

SUPPLEMENT No. 509

Häkki-Rönnholm Eeva:

Investigation of paint systems from MV Estonia Visor Bottom Lock.

Research Report No. RTE57243/96.

VTT Building Technology.

Espoo 1996.

Requested by The Joint Accident Investigation Commission of MV ESTONIA
Accident Investigation Board
P.O.Box 1
FIN 00131 Helsinki

Order Chief Research Scientist Klaus Rahka, VTT, 4.12.1996

Contact person Group Manager Eva Häkkä-Rönnholm
VTT Building Technology
P.O.Box 18011
02044 VTT
Tel. + 358 9 456 4930
Fax. + 358 9 456 7006

Task **Investigation of the paint systems from MV Estonia Visor Bottom Lock**
Note: This report is a revised version of the research report RTE57243/96 dated 7.1.1997. In this revised version the layout of figures 1 and 4 has been changed, the locations of sampling have been pointed out and the views of the objects have been clarified.

Samples Paint coatings from MV Estonia Visor Bottom Lock taken from:

- the Forepeak deck starboard lug (Royal Institute of Technology, KTH sample nr 4543) and
- the Visor lug (Royal Institute of Technology, KTH sample nr 4511)

The samples are presented in figures 1-5.

Paint sample taken from top face

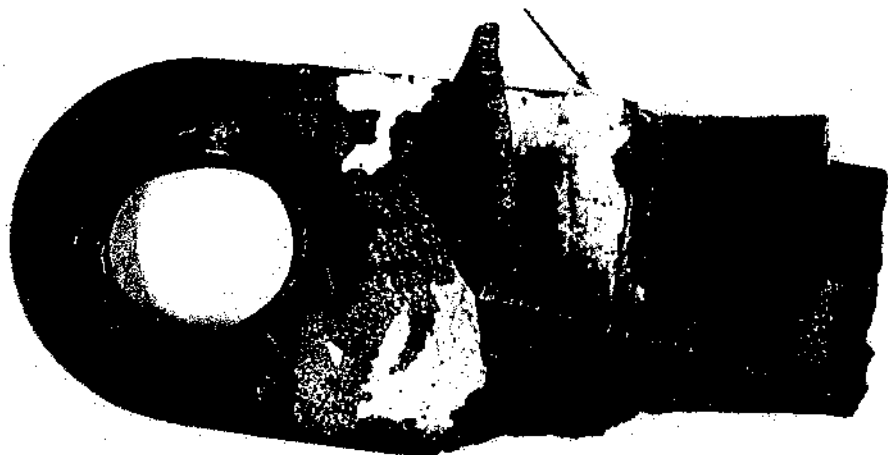


Figure 1. Visor lug, KTH sample nr 4511, view from starboard.

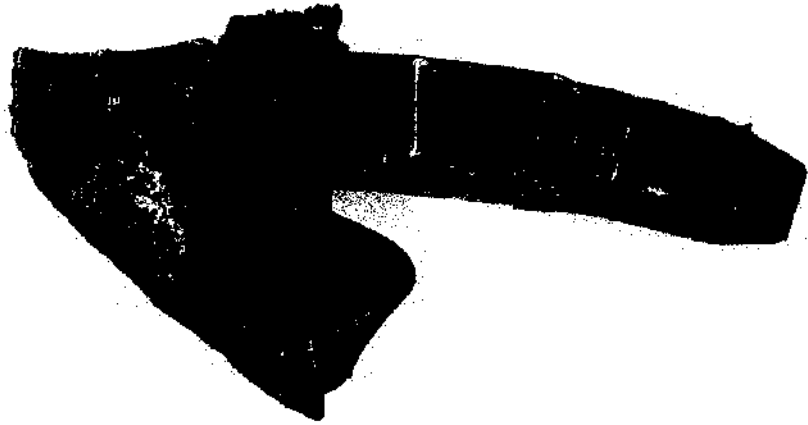


Figure 2. Visor lug, KTH sample nr 4511, bottom view.

