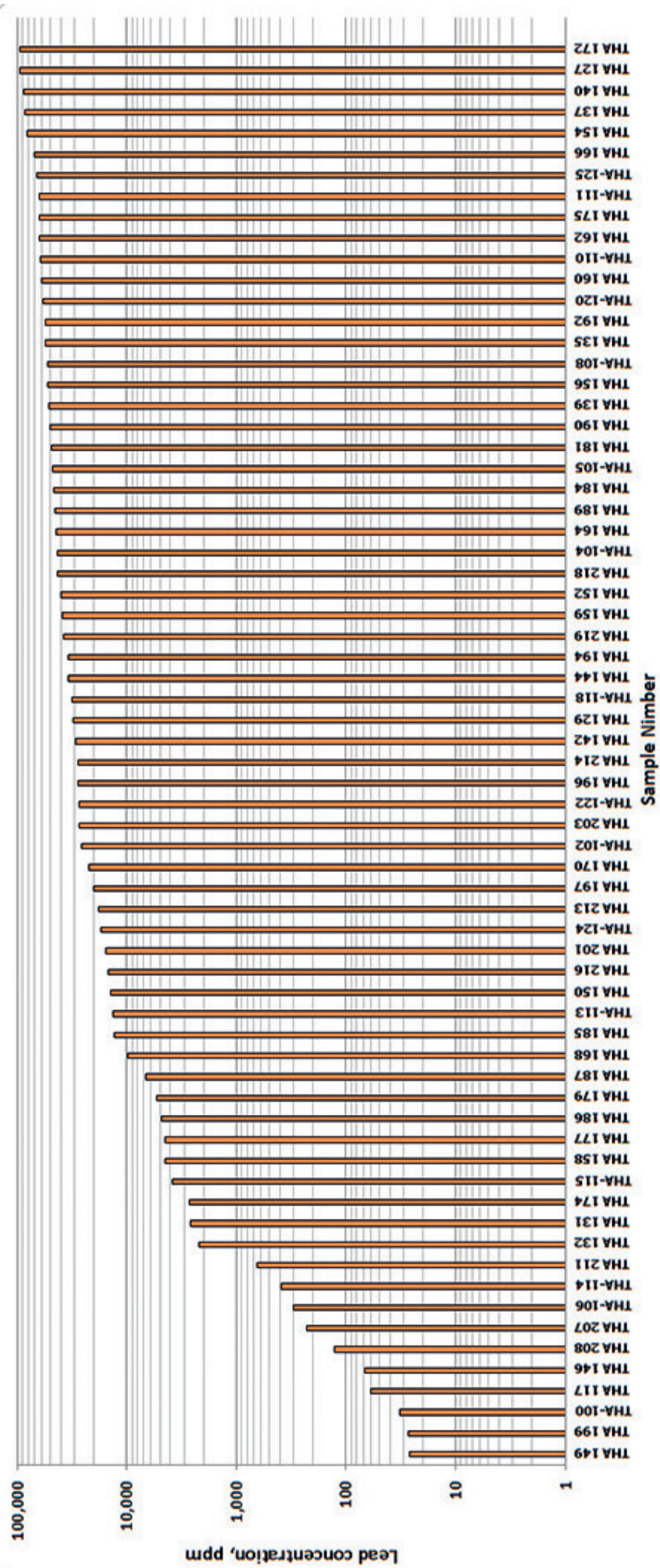


Figure 1: Lead content in 68 bright color samples of enamel household paints

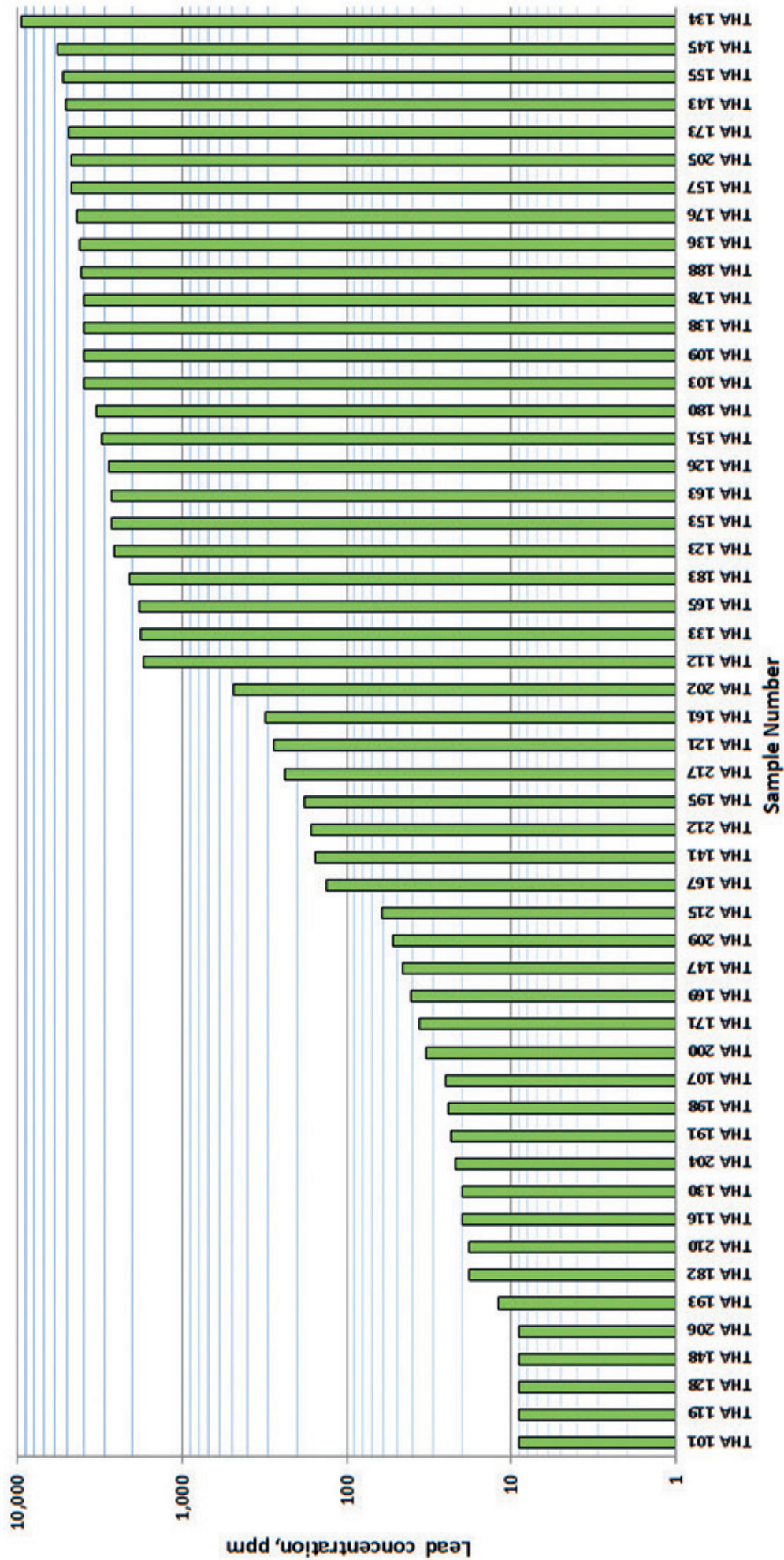


Figure 2: Lead content in 52 white color samples of enamel household paints



## Lead Content Categorized by Manufacturers and Brands

The 120 paints analyzed in this study represent 68 brands. Of these, 63 paint brands, or 93 percent, include paints with lead levels above 100 ppm and 47 brands, or 69 percent, include paints with lead levels above 10,000 ppm, as detailed in Table 3. See more details in *Appendix 4*.

**Table 3: Lead Content and Percentage of Surveyed Brands**

Color of Paints	Number of Brands	Number and Percentage of Brands		
		Lead ≤ 100 ppm	Lead > 100 ppm	Lead > 10,000 ppm
<b>Total</b>	<b>68</b>	<b>22 (32%)</b>	<b>63 (93%)</b>	<b>47 (69%)</b>
● Bright Color (mainly yellow)	64	5 (8%)	60 (94%)	47 (71%)
● White Color	51	20 (39%)	32 (63%)	-

A total number of 42 manufacturers produced the 68 brands analyzed in this study. Amongst the 42, four are multinational corporations based in other countries, three are large Thai corporations and remaining are small and medium enterprises (SMEs) as defined by the Small and Medium Enterprise Development Bank of Thailand (SME Bank). No manufacturer details were provided for two of the brands analyzed (four samples).

Of the 42 manufacturers, 15 produced or distributed enamel paints with lead concentration below 100 ppm. Four of these manufacturers produced both bright and white colored paints with lead content below 100 ppm, and 10 manufacturers produced white paints with low lead levels (below 100 ppm), but brightly colored paints with high lead levels. One manufacturer produced only white colored paints, so no comparison could be made with brightly colored paints. More details can be found in *Appendix 5*.

## Lead content in other surface coating products

In addition to the 120 enamel paints, this study also determined the lead content in five other surface coating products: metal primer, primer for old concrete, and wood stain. These products are sold in retail stores along with household paints for general consumer use. Inside the home, metal primers are often used to coat metallic doors, windows and stair railings before applying paint. Primers for old concrete are used to coat concrete walls before applying paint. Wood stains are used as a colorless coating for wooden doors and window sills. Results of the analysis are shown in Table 4.

**Table 4: Lead content in other surface coating products**

No.	Brand/Product	Country of Brand Headquarter	Color	Can Size	Date of Manufacture	Lot No.	Lead Information on Can	Lead content (ppm)
THA 220	Rust-Oleum Red Metal Primer	USA	Red 1069	0.946 L	01/02/12	Lot. D1220108	None	136,000
THA 221	IEC Primer for Old Concrete	Thailand	MAFIX 600	0.946 L	23/10/10	Lot. 310193	None	162
THA 222	Lena Wood Stain Gloss Finish	Thailand	Palisander LW-016	900g.	14/02/11	Lot. 11020098	None	2,800
THA 223	TOA Wood Stain Gloss Finish	Thailand	Autumn Teak G 07	0.946 L	N/A	Batch. 120329102	"No added Lead, No Added Mercury"	34
THA 224	Jotun Gardex Red Metal Primer	Norway	Red	0.946 L	26/12/12	Lot. 2X4REDBVA	None	67

Lead content in descending order: Rust-Oleum Red Metal Primer, LENA Wood Stain Gloss Finish and IEC Primer for Old Concrete. Trace amounts of lead were found in Jotun Gardex Red Metal Primer and TOA Wood Stain. The above data suggests that primers and wood stains with both high and low lead levels are available on the Thai market.

### Lead Content Labels

Approximately one quarter of the analyzed paints (29 of 120) were sold with self-certified labels advertising “No Added Lead,” “Lead Free,” or “100% Lead Free.” However, samples from over half of these paints (17 of 29) contained lead content over 100 ppm. All of these paint labels also claimed to have no added mercury. However, the scope of this study did not include an analysis of mercury in paints. Thailand currently has no mandatory measures on labeling regarding the content of lead, lead dust hazards or other toxic substances in household paint products.

