

# **Exposure at Paint Removal with the Speedheater Infrared System**

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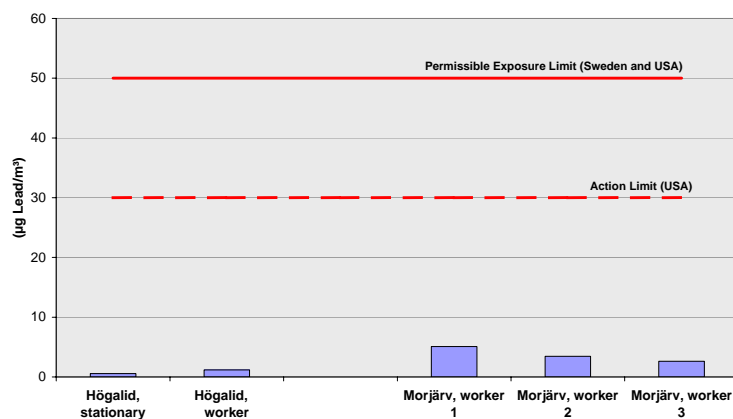
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## Summary

IVF has, commissioned by Speedheater System AB, monitored lead exposure during removal of lead-pigmented paint on two occasions and from two objects: window frames from the Högalid Church vicarage and the tower of Morjärv Church in the North of Sweden. The tests followed international practice and were designed to indicate reasonable worst-case conditions.

The five test results ranged from 0,5 to 5,1  $\mu\text{g}/\text{m}^3$ , well below permissible exposure limit.



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## Scope and background

The Speedheater System is used to remove paint, which may contain hazardous substances, lead in particular. Lead oxide was earlier commonly used as a white pigment in paint. In order to investigate possible personal exposure to lead when working with the system, test was carried out by IVF at the request of Speedheater System AB.

Speedheater System AB intends to use the results to assess and understand possible risks and further improve products, methodology and information.

As lead-pigmented paints are not sold in Sweden after 1968, these paints are nowadays rare to find on Swedish objects. Two churches under maintenance were found as suitable test objects.

When using the system, paint is heated to a moderate temperature, about 100-200 °C, down to the substrate. After sufficient time the paint will be soft and is easily scraped off. When paint is heated, regardless of which method is used and the higher the temperature, fumes are emitted and fume particles may carry lead pigments. The actual scraping also generates dust, especially if the heating is not allowed to last long enough to thoroughly soften all the paint to be removed. Dust particles ought to have essentially the same content as the paint itself, including lead if any.

The tests were designed to find reasonable worst-case conditions, since the aim was to design for safety under all common work conditions. The test cannot distinguish between dust and fume and both sources may contribute to the results.

Exposure tests were carried out with the procedures recommended by the Swedish Work Environment Authority (AFS 1992:17, Lead, and AFS 2007:17, Permissible Exposure Limits and Measures against Air Pollutants) and the Swedish/European standard SS-EN 689.

The purpose was not to benchmark different paint removal methods, and thus no reference tests were made using alternative methods, such as scraping alone, hot air gun, blasting or grinding. Neither were additional work, such as work place cleaning, monitored.

## Test object 1: Window-frames from the vicarage of the Högalid Church, Stockholm

**Date of test:** The sampling where made during about 5 hours, excluding a lunch brake, on 20 July 2005.

**Object:** The Högalid Church in Stockolm City was erected in 1916-1923. Its vicarage was built around 1927. It is run and maintained by the local congregation of the Swedish church. The buildings are now being renovated. The windows of the vicarage are original and painted twice with a linseed oil-based and lead

oxide-pigmented paint and a third time more recently with an alkyd-based and lead free paint. The National Heritage Board Lead has verified lead on paint chip samples.



**Contractor:** Fönsterhantverkarna i Aros AB, a small enterprise specialized in window renovation. The contractor has limited experience of using the Speedheater System and the workers have no specific training for its use.

**Test site:** The window frames of the vicarage were transported to the premises of the contractor for removal of the old paint and were later repainted. The exposure test was made in a small room in the contractor's workshop. The ventilation system was shut off throughout the sampling with the intention of monitoring a worst-case condition.