Paint sample from top face

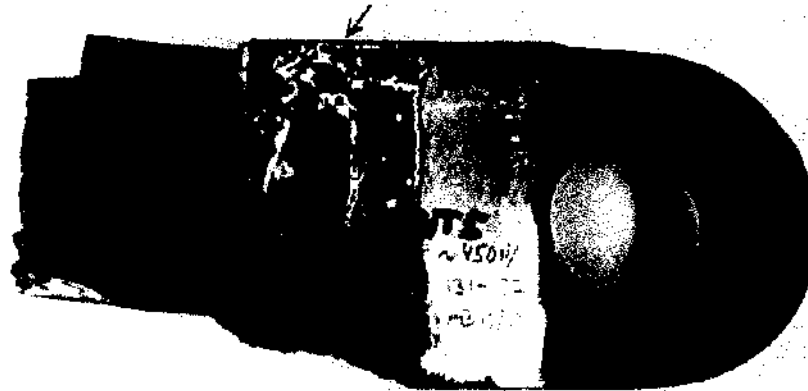
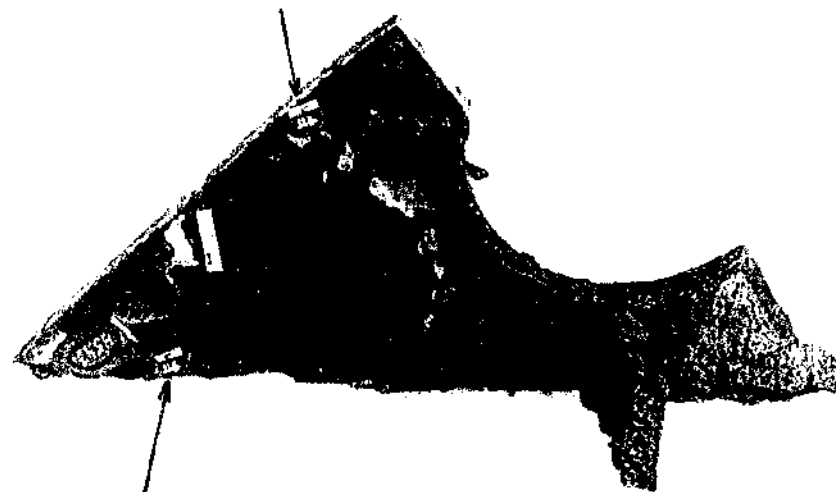


Figure 3. Visor lug, KTH sample nr 4511, view from port.

Paint sample 1



Paint sample 4

Figure 4. Forepeak deck starboard lug, KTH sample nr 4543, view from starboard.

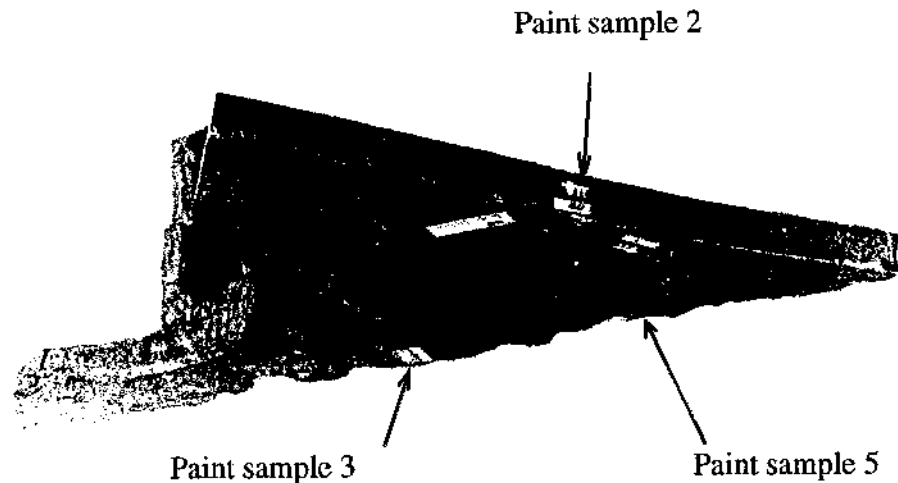


Figure 5. Forepeak deck starboard lug, KTH sample nr 4543, view from above aft port.