**Table 5: Examples of Lead-Free Labels and Actual Lead Content**

 <p>Lead Content 56,000 ppm (THA192) Denzo Paint by Thai TOA Industries</p>	 <p>Lead Content 53,000 ppm (THA108) Ben-Tone Paint by B.N. Brother</p>
 <p>Lead Content 49,000 ppm (THA181) Sisto Paint by Season Paints</p>	
 <p>Lead Content 48,000 ppm (THA105) Beger Shield Paint by B.N. Brother</p>	 <p>Lead Content 43,000 ppm (THA104) Beger Delight Titanium Paint by B.N. Brother</p>



Lead Content 34,000 ppm (THA194)  
Kinzo Paint by Thai TOA Industries



Lead Content 28,000 ppm (THA196)  
Tora Paint by Thai TOA Industries



Lead Content 18,000 ppm (THA213)  
Rocket Paint by T-Paint



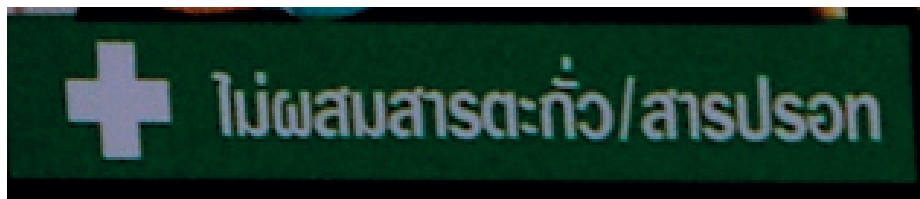
Lead Content 2,600 ppm (THA131)  
Sunke Paint by Golden Arrow Trading



Lead Content 640 ppm (THA211)  
Super Matex Paint by TOA Paint



Lead Content 230 ppm (THA207)  
TOA Glipton Paint by TOA Paint



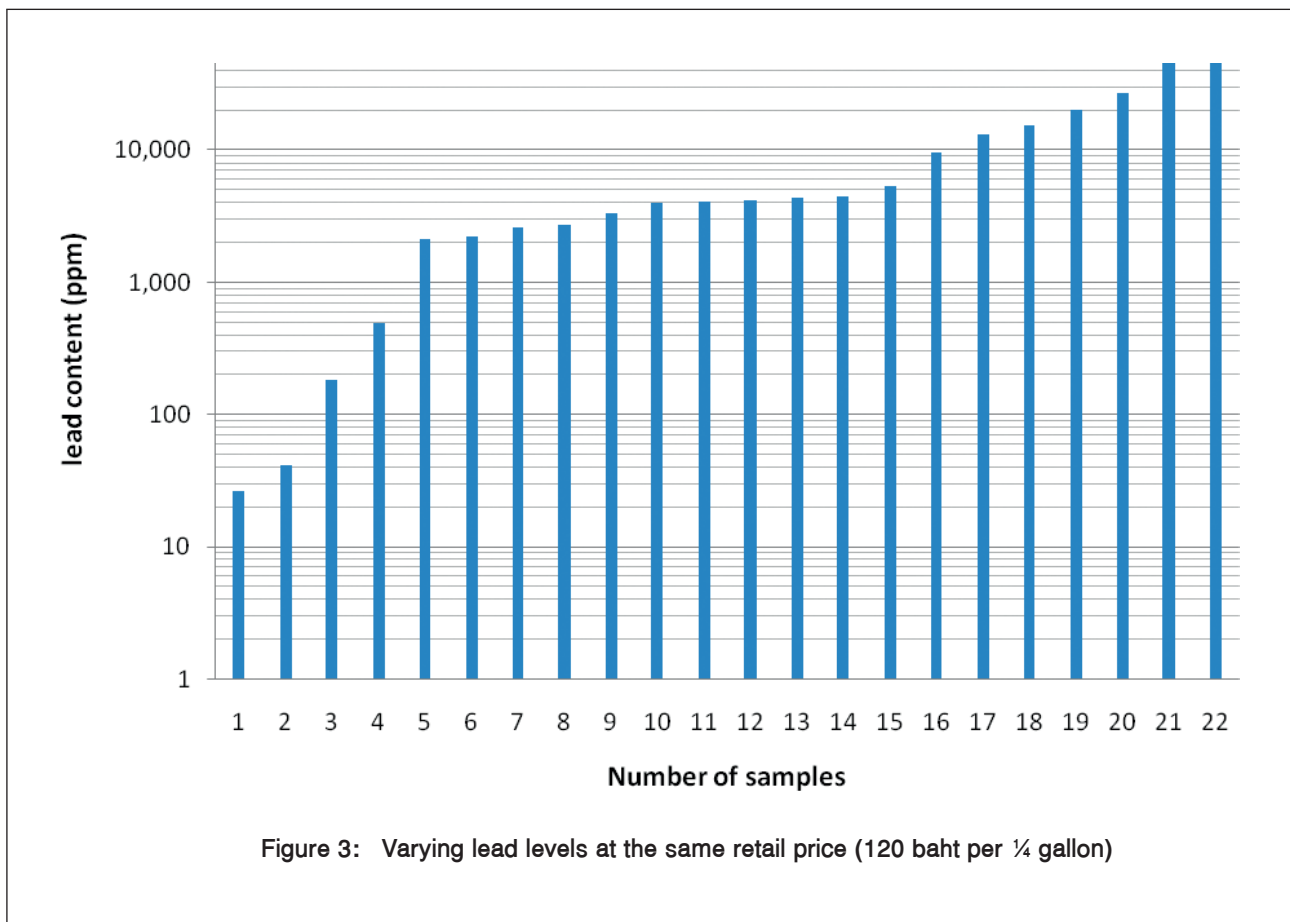
Lead Content 390 ppm (THA114)  
Captain Paint by Captain Coating (managed by TOA Paint)

## Lead Content and Retail Price

An analysis of enamel household paints sold in similar volumes found no correlation between lead content and sale price. Of 107 paints sold in ¼ gallon cans (approximately 1 liter), retail prices ranged broadly from 80-353 baht. Approximately 70 percent of these paints were sold at prices ranging from 100-150 baht. Twenty-one paints with low lead content in compliance with the Thai voluntary standard (no more than 100 ppm) ranged in price from 90-296 baht per ¼ gallon. Of 86 samples of paints that did not comply with the Thai voluntary standard (lead content over 100 ppm), prices ranged from 80-353 baht per ¼ gallon.

A comparison among paints of the same sale price also found a wide range of lead levels. For example, 22 samples sold at 120 baht per ¼ gallon contained lead levels ranging from 26 ppm to 63,000 ppm.

The broad price range for low lead paints shows that the production of low lead paint is feasible at both low and high retail prices, and that lead content may not be a major factor in retail price.



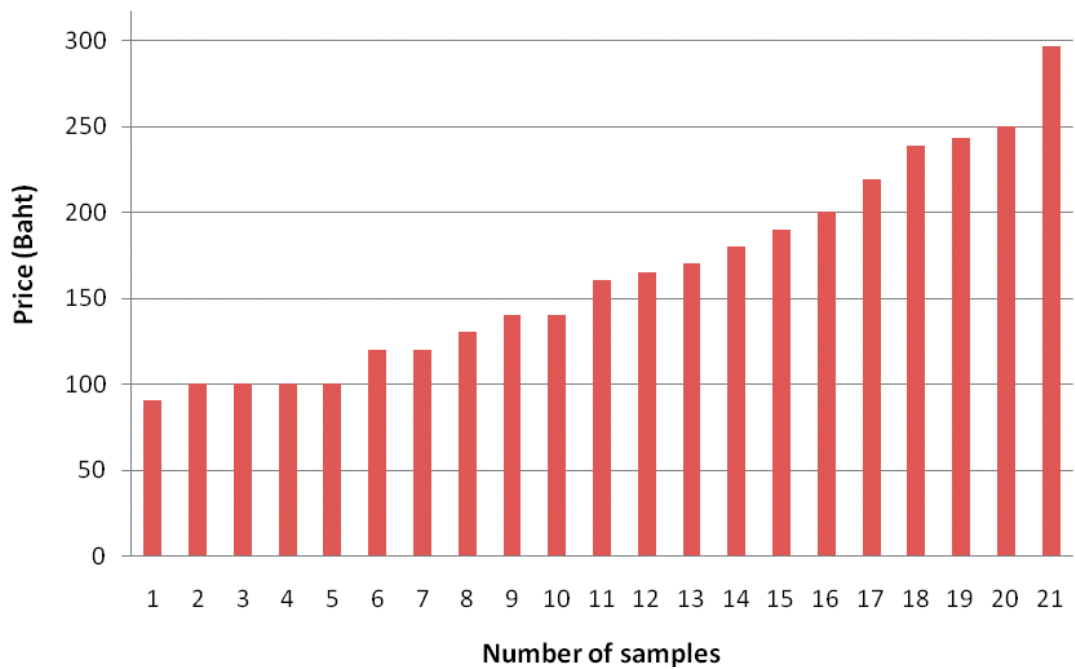


Figure 4: Varying retail prices for low lead paints ( $\leq 100$  ppm)

### *Production of Enamel Paint with Low Lead Levels*

The survey found four manufacturers — AkzoNobel Paints (Thailand), Captain Coating, Jotun (Thailand), and TOA Paint (Thailand) — producing both and white colors of paint with low lead levels (not exceeding 100 ppm). In addition, 10 manufacturers produced white paints with low lead levels, but bright colored products with high lead levels. This suggests that producing paints with low lead levels is feasible in Thailand.

## Conclusion and Recommendations

**Lead** paints continue to be sold widely on the Thai market. Most enamel household paints (79%) contain levels of lead above 100 ppm, which is the existing voluntary standard for consumer safety. Consumers have no way of distinguishing safe paints, due to the lack of reliable labels. The production of paint in compliance with the voluntary standard in Thailand is feasible and affordable for both bright color (yellow, red, etc) and white color paints. Some manufacturers, including SMEs, are already producing paints with lead levels within 100 ppm. One third of paint manufacturers included in the study produce paints with low lead levels within 100 ppm in a wide range of prices. However, without mandatory standards, few paint manufacturers have the incentive to achieve this standard consistently, and more than half of paint manufacturers choose not to comply at all.

EARTH recommends:

- 1. Mandatory standards** for lead content in enamel household paints not exceeding 0.06% or 600 ppm which should take effect by 2014 as an immediate measure, and stricter mandatory standards of 0.01% or 100 ppm in the future to ensure consumer safety
- 2. Required warning labels** indicating the health risks of lead, lead dust hazards, and the lead content in household paints, which should take effect by 2014 enabling consumers to make informed choices
- 3. Government assistance to small and medium enterprises (SMEs)** to ensure that all paint manufacturers will have equal opportunity to market high quality paints with little or no lead content.
- 4. Regular monitoring of the household paint market** by relevant government agencies, to evaluate the level of compliance and to guarantee consumer safety
- 5. Increased public awareness of the health and environmental danger of lead paint**, with continued communication from the government, manufacturers and civil society. In the beginning, public awareness campaigns may target major consumers of paint, such as child-care centers, schools, hospitals and large-scale residential buildings.