**Sampling:** Fumes and dust particles in the air were sampled on 25 mm filters. One sample was taken stationary in the room and one from the shoulder of the worker, who were using a Speedheater for paint removal throughout the sampling time. Sampling data is given in Appendix 1.



**Analysis:** Filters were sent to Analytica AB, an accredited laboratory, where they were weighted and multi element-analyzed by ICP-MS (inductively coupled plasma and mass spectroscopy).

## **Test object 2: The tower of Morjärv Church**

**Date of test:** 29 August 2005

**Object:** The Morjärv Church, situated in a small village in northern Sweden, was completed in 1929. It is run and maintained by the congregation of the Swedish church. The tower was stripped of the old paint during a few weeks and later repainted. According to the contractor the siding was originally painted, then additionally once or twice with linseed oil-based and lead oxide-pigmented paint. More recently it has been painted one time with an alkyd-based and lead free paint. The contractor's paint supplier has verified the presence of lead on paint chip samples.

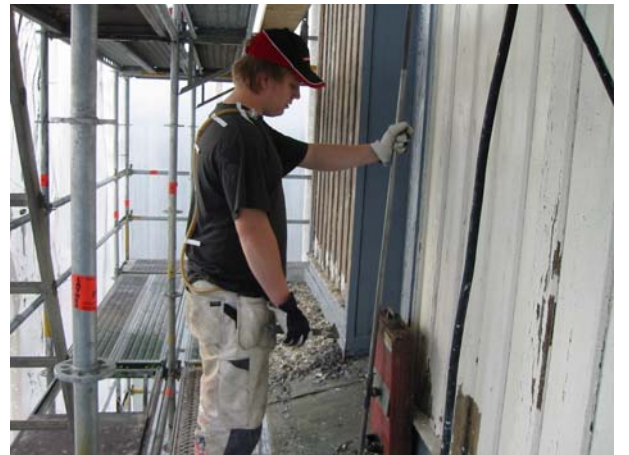


**Contractor:** Sanfridssons Måleri AB, Piteå. The contractor is well experienced from using the Speedheater and working with lead-pigmented paint, and the workers are trained for using the Speedheater System.

**Test site:** The church was reached from a scaffold completely decked with plastic curtains on the outside. This created a rather closed working room, in which the test was done.

**Sampling:** Fumes and dust particles in the air were sampled on 25 mm filters. One sample was taken from the shoulders of each of the three workers, all using a Speedheater for paint removal throughout the sampling time. Recommended work procedures for the Speedheater System were followed. Sampling data is given in Appendix 1.

**Analysis:** Filters were sent to the accredited laboratory of the Department of Occupational and Environmental Medicine at Örebro University Hospital, where they were weighted and multi-element analyzed by ICP-MS.



## Results

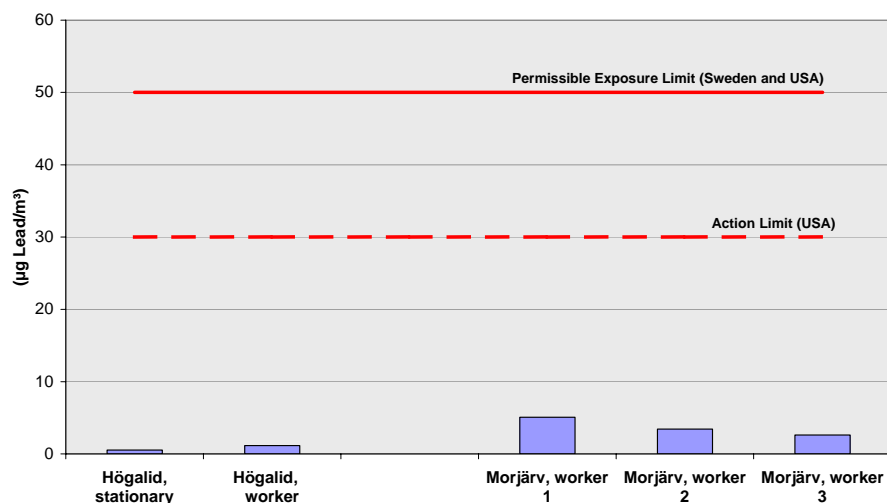
The results are shown in the following Table:

	Total dust (mg/m <sup>3</sup> )	Lead (µg/m <sup>3</sup> ) <sup>a</sup>
Högalid vicarage window, stationary	0,5	1,2
Högalid vicarage window, worker	0,5	0,5
Morjärv Church, worker 1	0,4	5,1
Morjärv Church, worker 2	0,2	3,4
Morjärv Church, worker 3	0,2	2,1
<i>Permissible exposure limit, Sweden (HGV)</i>	<i>5<sup>b</sup></i>	<i>50<sup>c, d</sup></i>
<i>Permissible exposure limit, USA (PEL)</i>	<i>15</i>	<i>50<sup>e</sup></i>

Notes:

- a.  $1 \mu\text{g}/\text{m}^3 = 0,001 \text{ mg}/\text{m}^3$ .
- b. Applies for organic dust, which should be appropriate for paint smoke.
- c. Sampling is made for all particles, whereas the Swedish lead HGV applies for inhalable particles. The results are thus interpreted as if all emitted particles are small enough to inhale, which follows the precautionary principle.
- d. Recurrent tests are required if exceeding 20 % of HGV, i.e.  $10 \mu\text{g}/\text{m}^3$ .
- e. Action limit is  $30 \mu\text{g}/\text{m}^3$ .

The limits apply to the total exposure during an 8-hour workday. Interpretation is made as if the work had continued in the same way during the complete workday, which is an overestimation of the exposure.



Other elements, such as zinc, chromium and iron, were also detected in the samples, indicating other pigments in the paint layers. These exposures were not the scope of the test, but according to the test results, they were low compared to each permissible exposure limit respectively.

## Concluding remarks

The tests followed international practice. Uncertainties of the sampling and analyses are regarded to be sufficiently small. Exposure conditions correspond to reasonable worst-case conditions. The five samples indicated lead exposures between 1 and 10 % of permissible limits in Sweden and USA. The levels are also below the action limit in USA and the level where recurrent tests are required in Sweden.

We thus conclude that the risk is very small for significant lead exposure when removing old lead-pigmented paint with Speedheater.

Exposure should nevertheless always be kept to a minimum. Appropriate precautions by clothing, ventilation and work procedures should be maintained and the Instructions and Safety Manuals respected.

## **Appendices**

- 1 Sampling data
- 2-4 Lab reports



## Appendix 1: Sampling data

### 1 20 July 2005

Site	The workshop of Fönsterhantverkarna i Aros AB, Västerås	
Work objects	Window-frames from the Högalid church, Stockholm	
Temperature	24,5 C	
Humidity	37 % RH	
Ventilation	Shut off in work room	
Analyses by	Analytica AB, Umeå, appendix 2	
Sample #	A5671	A5672
Location	Stationary	Worker
Start	07:45	07:45
Stop	14:16	14:25
Sample time (min)	391	400
(excl. brake)	309	319
Air flow (l/min)	2,7	2,55
Sample volume (l)	834,3	813,45

### 2 29 August 2005

Site	The tower Morjärv church, enclosed by a covered scaffold		
Work object	The siding of the church tower		
Entrepreneur	Sanfridssons Måleri, Piteå		
Weather (at start)	Sunny with light clouds, wind still, 14 C		
(at end)	Cloudy, windy, 13 C		
Analyses by	Department of Occupational and Environmental Medicine, Örebro, appendix 3 and 4		
Sample #	3487	3488	3489
Location	Worker 1	Worker 2	Worker 3
Sample time (min)	285	284	270
Air flow (l/min)	2,1	2,13	2,15
Sample volume (l)	598,5	604,92	580,5

Projekt

**IVF Industrieforskning o Utveckl. AB**  
**Rickard Berglund**

 Registrerad 2005-07-05  
 Utfärdad 2005-07-21

**Argongatan 30**  
**431 53 Mölndal**
**Analys: A6D**

Er beteckning		A5671			
Labnummer		U10202523			
Parameter	Resultat	Mätosäkerhet	Enhet	Metod	Utf
Dammvikt	0.5	0.02-0.04	mg tot	1	V
As*	<0.04		µg tot	2	S
Ca*	<20		µg tot	2	A
Cd*	0.0063		µg tot	2	S
Co*	0.0074		µg tot	2	S
Cr*	0.254		µg tot	2	S
Cu*	0.0603		µg tot	2	S
Fe*	0.650		µg tot	2	S
Mn*	0.0315		µg tot	2	S
Mo*	0.0028		µg tot	2	S
Ni*	<0.02		µg tot	2	S
Pb*	0.446		µg tot	2	S
V*	0.0012		µg tot	2	S
Zn*	6.20		µg tot	2	S