Performance of the task Samples of paint coatings were taken at VTT from the surface of the Forepeak deck starboard lug and from the Visor lug. From the paint coatings cross section samples were prepared.

The cross sections were investigated by using stereomicroscope and Scanning Electron Microscope (SEM). The image of the cross section was prepared using the backscatter electron - technique (BSE). The BSE-image gives information of the composition of the sample: elements with small atomic weight show darker in the image and the higher the atomic weight, the lighter the appearance.

Analysis of the cross section was performed by using Energy Dispersive Spectrometry (EDS). The EDS-equipment was connected to the Scanning Electron Microscope. EDS gives qualitative and semi-quantitative analysis of the elements.

Research results

Forepeak deck starboard lug (KTH 4543)

The paint system consisted of several paint layers. Many of the layers were discontinuous. The shade of the partly flaked top paint of the coating system was blue. The underlying paint layer was of a slightly lighter shade of blue. White and red paint spots (splashes) were found on the surface. The white and red paint spots on the surface as well as cross sections of four pieces of paint sample from the Forepeak deck starboard lug were analysed.

- Forepeak deck starboard lug , paint sample 1

Six paint layers were found. The BSE-image of the cross section of the sample is given in figure 6 and the corresponding EDS-analyses of the paint layers are given in Appendix 1 in figures A1-1 to A1-6.

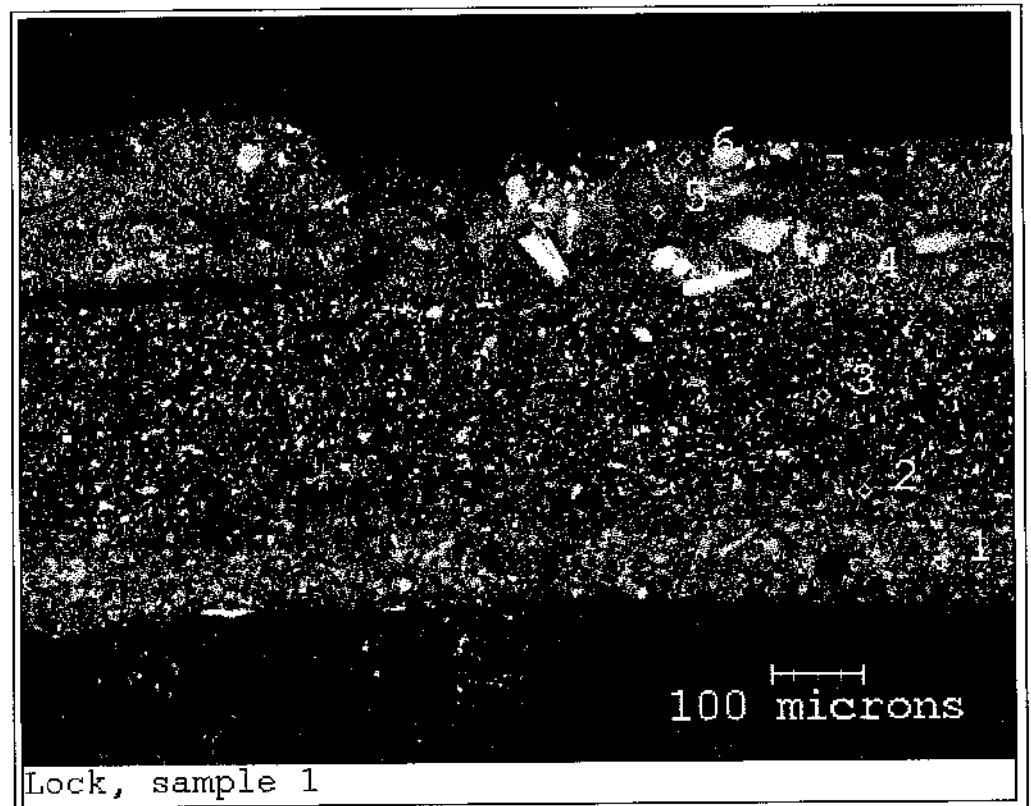


Figure 6. Forepeak deck starboard lug, paint sample 1, cross section. The paint layers and the analysis spots are numbered from 1 to 6.