**Appendix 1: Enamel Decorative Paints Purchased in Thailand and Analyzed for Lead Content**

\*Lead Label = Label claims to have “no added lead” or to be lead-free

Sample Number	Manufacturing Company	Brand Name	Color	Can Size	Retail Price (baht)	Lot No. / Date of Manufacture	Date of Purchase	Lead Label*	Lead Content (ppm)
THA 100	AKZO Nobel Paint (Thailand)	ICI Supercote	Yellow 45YY51/758	0.89 L	296.37	Base 5: A395- CS5	20-Feb-13	Y	32
THA 101	AKZO Nobel Paint (Thailand)	ICI Supercote	White 5130296 A395-250	0.946 L	180	Bx. P 301248177	21-Feb-13	Y	< 9
THA 102	Asia Pearl Paint	SEACO Synthetic Enamel high Gloss	Yellow 326	0.9 L	130	Lot 3226016 Mfg. 21/1/2013	15-Feb-13	-	26,000
THA 103	Asia Pearl Paint	SEACO Synthetic Enamel high Gloss	White 300	0.90 L	130	Lot.3510026 Mfg. 11/2/2013	21-Feb-13	-	4,000
THA 104	B.N. Brother	Beger Delight Titanium	Reddish Yellow G-6303	0.946 L	170	Lot. 115454 Mfg. 270611	19-Feb-13	Y	43,000
THA 105	B.N. Brother	Beger Shield Super Gloss Enamel	Sulphur Yellow B-160	0.946 L	160	Lot. 115897 Mfg. 080711	12-Feb-13	Y	48,000
THA 106	B.N. Brother	Beger Shield Super Gloss Enamel	Sunny at Heart (Yellow)	0.946 L	240	Base D: 180812 Mfg. 20/02/13	20-Feb-13	Y	300
THA 107	B.N. Brother	Beger Shield Super Gloss Enamel	Primrose White B 008	0.946 L	238.43	Base A: 050113 Mfg. 20/02/13	20-Feb-13	Y	25
THA 108	B.N. Brother	Ben-Tone Super Gloss Enamel	Lemon Yellow G-301	0.875 L	110	Lot 110413 Mfg. 100111	20-Feb-13	Y	53,000
THA 109	B.N. Brother	Ben-Tone Super Gloss Enamel	White G-101	0.875 L	140	Lot. 123002004277 Mfg. 311012	22-Feb-13	Y	4,000
THA 110	Berger Paint (Thailand)	WINLEX Gloss Enamel	Golden Yellow 130	0.946 L	100	Berger 000MPI	13-Feb-13	-	62,000
THA 111	Berger Paint (Thailand)	PLATONG Gloss Enamel	Medium Yellow 380	0.875 L	110	Lot. PBS 1206724 Mfg. 29/06/2012	15-Feb-13	-	63,000
THA 112	Berger Paint (Thailand)	PLATONG Gloss Enamel	White 399	0.875 L	98	Lot. PBS 1300426 399 Mfg. 11/01/2013	22-Feb-13	-	1,710
THA 113	Captain Coating	LONGLIFE High Gloss Enamel	Imperial Yellow 2300	0.946 L	190	Lot. 1107203392	14 Feb 2013	-	13,500
THA 114	Captain Coating	CAPTAIN High Gloss Enamel Superior Finish	Temple Yellow 311	0.946 L	352.91	Base D: Lot. 1301211409 Mfg. 20/02/13	20-Feb-13	Y	390
THA 115	Captain Coating	MARK Gloss Enamel	Reddish Yellow 0M831	0.875 L	100	Lot. 1210209969	23-Feb-13	-	3,800
THA 116	Captain Coating	MARK Gloss Enamel	White 0M810	0.875 L	100	Lot. 1209209614	23-Feb-13	-	20
THA 117	Captain Paint (Thailand)	CAPTAIN High Gloss Enamel Superior Finish	Frosted lime 319	0.946 L	190	Lot. 24710005	12-Feb-13	Y	60
THA 118	Delta Paint	National Gloss Synthetic Resin Enamel	Sunflower 303	0.875 L	130	Batch 108220 Mfg. 5/2007	14-Feb-13	-	32,000



Sample Number	Manufacturing Company	Brand Name	Color	Can Size	Retail Price (baht)	Lot No. / Date of Manufacture	Date of Purchase	Lead Label*	Lead Content (ppm)
THA 119	Delta Paint	National Gloss Synthetic Resin Enamel	White 101	0.875 L	100	Batch. 552021492 Mfg.11-2012	22-Feb-13	-	9
THA 120	Delta Paint	Delta Gloss Enamel	Sulphur Yellow 820	0.946 L	170	Batch. 55201428 Mfg. 8/2012	17-Feb-13	-	58,000
THA 121	Delta Paint	Delta Gloss Enamel	Cool White 810	0.946 L	165	Batch. 552010648 Mfg. 11-2012	21-Feb-13	-	280
THA 122	Delta Paint	IBC High Gloss Enamel	Yellow Orange 444	0.875 L	120	Lot. 101939 Mfg. 2/2007	21-Feb-13	-	27,000
THA 123	Delta Paint	IBC High Gloss Enamel	White 111	0.946 L	120	Mfg. 12 2008 Lot.10784	21-Feb-13	-	2,600
THA 124	DINCO (Thailand)	WINDY Synthetic Resin Gloss Enamel	Yellow	0.3 L	45	N/A	21-Feb-13	-	17,200
THA 125	DL	POWER Gloss Finish	Medium Gold 316	0.946 L	110	Lot. 550828	23-Feb-13	-	66,000
THA 126	DL	POWER Gloss Finish	White 300	0.946 L	110	Lot. 550906	23-Feb-13	-	2,800
THA 127	DYNO Paint	RUST-OLEUM Protective Enamel	Safety Yellow 944	0.946 L	315	Batch D1212405 Mfg. 250112	13-Feb-13	-	95,000
THA 128	DYNO Paint	RUST-OLEUM Protective Enamel	White 2766	0.236 L	99	Lot. 1310802 Mfg. 080113	21-Feb-13	-	<9
THA 129	DYNO Paint	DYNO Pro Gloss Enamel	Bright Yellow G*115	0.946 L	245	Lot. S13011810 Mfg. 180113	13-Feb-13	-	31,000
THA 130	DYNO Paint	DYNO Pro Gloss Enamel	White G 100	0.946 L	219	Lot. S12120704 Mfg. 111212	21-Feb-13	-	20
THA 131	Golden Arrow Coating	SUNKE High Gloss Enamel	Oxide Yellow G 300	0.8 L	170	Lot. 1108313	21-Feb-13	Y	2,600
THA 132	HACHEM Paint	MARCO High Gloss Enamel	River Blue M-637	0.775 L	120	Lot. 114145 Mfg. 23/9/11	19-Feb-13	-	2,200
THA 133	HACHEM Paint	LOTTO Super Gloss Enamel	White L-100	0.825 L	130	Lot. 114938 15/12/....	21-Feb-13	-	1,780
THA 134	HARTFORD Paint	SEA KING High Gloss Enamel	Lily White SK 420	0.946 L	120	Batch OVO71225 Mfg. 15-7-09	14-Feb-13	-	9,500
THA 135	HATO Paint (J.K.R.)	N.O.C. Synthetic Enamel	Yellow S-234	0.875 L	120	Lot. 1211-7645-S-234 Mfg. 12/11/2012	15-Feb-13	-	56,000
THA 136	HATO Paint (J.K.R.)	N.O.C. Synthetic Enamel	White S-2600	0.875 L	120	1208-6364-S-2600 Mfg. 03/09/12	21-Feb-13	-	4,200
THA 137	HATO Paint	HATO Synthetic Enamel	Yellow	0.1 L	20	N/A	12-Feb-13	-	86,000
THA 138	HATO Paint (J.K.R.)	HATO Synthetic Enamel	White	0.3 L	40	N/A	21-Feb-13	-	4,000
THA 139	IEC Paint	IEC Enamel Paint	Sunspot A-177	0.3 L	50	N/A	14-Feb-13	-	51,000

Sample Number	Manufacturing Company	Brand Name	Color	Can Size	Retail Price (baht)	Lot No. / Date of Manufacture	Date of Purchase	Lead Label*	Lead Content (ppm)
THA 140	J.B.P. International Paint	Super Gloss JBP Synthetic Enamel	Golden Yellow 003	0.946 L	155	Lot. 31/538 060812	12-Feb-13	-	87,000
THA 141	J.B.P. International Paint	Super Gloss JBP Synthetic Enamel	White 001	0.946 L	160	Lot. 31/573 200812	26-Feb-13	-	156
THA 142	J.B.P. International Paint.	AAA Synthetic Enamel	Marigold 1227	0.875 L	140	Lot. 35/293 Mfg. 080512	19-Feb-13	-	29,000
THA 143	J.B.P. International Paint	AAA Synthetic Enamel	White 1001	0.875 L	150	Lot. 35/160 050312	24-Feb-13	-	5,100
THA 144	J.B.P. International Paint	Columbia Synthetic Enamel	Marigold 2227	0.875 L	140	Lot. 36/246 190711	20-Feb-13	-	34,000
THA 145	J.B.P. International Paint	Columbia Synthetic Enamel	White 2001	0.875 L	140	Lot. 36/79 050312	26-Feb-13	-	5,700
THA 146	Jotun Thailand	JOTUN Gardex Premium Enamel	Zinc Yellow 1018	0.9 L	250	Base B: 10/07/12 Lot. 2X2MBSAUA	21-Feb-13	Y	67
THA 147	Jotun Thailand	JOTUN Gardex Premium Enamel	Antique White (1016/S2005-Y20R)	0.9 L	242.78	Base A: 17/01/13 Lot. 2X2MAWAUA	20-Feb-13	Y	46
THA 148	Jotun Thailand	JOTAGLOSS	Candle White 1052	3.6 L	550	Base A: 04/07/12 Lot. 2Y6MAWDRA	4-Mar-13	Y	<9
THA 149	KOSMIK Polymer	SUPER-K High Gloss Enamel	Parade Blue SK 303	0.75 L	120	Batch 109025	14-Feb-13	-	26
THA 150	LENA (Thailand)	BUNDAI Gloss Finish	Reddish Yellow D 155	850 g.	110	Lot. 8070664 Mfg. 170708	21-Feb-13	-	14,200
THA 151	LENA (Thailand)	BUNDAI Gloss Finish	White D 100	800 g.	125	Lot. 13010079 Mfg. 220113	19-Feb-13	-	3,100
THA 152	LENA (Thailand)	LENA High Quality Gloss Enamel	Reddish Yellow L 421	800g.	135	Lot. 12060694 Mfg. 180612	21-Feb-13	-	40,000
THA 153	LENA (Thailand)	LENA High Quality Gloss Enamel	White L 400	800g.	135	Lot. 13010030 Mfg. 080113	21-Feb-13	-	2,700
THA 154	LEO Paint.	Bald Eagle Synthetic Enamel	Yellow Orange E-444	0.875 L	130	Mfg.16/6/2010	19-Feb-13	-	82,000
THA 155	LEO Paint.	Bald Eagle Synthetic Enamel	White E-111	0.875 L	130	Mfg. 28/3/2012	26-Feb-13	-	5,300
THA 156	LEO Paint.	BIG Synthetic Enamel	Orange B-12	0.3 L	45	Mfg. 30/01/2012	21-Feb-13	-	53,000
THA 157	LEO Paint.	BIG Synthetic Enamel	White B-01	0.3 L	45	Mfg. 14/08/2012	21-Feb-13	-	4,700
THA 158	LEO Paint.	TIGER Synthetic Enamel	Zircon Blue 834	0.88 L	120	Mfg. 10.08.09	14-Feb-13	-	4,500
THA 159	Lotto Paint	LOTTO Super Gloss Enamel	Reddish Yellow L-1155	0.825 L	130	Batch 104325 Mfg. 6.9.10	12-Feb-13	-	39,000
THA 160	Maneekarn Paint	D.I.Y. Synthetic Gloss Enamel	Butter Cup 175	0.75 L	125	Mfg. 070809	21-Feb-13	-	60,000