Er beteckning		A5672			
Labnummer		U10202524			
Parameter	Resultat	Mätosäkerhet	Enhet	Metod	Utf
Dammvikt	0.4	0.02-0.04	mg tot	1	V
As*	<0.04		µg tot	2	S
Ca*	<20		µg tot	2	A
Cd*	0.0136		µg tot	2	S
Co*	0.0118		µg tot	2	S
Cr*	0.241		µg tot	2	S
Cu*	0.112		µg tot	2	S
Fe*	1.40		µg tot	2	S
Mn*	0.0543		µg tot	2	S
Mo*	0.0027		µg tot	2	S
Ni*	0.0213		µg tot	2	S
Pb*	0.944		µg tot	2	S
V*	0.0028		µg tot	2	S
Zn*	14.6		µg tot	2	S



TJÄNSTESTÄLLE, HANDLÄGGARE

DATUM

BETECKNING

2005-09-12

Idnr: 67605-2

Ankomstdatum: 2005-08-31

Analysdatum: 2005-09-08

IVF

Richard Berglund

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431 53 Mölndal

Debiteringsadress:

Se svarsadress

**Multielement i luftprov**

Provet märkt	µg/prov					
	3487	3488	3489			
Beryllium (Be)	<0,1	<0,1	<0,1			
Magnesium (Mg)	<2	<2	<2			
Aluminium (Al)	<20	<20	<20			
Kalcium (Ca)	<20	<20	<20			
Vanadin (V)	<0,1	<0,1	<0,1			
Krom (Cr)	<2	<2	<2			
Järn (Fe)	<20	<20	<20			
Mangan (Mn)	<0,1	<0,1	<0,1			
Kobolt (Co)	<0,1	<0,1	<0,1			
Nickel (Ni)	<2	<2	<2			
Koppar (Cu)	<2	<2	<2			
Zink (Zn)	9	5	3			
Arsenik (As)	<0,1	<0,1	<0,1			
Molybden (Mo)	<2	<2	<2			
Kadmium (Cd)	<0,1	<0,1	<0,1			
Antimon (Sb)	0,1	<0,1	<0,1			
Barium (Ba)	<2	<2	<2			
Tallium (Tl)	<0,1	<0,1	<0,1			
Bly (Pb)	3,0	2,1	1,5			

Analysmetod: Induktivt kopplat plasma - masspektrometri ICP-MS

Krister Berg  
Avdelningschef

Carin Norberg  
Handläggare  
019-602 35 91

Provtagning är utförd av uppdragsgivaren. Eventuell beriknad luftkoncentration är baserad på av uppdragsgivaren angiven luftvolym eller provtagningstid. Ytterligare uppgift om analysmetoden lämnas på begäran. Denna rapport får endast återges i sin helhet.

Dok beteckning BLA 099

Utgåva 1



TJÄNSTESTÄLLE, HANDLÄGGARE

DATEM  
2005-09-06

Id nr: 67605-1 <sup>BETECKNING</sup>

Ankomstdatum: 2005-08-31

Analysdatum: 2005-09-05

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Debiteringsadress:  
Se svarsadress

### Damm i luftprov

Provet märkt	mg/filter			
3487	0,24 ±0,04			
3488	0,13 ±0,04			
3489	0,10 ±0,04			

Analysmetod: Gravimetrisk bestämning

Den angivna mätosäkerheten ( $U=k \cdot u_c$ ) är en utvidgad osäkerhet med hänsyn till alla kända osäkerhetskällor och beräknad med en täckningsfaktor  $k=2$ , vilket ungefär svarar mot ett 95% konfidensintervall.

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Provtagning är utförd av uppdragsgivaren. Eventuell beräknad luftkoncentration är baserad på av uppdragsgivaren angiven luftvolym eller provtagningstid  
Ytterligare uppgift om analysmetoden lämnas på begäran.

Denna rapport får endast återges i sin helhet

Dok beteckning: BLA 074

Utgåva 4