Shades of the layers: 1-white; 2-grey; 3-blue; 4-red; 5-white; 6-blue

- Forepeak deck starboard lug, paint sample 2

Seven paint layers were found. The BSE-image of the cross section of the sample is given in figure 7 and the corresponding EDS-analyses of the paint layers are given in Appendix 2 in figures A2-1 to A2-7. According to the appearance and the results of the EDS-analysis the layers 4 and 5 seem to be identical.

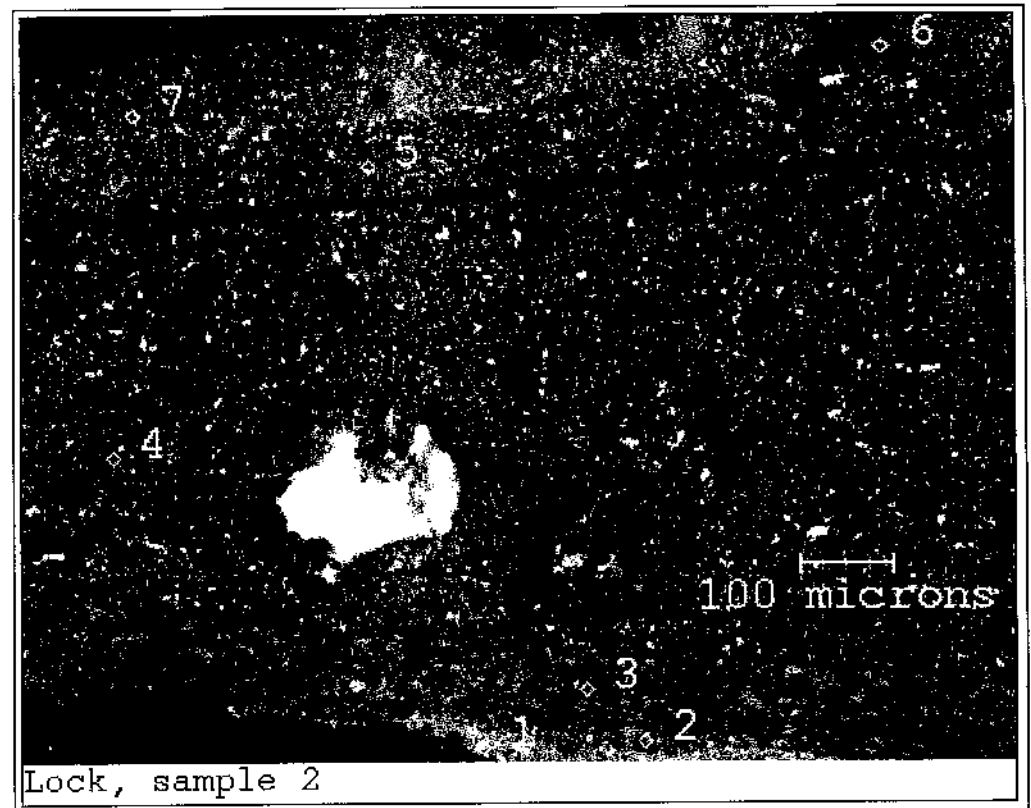


Figure 7. Forepeak deck starboard lug, paint sample 2, cross section. The layers and the analysis spots are numbered from 1 to 7. Shades of the layers: 1-light brown; 2-white (discontinuous), 3-grey; 4- blue; 5-blue; 6-white (discontinuous); 7-blue. Black crevice between layers 4 and 5.