Sample Number	Manufacturing Company	Brand Name	Color	Can Size	Retail Price (baht)	Lot No. / Date of Manufacture	Date of Purchase	Lead Label*	Lead Content (ppm)
THA 161	Maneekarn Paint	D.I.Y. Synthetic Gloss Enamel	White 100	0.75 L	125	Mfg. 04/05/12	18-Feb-13	-	310
THA 162	MAXZO paint	SUPERSEF High Gloss Enamel	Yellow G 2103	0.900 L	130	5501166#001	24-Feb-13	-	63,000
THA 163	MAXZO paint	SUPERSEF High Gloss Enamel	White G 1000	0.900 L	130	5512263#079	24-Feb-13	-	2,700
THA 164	N/A	SEFCO Synthetic Enamel	Reddish Yellow S 155	0.85 L	125	Batch 07449 Mfg. 02/2012	12-Feb-13	-	44,000
THA 165	N/A	SEFCO Synthetic Enamel	White S 100	0.85 L	145	Lot. 02564 05/2010	21-Feb-13	-	1,820
THA 166	N/A	MP3	Yellow Orange 444	0.947 L	110	Mfg. 190609	5-Mar-13	-	69,000
THA 167	N/A	MP3	White 111	0.947 L	110	Mfg. 19/09/12	5-Mar-13	-	133
THA 168	Nam Dee Watana Chemical Co.,Ltd.	TURBO Gloss Enamel	Reddish Orange G 2159	0.9 kg.	140	Lot. 1209283 Mfg. 25-9-12	5-Mar-13	-	9,800
THA 169	Nam Dee Watana Chemical Co.,Ltd.	TURBO Gloss Enamel	Sky White G 5011	0.9 L	120	Batch 0601424 Mfg. 23.1.2006	14-Feb-13	-	41
THA 170	Nippon Paint (Thailand)	BODELAC 1000 Synthetic Resin Enamel	Yellow 124	1 Gal.	600	Lot. 20070618 Mfg. 25.06.2007	5-Mar-13	-	22,000
THA 171	Nippon Paint (Thailand)	BODELAC 1000 Synthetic Resin Enamel	White 900	1 Gal.	600	Lot. 20091208 Mfg.15.12.2009	5-Mar-13	-	36
THA 172	Nippon Paint Decorative Coating (Thailand) Co., Ltd.	SHIELDPro Alkyd Enamel Paint	Canary 9804	0.946 L	140	Batch 20120824 Mfg. 03 09 2012	13-Feb-13	-	95,000
THA 173	Nippon Paint Decorative Coating (Thailand) Co., Ltd.	SHIELDPro Alkyd Enamel Paint	White 9800	0.946 L	140	Lot. 20121115 Mfg. 26.11.2012	21-Feb-13	-	4,900
THA 174	PM Paint	JACOB Synthetic Resin Enamel	Magnolia S113	0.85 L	120	Mfg. 240811	14-Feb-13	-	2,700
THA 175	PPM Commercial	VICTOR High Gloss Enamel	Lemon Yellow P-434	0.9 kg.	120	Batch. 24340549	4-Mar-13	-	63,000
THA 176	PPM Commercial	VICTOR High Gloss Enamel	White P-111	0.9 kg.	120	Batch. 21111360	4-Mar-13	-	4,400
THA 177	R.P.S.C. Chemical	MAY Gigh Gloss Enamel	Red A 222	0.875 L	115	1104155 28-04-11	24-Feb-13	-	4,500
THA 178	R.P.S.C. Chemical	MAY High Gloss Enamel	White A 111	0.875 L	120	1911118 09-11-12	24-Feb-13	-	4,000
THA 179	Sahathat	Xen Synthetic Gloss Enamel	Butter Cup 175	0.9 L	120	Batch 0802655	14-Feb-13	-	5,300
THA 180	Sahathat	Xen Synthetic Gloss Enamel	White 100	0.900 L	120	0710156	26-Feb-13	-	3,300

Sample Number	Manufacturing Company	Brand Name	Color	Can Size	Retail Price (baht)	Lot No. / Date of Manufacture	Date of Purchase	Lead Label*	Lead Content (ppm)
THA 181	Season Paints (Thailand)	SISTO Super High Gloss Enamel	Sulphur Yellow S-103	0.825 L	130	Lot. 0460	21-Feb-13	Y	49,000
THA 182	Season Paints (Thailand)	SISTO Super High Gloss Enamel	White S-100	0.825 L	130	Lot. 1461	21-Feb-13	Y	18
THA 183	SEFCO Chemical (2001)	Y2K SAFCO Syntheic High Gloss Enamel	White Y 100	0.85 L	120	Lot. 13960 Mfg.01/2013	21-Feb-13	-	2,100
THA 184	SEFCO Chemical (2001)	Y2K SEFCO Syntheic High Gloss Enamel	Sulphur Yellow Y 2160	0.850 L	100	Lot 61047 Mfg.05.08	19-Feb-13	-	46,000
THA 185	Siam Paint Industry	C-20 Synthetic Enamel High Gloss	Tangerine 730	0.946 L	120	Lot. 403102	14-Feb-13	-	13,100
THA 186	SUNCO Chemical	V-Coat Synthetic Gloss Enamel	Willow Green	0.8 L	100	Batch 0737 Mfg. 07.02.06	4-Mar-13	-	4,800
THA 187	T.K.S Chemical (Thailand)	TEMCO Enamel Paint	Pel Ivory T 312 (Yellow)	0.8 L	130	Batch 005022	12-Feb-13	-	6,800
THA 188	T.K.S.Chemical (Thailand)	TEMCO Enamel Paint	White T 400	0.8 L	120	001013	26-Feb-13	-	4,100
THA 189	Taveepaibul	TVB Gloss Enamel	Reddish Yellow T-420	0.946 L	116	Lot. 111402 Mfg. 260511	20-Feb-13	-	45,000
THA 190	Thai Kansai Paint	FTALIT Synthetic Resin Enamel	Lemon Yellow 581	0.946 L	165	Lot. 0061085 Mfg. 25.06.2010	13-Feb-13	-	50,000
THA 191	Thai Kansai Paint	FTALIT Synthetic Resin Enamel	White 531	0.946 L	165	Lot 2010879 Mfg. 1/2/12	4-Mar-13	-	23
THA 192	Thai TOA Industries	DENZO Synthetic Gloss Enamel	Yellow D-612	0.85 L	115	Batch 466302 Mfg. 14.2.2012	12-Feb-13	Y	56,000
THA 193	Thai TOA Industries	DENZO Synthetic Gloss Enamel	White D 600	0.85 L	160	Lot. 374201 Mfg. 080113	21-Feb-13	Y	12
THA 194	Thai TOA Industries	KINZO Synthetic Enamel	Yellow K-712	0.85 L	130	Lot. 655601 Mfg. 171008	20-Feb-13	Y	34,000
THA 195	Thai TOA Industries	KINZO Synthetic Enamel	Flat White K-744	0.85 L	120	Lot. 680601 Mfg. 11 3 2011	26-Feb-13	Y	181
THA 196	Thai TOA Industries	TORA Synthetic High Gloss Enamel	Yellowish Orange T-157	0.946 L	160	Lot. 731401 Mfg. 25/3/2011	15-Feb-13	Y	28,000
THA 197	ThongThai (Paints Industry)	HUNTER Synthetic Enamel	Brown Yellow 240	0.75 L	120	6081	12-Feb-13	-	20,000
THA 198	ThongThai (Paints Industry)	HUNTER Synthetic Enamel	White 200	0.75 L	100	Lot. 1-6235	5-Mar-13	-	24
THA 199	TOA Paint (Thailand)	4 Seasons High Gloss Enamel	Scarlet Medium 229 (Red)	0.946 L	140	Lot. 383624 1207	21-Feb-13	Y	27
THA 200	TOA Paint (Thailand)	4 Seasons High Gloss Enamel	White F 1000	0.946 L	140	Lot. 399255 0908	19-Feb-13	Y	33
THA 201	TOA Paint (Thailand)	Homecote Enamel Gloss	Lemon Yellow H581	0.875 L	120	Batch 120626101	13-Feb-13	-	15,400
THA 202	TOA Paint (Thailand)	Homecote Enamel Gloss	White H 100	0.875 L	120	Batch 130111101	4-Mar-13	-	490

Sample Number	Manufacturing Company	Brand Name	Color	Can Size	Retail Price (baht)	Lot No. / Date of Manufacture	Date of Purchase	Lead Label*	Lead Content (ppm)
THA 203	TOA Paint (Thailand)	KOBE Gloss Synthetic Enamel	Lemon Yellow K204	0.875 L	90	Batch. 130204101	15-Feb-13	-	27,000
THA 204	TOA Paint (Thailand)	KOBE Gloss Synthetic Enamel	White	0.875 L	90	Batch. 130212101	21-Feb-13	-	22
THA 205	TOA Paint (Thailand)	Mandarin Duck Brand Synthetic Gloss Enamel Paint	Cream M113	3.5 L	350	Mfg. 4/1999 309368	13-Feb-13	-	4,700
THA 206	TOA Paint (Thailand)	Mandarin Duck Brand Synthetic Gloss Enamel Paint	White M 111	0.875 L	100	Batch. 121115102	4-Mar-13	-	<9
THA 207	TOA Paint (Thailand)	TOA Super High Gloss Enamel Glipton	Butter Cup Yellow G 175	0.946 L	306.94	Base D: Batch 130130101	20-Feb-13	Y	230
THA 208	TOA Paint (Thailand)	TOA Super High Gloss Enamel Glipton	Sulphur Yellow G 160	0.946 L	190	Batch 121208101	12-Feb-13	Y	126
THA 209	TOA Paint (Thailand)	TOA Super High Gloss Enamel Glipton	White G 100	0.946 L	170	Batch 120809101	21-Feb-13	Y	52
THA 210	TOA Paint (Thailand)	TOA Flat Enamel	Flat White F222	0.946 L	200	Batch. 121219101	19-Feb-13	-	18
THA 211	TOA Paint (Thailand)	SUPER MATEX	Red Signal MX-1437	0.946 L	135	Lot. 308006 0409	23-Feb-13	Y	640
THA 212	TOA Paint (Thailand)	SUPER MATEX	White MX-1000	0.946 L	135	Batch. 120601101	23-Feb-13	Y	164
THA 213	T-Paint	ROCKET Enamel Gloss	Yellow Orange RE301	0.875 L	140	Batch. 111201101	20-Feb-13	Y	18,300
THA 214	U.R. Chemical (Thailand)	LOBSTER Synthetic Resin Gloss Enamel	Yellow	0.280 L	55	11/09/21-0310LT21#909	18-Feb-13	-	28,000
THA 215	U.R. Chemical (Thailand)	LOBSTER Synthetic Resin Gloss Enamel	White	0.280 L	40	n/a	21-Feb-13	-	61
THA 216	V.Brother Industry	SAM LAC Synthetic Enamel	Yellow SL 612	0.80 L	115	Lot. SL-612 170510 Mfg. 18.03.2010	19-Feb-13	-	14,900
THA 217	V.Brother Industry	SAM LAC Synthetic Enamel	White SL 600	0.80 L	115	Lot. 250412 Mfg. 22-8-11	21-Feb-13	-	240
THA 218	World Paint	WorldTone High Gloss Enamel	Scarlet Medium 229 (Red)	0.85 L	100	0520112	12-Jul-12	-	43,000
THA 219	World Paint	WorldTone High Gloss Enamel	Lemon Yellow 211	0.946 L	80	Batch 0360304	4-Mar-13	-	38,000

