

Analytical Methods for Measuring Lead in New Paint

Global Policymakers
Webinar on Eliminating
Lead in Paint through
Regulatory Action

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Eliminate Lead Paint

Outline

- Objectives of lead paint testing
- Overview of sample methods
- Overview of test methods: laboratory and portable methods
- Considerations when choosing a laboratory
- Quality considerations
- Considerations for building laboratory capacity

Objectives of Lead Paint Testing

- To determine if paint meets the regulatory requirement for permitted lead content
- Paint manufacturers and importers – to obtain documentation of compliance with lead paint limit
 - **Third-party laboratory certification:** use a nationally or internationally accredited laboratory that can measure the lead content to the required limit (e.g. 90 ppm) to support a Declaration of Conformity
- Government – testing for compliance with lead paint limit
 - Use a nationally or internationally accredited laboratory or suitable portable analysis technology to test for compliance with regulatory limit

Sampling Methods

- Most common method is to apply paint to a homogeneous metal-free surface such as glass or wood
- Paint is allowed to dry then a sample is scraped off for analysis in a laboratory
- Lead content may also be measured directly from surface using portable high definition x-ray fluorescence and reported in ppm
- Possible to measure lead in sample of wet paint using special sampling cup and high definition x-ray fluorescence



Two testing options for compliance assessment

- Laboratory analysis (various methods) – samples are collected and sent to a laboratory
 - results are reported after a period of time
- Portable analysis using high-definition X-ray fluorescence (HDXRF) – analysis can be done outside a laboratory e.g. at customs
 - results are available immediately

Three commonly used laboratory methods for lead paint

- Flame atomic absorption spectrometry (FAAS)
- Electrothermal or graphite furnace atomic absorption spectrometry (ETAAS/GFAAS)
- Inductively-coupled plasma atomic emission spectrometry (ICP-AES)
- Methods differ in complexity, limit of detection and cost
- International standards exist for each

Considerations when choosing a laboratory

- Laboratory's experience and capacity in lead paint analysis
- If possible, accreditation through a recognized proficiency testing scheme
- Analytical methods used (e.g. FAAS, GFAAS/ETAAS, ICP-AES)
 - limit of detection – is it adequate to confirm compliance?
- Sample requirements specified by laboratory
- Costs per sample, including any shipping costs
- Turn-around time

Laboratory should demonstrate compliance with quality standards

- Trained personnel and good quality assurance procedures are essential to ensure accuracy and reliability of results
- Laboratory should have certification to show it works to an international standard e.g., ISO/ IEC 17025
- Laboratory should comply with national or international standards for sample preparation and analysis for lead in paint
- Laboratory should be accredited to conduct analyses by a national or international accreditation program

There are international standards for paint sample preparation

- ISO 1513, Paints and varnishes - examination and preparation of test samples
- ASTM E1645-01, Practice for Preparation of dried paint samples by hotplate or microwave digestion for subsequent lead analysis
- ASTM E1979-12, Practice for ultrasonic extraction of paint, dust, soil, and air samples for subsequent determination of Lead

There are international standards for analyzing lead in paint

- ISO 6503, Paints and varnishes - Determination of total lead - flame atomic absorption spectrometric method. (For measurement of lead concentration of 0.01% to 2.0%)
- ASTM D3335-85a (2014), Standard test method for low concentrations of lead, cadmium, and cobalt in paint by atomic absorption spectroscopy. (For measurement of lead concentration of 0.01% to 5.0%)
- ASTM E1613-12, Standard test method for determination of lead by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES), Flame Atomic Absorption Spectrometry (FAAS), or Graphite Furnace Atomic Absorption Spectrometry (GFAAS) techniques (Measurement of lead concentration differs per analytical technique)

Environmental Lead Proficiency Analytical Testing (ELPAT) Program

- Operated by American Industrial Health Association
- ELPAT program measures proficiency in lead analysis of environmental samples
- Performance evaluation materials prepared for lead in paint, in soil and in dust
- Sent to >250 laboratories around the world on a quarterly basis
- non-US laboratories currently in Australia (3), Canada (1), France (1), Japan (2), Korea (3)

High-Definition XRF (HDXRF)

- Relatively new technology using optics to enable measurement of very low concentrations of lead
- Comparable results to laboratory methods and suitable for compliance testing of new paints
 - approved as alternative to laboratory methods in the USA – ASTM F2853-10
- Paint sample on metal-free homogeneous surface placed in front of device – lead concentration shown on screen within minutes
- Portable and bench-top models available
- Expensive to buy but cheaper to operate than conventional laboratory methods
- Uses ionizing radiation so specific health-and-safety and training needs

Increasing demand for laboratory testing creates a market

- Regulations specifying a low limit on lead content of paint create a demand for laboratories to carry out compliance testing
- A laboratory can provide a service to manufacturers and regulatory authorities in multiple countries
- Establishing a laboratory service requires significant resources, therefore business case must be made
- May be possible to expand an existing laboratory service

Considerations for building laboratory capacity

- Can lead paint analysis be added to an existing service, e.g.
 - is the necessary equipment already available (e.g. GFAAS)?
 - what additional equipment (e.g. lamps), reagents and training are needed?
 - is there a sufficient demand for the service to be sustainable (e.g. offering third-party testing to manufacturers, compliance testing for regulators)
- Is the service already available in a laboratory at home or abroad at a good price
- Large paint manufacturers have lab capacity and trained personnel that can be utilized to supplement government testing

Conclusions

- Lead paint testing is a key enforcement and compliance tool in the Lead Paint Model Law
- Regulations drive development of lead paint test methods, technologies and laboratory networks
- Analytical methods include laboratory methods and portable methods that vary in cost and resource needs
- Existing international standards exist for laboratory competency, sampling and testing

Available WHO resources

- Brief guide to analytical methods for measuring lead in paint



- <https://www.who.int/publications/i/item/9789240006058>

Appendix

Units for reporting lead content in new paint

- Regulatory limits for total lead concentration may be expressed as parts per million (ppm), percent (%) or mg/kg
- $90 \text{ ppm} = 0.009\% = 90 \text{ mg/kg}$
- Laboratory methods can report in any of the above units
- Lead content on a painted surface may also be reported in mg/cm^2 but this is not appropriate for compliance assessment for lead in new paint
 - not a mass concentration measurement
 - cannot reliably be converted to mass concentration measurement

Thank you!



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