- Forepeak deck starboard lug, paint sample 3

Five paint layers were found. The BSE-image of the cross section of the sample is given in figure 8 and the corresponding EDS-analyses of the paint layers are given in Appendix 3.

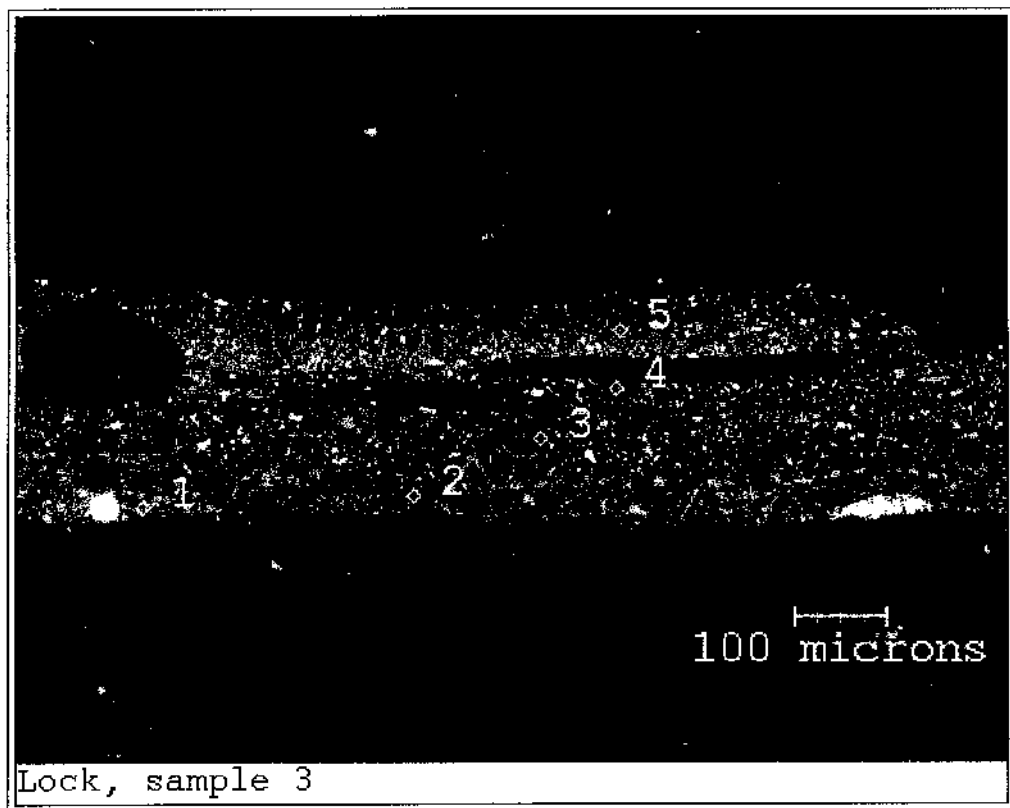


Figure 8. Forepeak deck starboard lug, paint sample 3, cross section. The layers and the analysis spots are numbered from 1 to 5. Shades of the layers: 1-white (discontinuous), 2-grey; 3- blue; 4-blue; 5- blue. Black crevice between the layers 3 and 4 as well as between layers 4 and 5.

- Forepeak deck starboard lug, paint sample 4

Four paint layers were found. The BSE-image of the cross section of the sample is given in figure 9 and the corresponding EDS-analyses of the paint layers are given in Appendix 4.