**Appendix 2: Lead Content in the 68 Bright Color Enamel Paints**

(in ascending order; shaded boxes depict paints complying with Thai voluntary standard of  $\leq 100$  ppm)

Sample Number	Brand/Product Name	Color	Country of Brand Headquarter*	Country of Manufacture*	Information on Lead Content	Parts Per Million Lead (dry weight)
THA 149	SUPER-K High Gloss Enamel	Parade Blue SK 303	Thailand	Thailand	-	26
THA 199	4 Seasons High Gloss Enamel	Scarlet Medium F 1103 (Red)	Thailand	Thailand	No Added Mercury/No Added Lead	27
THA 100	ICI Supercote	Yellow (45YY51/758)	Netherlands	Thailand	No Added Lead/No Added mercury	32
THA 117	CAPTAIN High Gloss Enamel Superior Finish	Frosted lime 319	Thailand	Thailand	No Added Lead/No Added Mercury	60
THA 146	JOTUN Gardex Premium Enamel	Zinc Yellow 1018	Norway	Thailand	100% Lead Free 100% Mercury Free	67
THA 208	TOA Super High Gloss Enamel Glipton	Sulphur Yellow G-160	Thailand	Thailand	No Added Lead/No Added Mercury	126
THA 207	TOA Super High Gloss Enamel Glipton	Butter Cup Yellow G 175	Thailand	Thailand	No Added Lead/No Added Mercury	230
THA 106	Beger Shield Super Gloss Enamel	Sunny at Heart (Yellow) 087-6	Thailand	Thailand	Mercury & Lead Free	300
THA 114	CAPTAIN High Gloss Enamel Superior Finish	Temple Yellow 311	Thailand	Thailand	No added Lead/No Added Mercury	390
THA 211	SUPER MATEX	Red Signal MX-1437	Thailand	Thailand	No Added Lead/No Added Mercury	640
THA 132	MARCO High Gloss Enamel	River Blue M-637	Thailand	Thailand	-	2,200
THA 131	SUNKE High Gloss Enamel	Oxide Yellow G 300	Thailand	Thailand	No Added Lead & Mercury	2,600
THA 174	JACOB Synthetic Resin Enamel	Magnolia JS113	Thailand	Thailand	-	2,700
THA 115	MARK Gloss Enamel	Reddish Yellow 0M831	Thailand	Thailand	-	3,800
THA 177	MAY High Gloss Enamel	Red A 222	Thailand	Thailand	-	4,500
THA 158	TIGER Synthetic Enamel	Zircon Blue 834	Thailand	Thailand	-	4,500
THA 186	V-Coat Synthetic Gloss Enamel	Willow Green G-156	Thailand	Thailand	-	4,800
THA 179	Xen Synthetic Gloss Enamel	Butter Cup 175	Thailand	Thailand	-	5,300
THA 187	TEMCO Enamel Paint	Pel Ivory T 312 (Yellow)	Thailand	Thailand	-	6,800
THA 168	TURBO Gloss Enamel	Reddish Orange G 2159	Thailand	Thailand	-	9,800
THA 185	C-20 Synthetic Enamel High Gloss	Tangerine 730	Thailand	Thailand	-	13,100
THA 113	LONGLIFE High Gloss Enamel	Imperial Yellow 2300	Thailand	Thailand	-	13,500

Sample Number	Brand/Product Name	Color	Country of Brand Headquarter*	Country of Manufacture*	Information on Lead Content	Parts Per Million Lead (dry weight)
THA 150	BUNDAI Gloss Finish	Reddish Yellow D 155	Thailand	Thailand	-	14,200
THA 216	SAM LAC Synthetic Enamel	Yellow SL 612	Thailand	Thailand	-	14,900
THA 201	Homecote Enamel Gloss	Lemon Yellow H581	Thailand	Thailand	-	15,400
THA 124	WINDY Synthetic Resin Gloss Enamel	Yellow	Thailand	Thailand	-	17,200
THA 213	ROCKET Enamel Gloss	Yellow Orange RE301	Thailand (copyright of British paint)	Thailand	No Added Lead/ No Added Mercury	18,300
THA 197	HUNTER Synthetic Enamel	Brown Yellow 240	Thailand	Thailand	-	20,000
THA 170	BODELAC 1000 Synthetic Resin Enamel	Yellow 124	Japan	Thailand	-	22,000
THA 102	SEACO Synthetic Enamel high Gloss	Yellow 326	Thailand	Thailand	-	26,000
THA 203	KOBE Gloss Synthetic Enamel	Lemon Yellow K204	Thailand	Thailand	-	27,000
THA 122	IBC High Gloss Enamel	Yellow Orange 444	Thailand	Thailand	-	27,000
THA 196	TORA Synthetic High Gloss Enamel	Yellowish Orange T-157	Thailand	Thailand	No Added Mercury/ No Added Lead	28,000
THA 214	LOBSTER Synthetic Resin Gloss Enamel	Yellow	Thailand	Thailand	-	28,000
THA 142	AAA Synthetic Enamel	Marigold 1227	Thailand	Thailand	-	29,000
THA 129	DYNO Pro Gloss Enamel	Bright Yellow G*115	Thailand	Thailand	-	31,000
THA 118	National Gloss Synthetic Resin Enamel	Sunflower 303	Thailand	Thailand	-	32,000
THA 144	Columbia Synthetic Enamel	Marigold 2227	Thailand	Thailand	-	34,000
THA 194	KINZO Synthetic Enamel	Yellow K-712	Thailand	Thailand	No Added Mercury/ No Added Lead	34,000
THA 219	WorldTone High Gloss Enamel	Lemon Yellow 211	Thailand	Thailand	-	38,000
THA 159	LOTTO Super Gloss Enamel	Reddish Yellow L-1155	Thailand	Thailand	-	39,000
THA 152	LENA High Quality Gloss Enamel	Reddish Yellow L 421	Thailand	Thailand	-	40,000
THA 104	Beger Delight Titanium	Reddish Yellow G-6303	Thailand	Thailand	No Added Lead/ No Added mercury	43,000
THA 218	WorldTone High Gloss Enamel	Scarlet Medium 229 (Red)	Thailand	Thailand	-	43,000
THA 164	SEFCO Synthetic Enamel	Reddish Yellow S 155	Thailand	Thailand	-	44,000
THA 189	TVB Gloss Enamel	Reddish Yellow T-420	Thailand	Thailand	-	45,000



Sample Number	Brand/Product Name	Color	Country of Brand Headquarter*	Country of Manufacture*	Information on Lead Content	Parts Per Million Lead (dry weight)
THA 184	Y2K SAFCO Synthetic High Gloss Enamel	Sulphur Yellow Y 2160	Thailand	Thailand	-	46,000
THA 105	Beger Shield Super Gloss Enamel	Sulphur Yellow B-160	Thailand	Thailand	Mercury & Lead Free	48,000
THA 181	SISTO Super High Gloss Enamel	Sulphur Yellow S-103	Thailand	Thailand	No Added Lead No Added Mercury	49,000
THA 190	FTALIT Synthetic Resin Enamel	Lemon Yellow 581	Thailand	Thailand	-	50,000
THA 139	IEC Enamel Paint	Sunspot A-177	Thailand	Thailand	-	51,000
THA 156	BIG Synthetic Enamel	Orange B-12	Thailand	Thailand	-	53,000
THA 108	Ben-Tone Super Gloss Enamel	Lemon Yellow G-301	Thailand	Thailand	No Added Mercury/No Added Lead	53,000
THA 192	DENZO Synthetic Gloss Enamel	Yellow D-612	Thailand	Thailand	No Added Mercury/No Added Lead	56,000
THA 135	N.O.C. Synthetic Enamel	Yellow S 234	Thailand	Thailand	-	56,000
THA 120	Delta Gloss Enamel	Sulphur Yellow 820	Thailand	Thailand	-	58,000
THA 160	D.I.Y. Synthetic Gloss Enamel	Butter Cup 175	Thailand	Thailand	-	60,000
THA 110	WINLEX Gloss Enamel	Golden Yellow 130	Singapore	Thailand	-	62,000
THA 111	PLATONG Gloss Enamel	Medium Yellow -380	Singapore	Thailand	-	63,000
THA 162	SUPERSEF High Gloss Enamel	Yellow G 2103	Thailand	Thailand	-	63,000
THA 175	VICTOR High Gloss Enamel	Lemon Yellow P-434	Thailand	Thailand	-	63,000
THA 125	POWER Gloss Finish	Medium Gold 316	Thailand	Thailand	-	66,000
THA 166	MP3	Yellow Orange 444	Thailand	Thailand	-	69,000
THA 154	Bald Eagle Synthetic Enamel	Yellow Orange E-444	Thailand	Thailand	-	82,000
THA 137	HATO Synthetic Enamel	Yellow	Thailand	Thailand	-	86,000
THA 140	Super Gloss JBP Synthetic Enamel	Golden Yellow 003	Thailand	Thailand	-	87,000
THA 127	RUST-OLEUM Protective Enamel	Safety Yellow 944	USA	Thailand	-	95,000
THA 172	SHIELDPro Alkyd Enamel Paint	Canary 9804	Japan	Thailand	-	95,000

\*Country of brand headquarters and country of manufacture is provided, but in some cases cannot be verified.

**Appendix 3: Lead Content in the 52 White Enamel Paints**

(in ascending order; shaded boxes depict paints complying with Thai voluntary standard of  $\leq 100$  ppm)

Sample Number	Brand / Product Name	Color	Country of Brand Headquarter*	Country of Manufacture*	Information on Lead Content	Parts Per Million Lead (dry weight)
THA 128	RUST-OLEUM Protective Enamel	White 2766	United state of America			< 9
THA 148	JOTAGLOSS	Candle White 1052	Norway	Thailand	100% Lead Free 100% Mercury Free	< 9
THA 206	Mandarin Duck Brand Synthetic Gloss Enamel Paint	White M 111	Thailand	Thailand		< 9
THA 101	ICI Supercote	White 5130296 A395-250	Netherland	Thailand	No Added Lead/ No Added mercury	< 9
THA 119	National Gloss Synthetic Resin Enamel	White 101	Thailand	Thailand		9
THA 193	DENZO Synthetic Gloss Enamel	White D 600	Thailand	Thailand	No Added Mercury/No Added Lead	12
THA 182	SISTO Super High Gloss Enamel	White S-100	Thailand	Thailand	No Added Lead No Added Mercury	18
THA 210	TOA Flat Enamel	Flat White F222	Thailand	Thailand		18
THA 116	MARK Gloss Enamel	White 0M810	Thailand	Thailand		20
THA 130	DYNO Pro Gloss Enamel	White G 100	Thailand	Thailand		20
THA 204	KOBE Gloss Synthetic Enamel	White K500	Thailand	Thailand		22
THA 191	FTALIT Synthetic Resin Enamel	White 531	Thailand	Thailand		23
THA 198	HUNTER Synthetic Enamel	White 200	Thailand	Thailand		24
THA 107	Beger Shield Super Gloss Enamel	Primrose White B 008	Thailand	Thailand	Mercury & Lead Free	25
THA 200	4 Season High Gloss Enamel	White F 1000	Thailand	Thailand	No Added Mercury/No Added Lead	33
THA 171	BODELAC 1000 Synthetic Resin Enamel	White 900	JAPAN	Thailand		36
THA 169	TURBO Gloss Enamel	Sky White G 5011	Thailand	Thailand		41
THA 147	JOTUN GardexPredium Enamel	Antique White (1016/S2005-Y20R)	Norway	Thailand	100% Lead Free 100% Mercury Free	46

Sample Number	Brand / Product Name	Color	Country of Brand Headquarter*	Country of Manufacture*	Information on Lead Content	Parts Per Million Lead (dry weight)
THA 209	TOA Super High Gloss Enamel Glipton	White G 100	Thailand	Thailand	No Added Lead/ No Added Mercury	52
THA 215	LOBSTER Synthetic Resin Gloss Enamel	White	Thailand	Thailand		61
THA 167	MP3	White 111	Thailand	Thailand		133
THA 141	Super Gloss JBP Synthetic Enamel	White 001	Thailand	Thailand		156
THA 212	SUPER MATEX	White MX-1000	Thailand	Thailand	No Added Lead/ No Added Mercury	164
THA 195	KINZO Synthetic Enamel	Flat White K-744	Thailand	Thailand	No Added Mercury/ No Added Lead	181
THA 217	SAM LAC Synthetic Enamel	White SL 600	Thailand	Thailand		240
THA 121	Delta Gloss Enamel	Cool White 810	Thailand	Thailand		280
THA 161	D.I.Y. Synthetic Gloss Enamel	100 White	Thailand	Thailand		310
THA 202	Homecote Enamel Gloss	White H 100	Thailand	Thailand		490
THA 112	PLATONG Gloss Enamel	White 399	Singapore	Thailand		1,710
THA 133	LOTTO Super Gloss Enamel	White L-1100	Thailand	Thailand		1,780
THA 165	SEFCO Synthetic Enamel	White S 100	Thailand	Thailand		1,820
THA 183	Y2K SAFCO Synthetic High Gloss Enamel	White Y 2100	Thailand	Thailand		2,100
THA 123	IBC High Gloss Enamel	White 111	Thailand	Thailand		2,600
THA 153	LENA High Quality Gloss Enamel	White L 400	Thailand	Thailand		2,700
THA 163	SUPERSEF High Gloss Enamel	White G 1000	Thailand	Thailand		2,700
THA 126	POWER Gloss Finish	White 300	Thailand	Thailand		2,800
THA 151	BUNDAI Gloss Finish	White D 100	Thailand	Thailand		3,100
THA 180	Xen Synthetic Gloss Enamel	White 100	Thailand	Thailand		3,300
THA 103	SEACO Synthetic Enamel high Gloss	White 300	Thailand	Thailand		4,000
THA 138	HATO Synthetic Enamel	White	Thailand	Thailand		4,000
THA 178	MAY High Gloss Enamel	White A 111	Thailand	Thailand		4,000

Sample Number	Brand / Product Name	Color	Country of Brand Headquarter*	Country of Manufacture*	Information on Lead Content	Parts Per Million Lead (dry weight)
THA 109	Ben-Tone Super Gloss Enamel	White G-101	Thailand	Thailand	No Added Mercury, No Added Lead	4,000
THA 188	TEMCO Enamel Paint	White T 400	Thailand	Thailand		4,100
THA 136	N.O.C. Synthetic Enamel	White S-2600	Thailand	Thailand		4,200
THA 176	VICTOR High Gloss Enamel	White P-111	Thailand	Thailand		4,400
THA 157	BIG Synthetic Enamel	White B-01	Thailand	Thailand		4,700
THA 205	Mandarin Duck Brand Synthetic Gloss Enamel Paint	Cream M113	Thailand	Thailand		4,700
THA 173	SHIELDPro Alkyd Enamel Paint	White 9800	JAPAN	Thailand		4,900
THA 143	AAA Synthetic Enamel	White 1001	Thailand	Thailand		5,100
THA 155	Bald Eagle Synthetic Enamel	White E-111	Thailand	Thailand		5,300
THA 145	Columbia Synthetic Enamel	White 2001	Thailand	Thailand		5,700
THA 134	SEA KING High Gloss Enamel	Lily White SK 420	Thailand	Thailand		9,500

\*Country of brand headquarters and country of manufacture is provided, but in some cases cannot be verified.

#### Appendix 4: Lead Content by Paint Brands\*

\*Duplicate brands indicate more than 1 color sample

47 Brands with Lead Content >10,000 ppm		
AAA Synthetic Enamel	Homecote Enamel Gloss	RUST-OLEUM Protective Enamel
Bald Eagle Synthetic Enamel	HUNTER Synthetic Enamel	SAM LAC Synthetic Enamel
Beger Delight Titanium	IBC High Gloss Enamel	SEACO Synthetic Enamel high Gloss
Beger Shield Super Gloss Enamel	IEC Enamel Paint	SEFCO Synthetic Enamel
Ben-Tone Super Gloss Enamel	KINZO Synthetic Enamel	Nippon ShieldPro Alkyd Enamel
BIG Synthetic Enamel	KOBE Gloss Synthetic Enamel	SISTO Super High Gloss Enamel
BODELAC 1000 Synthetic Resin Enamel	LENA High Quality Gloss Enamel	Super Gloss JBP Synthetic Enamel
BUNDAI Gloss Finish	LOBSTER Synthetic Resin Gloss Enamel	SUPERSEF High Gloss Enamel
C-20 Synthetic Enamel High Gloss	LONGLIFE High Gloss Enamel	TORA Synthetic High Gloss Enamel
Columbia Synthetic Enamel	LOTTO Super Gloss Enamel	TVB Gloss Enamel
D.I.Y. Synthetic Gloss Enamel	MP3	VICTOR High Gloss Enamel
Delta Gloss Enamel	N.O.C. Synthetic Enamel	WINDY Synthetic Resin Gloss Enamel
DENZO Synthetic Gloss Enamel	National Gloss Synthetic Resin Enamel	WINLEX Gloss Enamel
DYNO Pro Gloss Enamel	PLATONG Gloss Enamel	WorldTone High Gloss Enamel
FTALIT Synthetic Resin Enamel	POWER Gloss Finish	WorldTone High Gloss Enamel
HATO Synthetic Enamel	ROCKET Enamel Gloss	Y2K SEFCO Synthetic High Gloss Enamel

63 Brands with Lead Content >100 ppm		
AAA Synthetic Enamel	BODELAC 1000 Synthetic Resin Enamel	DENZO Synthetic Gloss Enamel
AAA Synthetic Enamel	BUNDAI Gloss Finish	DYNO Pro Gloss Enamel
Bald Eagle Synthetic Enamel	BUNDAI Gloss Finish	FTALIT Synthetic Resin Enamel
Bald Eagle Synthetic Enamel	C-20 Synthetic Enamel High Gloss	HATO Synthetic Enamel
Beger Delight Titanium	CAPTAIN High Gloss Enamel Superior Finish	HATO Synthetic Enamel
Beger Shield Super Gloss Enamel	Columbia Synthetic Enamel	Homecote Enamel Gloss
Beger Shield Super Gloss Enamel	Columbia Synthetic Enamel	Homecote Enamel Gloss
Ben-Tone Super Gloss Enamel	D.I.Y. Synthetic Gloss Enamel	HUNTER Synthetic Enamel
Ben-Tone Super Gloss Enamel	D.I.Y. Synthetic Gloss Enamel	IBC High Gloss Enamel
BIG Synthetic Enamel	Delta Gloss Enamel	IBC High Gloss Enamel
BIG Synthetic Enamel	Delta Gloss Enamel	IEC Enamel Paint
JACOB Synthetic Resin Enamel	PLATONG Gloss Enamel	SUPERSEF High Gloss Enamel
KINZO Synthetic Enamel	POWER Gloss Finish	TEMCO Enamel Paint
KINZO Synthetic Enamel	POWER Gloss Finish	TEMCO Enamel Paint
KOBE Gloss Synthetic Enamel	ROCKET Enamel Gloss	TIGER Synthetic Enamel
LENA High Quality Gloss Enamel	RUST-OLEUM Protective Enamel	TOA Super High Gloss Enamel Glipton

LENA High Quality Gloss Enamel	SAM LAC Synthetic Enamel	TOA Super High Gloss Enamel Glipton
LOBSTER Synthetic Resin Gloss Enamel	SAM LAC Synthetic Enamel	TORA Synthetic High Gloss Enamel
LONGLIFE High Gloss Enamel	SEA KING High Gloss Enamel	TURBO Gloss Enamel
LOTTO Super Gloss Enamel	SEACO Synthetic Enamel high Gloss	TVB Gloss Enamel
LOTTO Super Gloss Enamel	SEACO Synthetic Enamel high Gloss	V-Coat Synthetic Gloss Enamel
Mandarin Duck Brand Synthetic Gloss Enamel	SEFCO Synthetic Enamel	VICTOR High Gloss Enamel
MARCO High Gloss Enamel	SEFCO Synthetic Enamel	VICTOR High Gloss Enamel
MARK Gloss Enamel	SHIELDPro Alkyd Enamel Paint	WINDY Synthetic Resin Gloss Enamel
MAY Gigh Gloss Enamel	SHIELDPro Alkyd Enamel Paint	WINLEX Gloss Enamel
MAY Gigh Gloss Enamel	SISTO Super High Gloss Enamel	WorldTone High Gloss Enamel
MP3	SUNKE High Gloss Enamel	WorldTone High Gloss Enamel
MP3	Super Gloss JBP Synthetic Enamel	Xen Synthetic Gloss Enamel
N.O.C. Synthetic Enamel	Super Gloss JBP Synthetic Enamel	Xen Synthetic Gloss Enamel
N.O.C. Synthetic Enamel	SUPER MATEX	Y2K SAFCO Syntheic High Gloss Ename
National Gloss Synthetic Resin Enamel	SUPER MATEX	Y2K SAFCO Syntheic High Gloss Ename
PLATONG Gloss Enamel	SUPERSEF High Gloss Enamel	