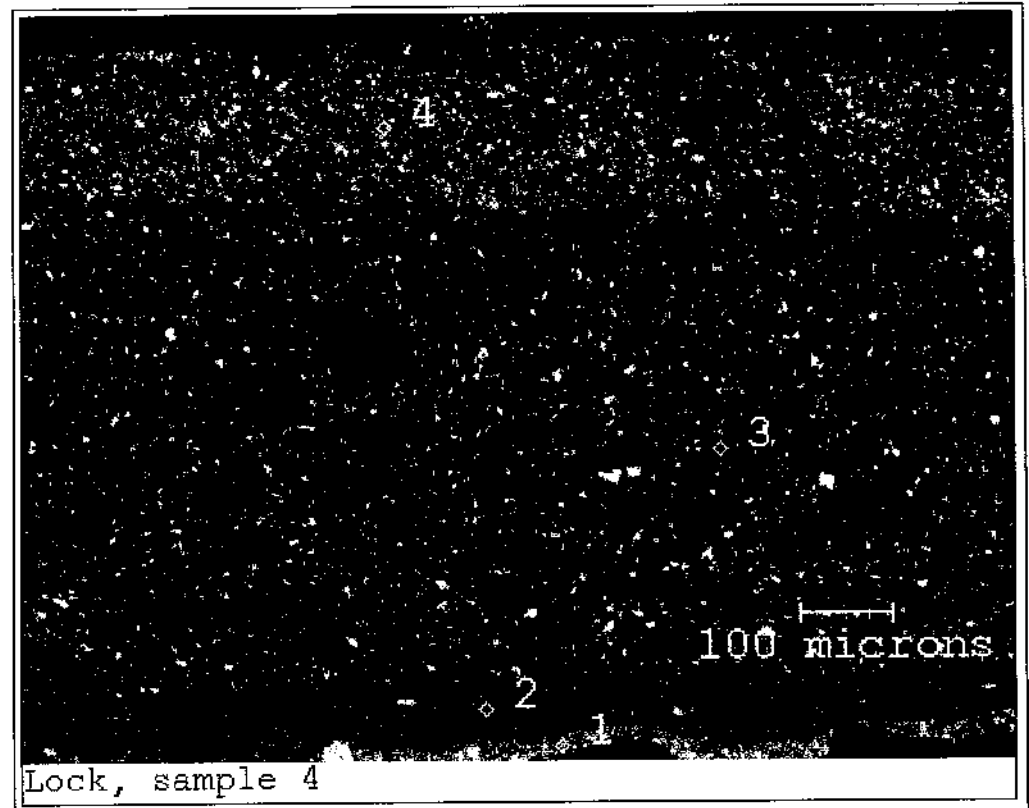


Figure 9. Forepeak deck starboard lug, paint sample 4, cross section. The layers and the analysis spots are numbered from 1 to 4. Shades of the layers: 1-light brown, 2-grey; 3-medium blue; 4-blue. Black crevice between layers 3 and 4.

- Forepeak deck starboard lug, paint sample 5

Paint sample 5 was analysed for the white and red paint spots found on the paint surface. The results of the EDS-analyses are given in Appendix 5. Stereomicroscope pictures of the paint splashes are presented in Appendix 6.

Visor lug (KTH 4511)

The BSE-image of the cross section of the paint system is given in figure 10. The layers found are marked from 1 to 9. Number 1 is the rust layer.

The paint system consisted of a multilayer coating with a very poorly adherent white top coat consisting of two layers (7 and 8 in Fig. 10).

The coating system under this loose paint layer had a red top coat (5 in Fig. 10). This red coating was built of two layers, some white paint (6 in Fig. 10) was seen here and there between these two red layers.

Some of the underlying layers were seen only here and there, for instance layer nr 9 was found only sporadically.

The EDS-analyses of the layers are given in Appendix 7.

↑ KS 57243/96



Figure 10 . Visor lug, paint system sample, cross section. Layer 1-rust; layer 2-yellowish; layer 3-white; layer 4-grey; layer 5-red; layer 6-white; layer 7-white; layer 8-grey; layer 9-light brown. Layers 8 and 7 were poorly adherent to the previous paint surface and rust was found underneath these layers.

Espoo 7.1.1997

Eva Häkkä-Rönholm
Group Manager

Paula Raivio
Research Scientist

Appendices

7 pcs

Distribution

Accident Investigation Board
VTT

Original, copies 6 pcs
Original, copies 2 pcs