22 Brands with Lead Content ≤ 100 ppm		
4 Seasons High Gloss Enamel	ICI Supercote	National Gloss Synthetic Resin Enamel
4 Seasons High Gloss Enamel	ICI Supercote	RUST-OLEUM Protective Enamel
Beger Shield Super Gloss Enamel	JOTAGLOSS	SISTO Super High Gloss Enamel
BODELAC 1000 Synthetic Resin Enamel	JOTUN GardexPredium Enamel	SUPER-K High Gloss Enamel
CAPTAIN High Gloss Enamel Superior Finish	JOTUN GardexPredium Enamel	TOA Flat Enamel
DENZO Synthetic Gloss Enamel	KOBE Gloss Synthetic Enamel	TOA Super High Gloss Enamel Glipton
DYNO Pro Gloss Enamel	LOBSTER Synthetic Resin Gloss Enamel	TURBO Gloss Enamel
FTALIT Synthetic Resin Enamel	Mandarin Duck Brand Synthetic Gloss Enamel	
HUNTER Synthetic Enamel	MARK Gloss Enamel	

**Appendix 5: Lead Content by Paint Manufacturers and Brands**

No.	Manufacturer Name	Country of Brand Headquarter	Country of Manufacture	Brand Surveyed	Sample #	Color	Lead Content (mg/kg)
1	AKZO Nobel Paint (Thailand) Co., Ltd	Netherland	Thailand	1. ICI Supercote	THA-100	Yellow (45YY51/758)	32
					THA-101	White 5130296 A395-250	< 9
2	Asia Pearl Paint Co., Ltd	Thailand	Thailand	1. SEACO Synthetic Enamel high Gloss	THA-102	Yellow 326	26,000
					THA-103	White 300	4,000
3	B.N. Brother Ltd.	Thailand	Thailand	1. Beger Delight Titanium	THA-104	Reddish Yellow G-6303	43,000
					THA-105	Sulphur Yellow B-160	48,000
				2. Beger Shield Super Gloss Enamel	THA-106	Sunny at Heart (Yellow) 087-6	300
					THA-107	Primrose White B 008	25
				3. Ben-Tone Super Gloss Enamel	THA-108	Lemon Yellow G-301	53,000
					THA-109	White G-101	4,000
4	Berger Paint (Thailand) Co.Ltd.	Singapore	Thailand	1. WINLEX Gloss Enamel	THA-110	Golden Yellow 130	62,000
					THA-111	Medium Yellow -380	63,000
				2. PLATONG Gloss Enamel	THA-112	White 399	1,710
5	Captain Coating Co., Ltd.	Thailand	Thailand	1. LONGLIFE High Gloss Enamel	THA-113	Imperial Yellow 2300	13,500
					THA-114	Tample Yellow 311	390
				2. CAPTAIN High Gloss Enamel Superior Finish	THA-117	Frosted lime 319	60
					THA-115	Reddish Yellow 0M831	3,800
					THA-116	White 0M810	20
6	Delta Paint Co., Ltd	Thailand	Thailand	1. National Gloss Synthetic Resin Enamel	THA-118	Sunflower 303	32,000
					THA-119	White 101	9
				2. Delta Gloss Enamel	THA-120	Sulphur Yellow 820	58,000
					THA-121	Cool White 810	280
				3. IBC High Gloss Enamel	THA-122	Yellow Orange 444	27,000
					THA-123	White 111	2,600
7	DINCO (Thailand) Co., Ltd	Thailand	Thailand	WINDY Synthetic Resin Gloss Enamel	THA-124	Yellow	17,200
8	DL Co., Ltd.	Thailand	Thailand	1. POWER Gloss Finish	THA-125	Medium Gold 316	66,000
					THA 126	White 300	2,800

No.	Manufacturer Name	Country of Brand Headquarter	Country of Manufacture	Brand Surveyed	Sample #	Color	Lead Content (mg/kg)
9	DYNO Paint Limited	Thailand	Thailand	1. RUST-OLEUM Protective Enamel (USA product)	THA 127	Safety Yellow 944	95,000
					THA 128	White 2766	< 9
				2. DYNO Pro Gloss Enamel	THA 129	Bright Yellow G*115	31,000
					THA 130	White G 100	20
10	Golden Arrow Coating Co., Ltd	Thailand	Thailand	1. SUNKE High Gloss Enamel	THA 131	Oxide Yellow G 300	2,600
11	HACHEM Paint Co., Ltd	Thailand	Thailand	1. MARCO High Gloss Enamel	THA 132	River Blue M-637	2,200
				2. LOTTO Super Gloss Enamel	THA 133	White L-1100	1,780
12	HARTFORD Paint Co., Ltd	Thailand	Thailand	1. SEA KING High Gloss Enamel	THA 134	Lily White SK 420	9,500
13	HATO Paint (J.K.R.) Co., Ltd	Thailand	Thailand	1. N.O.C. Synthetic Enamel	THA 135	Yellow S 234	56,000
					THA 136	White S-2600	4,200
				2. HATO Synthetic Enamel	THA 137	Yellow	86,000
					THA 138	White	4,000
14	IEC Paint Co., Ltd.	Thailand	Thailand	1. IEC Enamel Paint	THA 139	Sunspot A-177	51,000
15	J.B.P. International Paint Co., Ltd.	Thailand	Thailand	1. Super Gloss JBP Synthetic Enamel	THA 140	Golden Yellow 003	87,000
					THA 141	White 001	156
				2. AAA Synthetic Enamel	THA 142	Marigold 1227	29,000
					THA 143	White 1001	5,100
				3. Columbia Synthetic Enamel	THA 144	Marigold 2227	34,000
					THA 145	White 2001	5,700
16	Jotun Thailand Co., Ltd	Norway	Thailand	1. JOTUN GardexPredium Enamel	THA 146	Zinc Yellow 1018	67
					THA 147	Antique White (1016/S2005-Y20R)	46
				2. JOTAGLOSS	THA 148	Candle White 1052	< 9
17	KOSMIK Polymer Co., Ltd	Thailand	Thailand	SUPER-K High Gloss Enamel	THA 149	Parade Blue SK 303	26
18	LENA (Thailand) Co., Ltd.	Thailand	Thailand	1. BUNDAI Gloss Finish	THA 150	Reddish Yellow D 155	14,200
					THA 151	White D 100	3,100
				2. LENA High Quality Gloss Enamel	THA 152	Reddish Yellow L 421	40,000
					THA 153	White L 400	2,700



No.	Manufacturer Name	Country of Brand Headquarter	Country of Manufacture	Brand Surveyed	Sample #	Color	Lead Content (mg/kg)
19	LEO Paint Co., Ltd.	Thailand	Thailand	1. Bald Eagle Synthetic Enamel	THA 154	Yellow Orange E-444	82,000
					THA 155	White E-111	5,300
				2. BIG Synthetic Enamel	THA 156	Orange B-12	53,000
					THA 157	White B-01	4,700
				3. TIGER Synthetic Enamel	THA 158	Zircon Blue 834	4,500
20	Lotto Paint Co., Ltd.	Thailand	Thailand	1. LOTTO Super Gloss Enamel	THA 159	Reddish Yellow L-1155	39,000
21	Maneekarn Paint	Thailand	Thailand	1. D.I.Y. Synthetic Gloss Enamel	THA 160	Butter Cup 175	60,000
					THA 161	100 White	310
22	MAXZO paint Co., Ltd.	Thailand	Thailand	1. SUPERSEF High Gloss Enamel	THA 162	Yellow G 2103	63,000
					THA 163	White G 1000	2,700
23	Nam Dee Watana Chemical Co.,Ltd.	Thailand	Thailand	1. TURBO Gloss Enamel	THA 168	Reddish Orange G 2159	9,800
					THA 169	Sky White G 5011	41
24	Nippon Paint (Thailand) Co., Ltd.	Japan	Thailand	1. BODELAC 1000 Synthetic Resin Enamel	THA 170	Yellow 124	22,000
					THA 171	White 900	36
				2. SHIELDPro Alkyd Enamel Paint	THA 172	Canary 9804	95,000
					THA 173	White 9800	4,900
25	PM Paint Co., Ltd.	Thailand	Thailand	1. JACOB Synthetic Resin Enamel	THA 174	Magnilia JS113	2,700
26	PPM Commercial Co., Ltd.	Thailand	Thailand	1. VICTOR High Gloss Enamel	THA 175	Lemon Yellow P-434	63,000
					THA 176	White P-111	4,400
27	R.P.S.C. Chemical Co., Ltd.	Thailand	Thailand	1. MAY High Gloss Enamel	THA 177	Red A 222	4,500
					THA 178	White A 111	4,000
28	Sahathat Co., Ltd.	Thailand	Thailand	1. Xen Synthetic Gloss Enamel	THA 179	Butter Cup 175	5,300
					THA 180	White 100	3,300
29	Season Paints (Thailand) Co., Ltd	Thailand	Thailand	1. SISTO Super High Gloss Enamel	THA 181	Sulphur Yellow S-103	49,000
					THA 182	White S-100	18
30	SEFCO Chemical (2001) Co., Ltd	Thailand	Thailand	1. Y2K SAFCO Synthetic High Gloss Enamel	THA 183	White Y 2100	2,100
					THA 184	Sulphur Yellow Y 2160	46,000
31	Siam Paint Industry Co.,Ltd	Thailand	Thailand	C-20 Synthetic Enamel High Gloss	THA 185	Tangerine 730	13,100

No.	Manufacturer Name	Country of Brand Headquarter	Country of Manufacture	Brand Surveyed	Sample #	Color	Lead Content (mg/kg)
32	SUNCO Chemical Ltd.	Thailand	Thailand	V-Coat Synthetic Gloss Enamel	THA 186	Willow Green G-156	4,800
33	T.K.S Chemical (Thailand) Co.,Ltd.	Thailand	Thailand	1. TEMCO Enamel Paint	THA 187	Pel Ivory T 312 (Yellow)	6,800
					THA 188	White T 400	4,100
34	TAVEEPAIBUL Co., Ltd	Thailand	Thailand	TVB Gloss Enamel	THA 189	Reddish Yellow T-420	45,000
35	Thai Kansai Paint Co., Ltd.	Thailand	Thailand	1. FTALIT Synthetic Resin Enamel	THA 190	Lemon Yellow 581	50,000
					THA 191	White 531	23
36	Thai TOA Industries Co., Ltd.	Thailand	Thailand	1. DENZO Synthetic Gloss Enamel	THA 192	Yellow D-612	56,000
					THA 193	White D 600	12
				2. KINZO Synthetic Enamel	THA 194	Yellow K-712	34,000
					THA 195	Flat White K-744	181
				TORA Synthetic High Gloss Enamel	THA 196	Yellowish Orange T-157	28,000
37	ThongThai (Paints Industry) Co., Ltd.	Thailand	Thailand	1. HUNTER Synthetic Enamel	THA 197	Brown Yellow 240	20,000
					THA 198	White 200	24
38	TOA Paint (Thailand) Co.,Ltd.	Thailand	Thailand	1. 4 Season High Gloss Enamel	THA 199	Scarlet Medium F 1103 (Red)	27
					THA 200	White F 1000	33
				2. Homecote Enamel Gloss	THA 201	Lemon Yellow H581	15,400
					THA 202	White H 100	490
				3. KOBE Gloss Synthetic Enamel	THA 203	Lemon Yellow K204	27,000
					THA 204	White K500	22
				4. Mandarin Duck Brand Synthetic Gloss Enamel Paint	THA 205	Cream M113	4,700
					THA 206	White M 111	< 9
				5. TOA Super High Gloss Enamel Glipton	THA 207	Butter Cup Yellow G 175	230
					THA 208	Sulphur Yellow G-160	126
					THA 209	White G 100	52
				6. TOA Flat Enamel	THA 210	Flat White F222	18
				7. SUPER MATEX	THA 211	Red Signal MX-1437	640
THA 212	White MX-1000	164					

No.	Manufacturer Name	Country of Brand Headquarter	Country of Manufacture	Brand Surveyed	Sample #	Color	Lead Content (mg/kg)
39	T-Paint	Thailand under copyright British Paint Limited	Thailand	ROCKET Enamel Gloss	THA 213	Yellow Orange RE301	18,300
40	U.R. Chemical Co., Ltd (Thailand)	Thailand	Thailand	1. LOBSTER Synthetic Resin Gloss Enamel	THA 214	Yellow	28,000
					THA 215	White	61
41	V.Brother Industry Co.,Ltd	Thailand	Thailand	1. SAM LAC Synthetic Enamel	THA 216	Yellow SL 612	14,900
					THA 217	White SL 600	240
42	World Paint Co.,Ltd	Thailand	Thailand	1. WorldTone High Gloss Enamel	THA 218	Scarlet Medium 229 (Red)	43,000
					THA 219	Lemon Yellow 211	38,000
	N/A	Thailand	Thailand	1. SEFCO Synthetic Enamel	THA 164	Reddish Yellow S 155	44,000
					THA 165	White S 100	1,820
	N/A	Thailand	Thailand	1. MP3	THA 166	Yellow Orange 444	69,000
					THA 167	White 111	133

- <sup>1</sup> WHO, 2010. *Childhood Lead Poisoning*, p.18. [www.who.int/ceh/publications/leadguidance.pdf](http://www.who.int/ceh/publications/leadguidance.pdf)
- <sup>2</sup> Ibid., p.12.
- <sup>3</sup> World Health Organization (WHO), 2006. *Preventing disease through healthy environments*, p. 6. [www.who.int/quantifying\\_ehimpacts/publications/preventingdisease.pdf](http://www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf)
- <sup>4</sup> WHO, 2011. *Evaluation of certain food additives and contaminants: 73rd report of the Joint FAO/WHO Expert Committee on Food Additives*. [apps.who.int/ipsc/database/evaluations/chemical.aspx?chemID=3511](http://apps.who.int/ipsc/database/evaluations/chemical.aspx?chemID=3511)
- <sup>5</sup> WHO, 2010. Exposure to lead: a major public health concern. [http://www.who.int/ipcs/assessment/public\\_health/lead/en/index.html](http://www.who.int/ipcs/assessment/public_health/lead/en/index.html)
- <sup>6</sup> Ministry of Commerce Notice No. 4 (1995) on Quality Requirements of Benzene Fuel dated September 8, 1995.
- <sup>7</sup> Needleman, H., 2004. *Lead Poisoning*. *Annu. Rev. Med.* 55, 209–22. [www.rachel.org/files/document/Lead\\_Poisoning.pdf](http://www.rachel.org/files/document/Lead_Poisoning.pdf)
- <sup>8</sup> Scientific Opinion on Lead in Food, EFSA Panel on Contaminants in the Food Chain (CONTAM), *EFSA Journal* 2010. [www.efsa.europa.eu/en/efsajournal/doc/1570.pdf](http://www.efsa.europa.eu/en/efsajournal/doc/1570.pdf)
- <sup>9</sup> Thai Industrial Standards (TIS) 272-2521 for emulsion paint
- <sup>10</sup> TIS 272-2549 for general use emulsion, TIS 2531-2549 for weather-resistant emulsion, TIS 2442-2552 for fire-resistant emulsion, TIS 2514-2553 for solar heat reducing emulsion and TIS 2515-2555 for glossy emulsion.
- <sup>11</sup> Thai Industrial Standards (TIS) 327-2553 for glossy alkyd enamel and TIS 1406-2553 for matte alkyd enamel.
- <sup>12</sup> TOA Group. Company Timeline. [www.toagroup.com/th/about/8/25-E0%B8%81%E0%B9%89%E0%B8%B2%E0%B8%A7%E0%B8%AA%E0%B8%B3%E0%B8%84%E0%B8%B1%E0%B8%8D.html](http://www.toagroup.com/th/about/8/25-E0%B8%81%E0%B9%89%E0%B8%B2%E0%B8%A7%E0%B8%AA%E0%B8%B3%E0%B8%84%E0%B8%B1%E0%B8%8D.html)
- <sup>13</sup> Congressional Committee on Industrial Issues, House of Representatives. Most Urgent Letter No. 10604/2555 to the Prime Minister. November 1, 2012.
- <sup>14</sup> Department of Local Administration, Ministry of Interior. Most Urgent Letter No. MI 0893.2/W5682 to Governors in Every Province. December 25, 2012.
- <sup>15</sup> Conference on Requiring Paint Products to Meet Industrial Standards. Organized by Thai Industrial Standards Institute. January 24, 2013 at Century Park Hotel, Bangkok.

<sup>16</sup> E.g. Gear Rural Municipality, Narathiwat. Municipal Notice on the Impact of Lead in Paints and Toy Products. February 5, 2013.

<sup>17</sup> National Economic and Social Advisory Council. Letter No. CS 0001/499 to the Prime Minister. March 25, 2013.

<sup>18</sup> Prime Minister's Cabinet Order No. NR 0505/22272. August 20, 2013.

<sup>19</sup> Eksangkul, Petcharat. Vice-President of Thai Paint Manufacturers Association. Measures to Reduce or Eliminate Lead from Household Paint. Presented at the Conference on Requiring Paint Products to Meet Industrial Standards. Organized by Thai Industrial Standards Institute. January 24, 2013 at Century Park Hotel, Bangkok.

<sup>20</sup> United Nations Environmental Programme (UNEP) and WHO. Report of the second meeting of the Global Alliance to Eliminate Lead Paint in Bangkok, July 9-11, 2012, page 4.

<sup>21</sup> Eksangkul, 2013.

<sup>22</sup> Department of Industrial Works, Ministry of Industry. October 11, 2013. [www.diw.go.th/job4/Allfac\\_detail.asp?class=04501&disp\\_class=45\(1\)](http://www.diw.go.th/job4/Allfac_detail.asp?class=04501&disp_class=45(1)) Accessed October 11, 2013.

<sup>23</sup> "Jotun targets 15% annual growth to become No.2 in 2 years" (in Thai), *Manager Daily*. November 20, 2012. [www.manager.co.th/iBizchannel/ViewNews.aspx?NewsID=9550000141666](http://www.manager.co.th/iBizchannel/ViewNews.aspx?NewsID=9550000141666) Accessed October 10, 2013; "Decorative paint market loses speed while consumers afraid of repeated flooding, lacking confidence in government prevention schemes" (in Thai), *Naew Na*. September 26, 2012. [www.ryt9.com/s/nnd/1496487](http://www.ryt9.com/s/nnd/1496487) Accessed October 10, 2013; "Second Q Paint Market in Full Speed, Commercials to Boost Sales" (in Thai), *Builder News*. October 15, 2012. [www.buildernews.in.th/page.php?a=10&n=139&cno=4174](http://www.buildernews.in.th/page.php?a=10&n=139&cno=4174) Accessed April 3, 2013; "Beger Paint boasts '5 Innovations' to become leader in every segment" (in Thai), *Manager Daily*. February 5, 2013. [www.manager.co.th/iBizChannel/ViewNews.aspx?NewsID=9550000141666](http://www.manager.co.th/iBizChannel/ViewNews.aspx?NewsID=9550000141666) Accessed April 3, 2013; Tunruangwetcharoon, Methawadee. "Nippon Paint targets 5% price adjustment" (in Thai), *Bangkok Business*. March 13, 2013.; Eksangkul, 2013; and "ASEAN decorative paint market on the rise, TOA set to expand production base" (in Thai), *Naew Na*. February 1, 2013. [www.naewna.com/business/39852](http://www.naewna.com/business/39852) Accessed April 3, 2013

<sup>24</sup> "Paint market in luck next year, new government products, receding floods and home renovations" (in Thai), *Banmuang*. November 27, 2010. [www.ryt9.com/s/bmnd/1037414](http://www.ryt9.com/s/bmnd/1037414) Accessed October 10, 2013. and in "ASEAN decorative paint market on the rise" (in Thai), *Naew Na*. February 1, 2013.

<sup>25</sup> Siam City Bank estimate. Cited in "Paint market continues to expand despite economic lull" (in Thai), *Bangkok Business*. November 7, 2008.

<sup>26</sup> TPMA estimate. Cited by Eksangkul, 2013.

<sup>27</sup> Jarukarn, Pannita and Siwilai Sakuljeen. "Paint: from innovation to segment war" (in Thai), *Siam Rat*. May 17-18, 2010, pp. 37-40.

<sup>28</sup> "TOA to devour ASEAN market" (in Thai), *Banmuang*. February 23, 2013.

<sup>29</sup> Jarukarn and Sakuljeen, 37-40.

<sup>30</sup> Tunruangwetcharoon, 2013 and Ministry of Commerce. Q&A Forum. September 3, 2007. [www2.moc.go.th/index\\_answer.php?wcad=9&wtid=46283&t=&filename=](http://www2.moc.go.th/index_answer.php?wcad=9&wtid=46283&t=&filename=) Accessed October 10, 2013.

<sup>31</sup> Ministry of Commerce, 2007.

<sup>32</sup> Ministry of Commerce, 2007 and “Jotun targets 15% annual growth to become No.2 in 2 years,” 2012.

<sup>33</sup> Jarukarn and Sakuljeen, 37-40.

<sup>34</sup> In the manufacturing sector, small enterprises are defined as having no more than 50 employees or no more than 50 million baht in fixed assets, excluding land. Medium enterprises are defined as having 50-200 employees or 50-200 million baht in fixed assets, excluding land. Large enterprises are defined as having more than 200 employees or 200 million baht in fixed assets, excluding land. From Small and Medium Enterprise Development Bank of Thailand, 2012. [www.smebank.co.th/en/definitions.php](http://www.smebank.co.th/en/definitions.php) Accessed October 11, 2013.

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