

INVESTIGATION REPORT No 23U-AR0075

10 August 2023

Tallinn, Tervise 20

| | |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Investigation applicant | Director of the Estonian Safety Investigation Bureau Märt Ots |
| Circumstances | During the preliminary assessment of M/S Estonia in the period from 19 July to 25 July 2023, a piece of metal was cut out of the edge of a hole in the starboard side of the wreck of the vessel. |
| Letter No | 27-2/2023/3775-1 |
| Letter | Compiled on: 27 July 2023 Arrived on: 27 July 2023 |
| Presented for the investigation | <p>Investigation object A piece of metal cut from the edge of a hole in the hull of the wrecked ship</p> <p>Information material Submitted by the Estonian Safety Investigation Bureau: 1. video screenshots and photogrammetric drawings (27 digital files) of the wreck of M/S Estonia; 2. 3D photogrammetric model of the wreck (online).</p> |
| Investigation type | Metals survey |
| Assignment | Does the submitted metal piece show any signs of contact or collision with a metal item/object? |
| Experts | Forensic Expert Meelis Toomet phone 663 6718, email meelis.toomet@ekei.ee |

Description of the investigation

An elongated strip-shaped piece of a metal plate was submitted for examination (Figure 1). The thickness of the plate is between 13–13.5 mm, the approximate length is 66.5 cm and the width at the widest point is 14.5 cm. The strip is rectangular in shape, with one longer straight cut edge and one shorter straight cut edge. The other longer edge shows signs of tearing.



Photo 1. Piece of metal submitted for examination, view from the curved side

Based on the information materials, the metal strip to be examined has been cut out of the edge of a hole in the ship's hull. The edge is curved towards the interior of the vessel. The cut-out

2(5)

strip is curved and the paint coating has probably separated (Photo 2).



Photo 2. Curvature of the metal strip

Based on the reference material photos, the curved side of the metal strip is the outer side of the hull. The photos show the opposite edge of the torn edge of the cut-out piece, which has bent and shifted towards the interior of the vessel. Moving downwards on the hull, the torn edge outside the cut-out continues as a crack in the hull and ends at a certain distance. The thickness of the metal strip decreases near the torn edge due to stretching. The thickness of the torn edge is mostly between 9.5–11 mm (Photos 3–6), decreasing further at the sharply angled tip of the strip (Photo 6), where the material has separated into layers and a possible joint is located (Photos 7–8).



Photo 3. Torn edge of metal strip, view of hull exterior.



Photo 4. Torn edge of metal strip, view of hull exterior.



Photo 5. Torn edge of metal strip, view of hull exterior.



Photo 6. Torn edge of metal strip, view of hull exterior.

4(5)



Photo 7. Torn edge of metal strip, view of hull exterior, possible joint.



Photo 8. Torn edge of metal strip, view of hull interior, possible joint.

The internal and external surfaces, as well as the torn edge of the submitted piece of metal were examined using a Leica M300 DENT stereomicroscope at various magnifications. The paint coating has likely separated, and the surface is corroded. No signs of mechanical contact with a metal object were observed and no transferred materials were found. The surface is uniformly corroded, with no deep scratches or scuff marks. Smaller possible contact marks have likely disappeared due to corrosion and the separation of the paint coating.

Investigation deliverables

No signs of contact or collision with a metal object were found on the metal piece submitted for examination.

Note: The piece of metal submitted for examination was sent for an explosives investigation (Chemistry Department of the Estonian Forensic Science Institute).

(signed digitally)
Meelis Toomet
Expert

INVESTIGATION REPORT

No 23U-AL0002

Tallinn, Tervise 20

15 August 2023

| | |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Investigation applicant | Director of the Estonian Safety Investigation Bureau Märt Ots |
| Circumstances | Investigation of the wreck of M/S Estonia |
| Procedural Case No | 27-2/2023/3841-1 |
| Investigation request | Compiled on: 2 August 2023 Arrived on: 3 August 2023 |
| Presented for the investigation | Investigation object (obtained on 28 July 2023 from the metal investigation of the Chemistry Department): elongated metal piece with a corroded surface |
| Investigation type | Explosives investigation |
| Assignment | 1. Are there any traces of explosives on the piece of metal submitted? 2. If so, which kind? |
| Expert | Forensic Expert Sven Laanet Telephone +372 6636721 , email sven.laanet@ekei.ee |

Description of the investigation

For the investigation, a piece of metal with a rusty surface with an approximate length of 65 cm, an approximate width of 14 cm at the wide end and 10 cm at the narrow end, and a thickness of more than 1 cm at the wide end and less than 1 cm at the narrow end was presented.

By washing the surface of the research object with acetone from the narrow end to approximately half the length of the object, a sample of the acetone solution was taken from the investigation object. The location of the sampling was determined according to an agreement with the investigation applicant, the other side of the object was not examined.

The sample was examined using a liquid chromatograph-mass spectrometer (KO-MR-AL03), a method approved by the Estonian Forensic Science Institute.

Investigation deliverables

As a result of the investigation, no traces of explosives were found on the investigation object.

Note: The piece of metal presented for the investigation will be returned to the investigation applicant.

(signed digitally)

Sven Laanet
Expert

INVESTIGATION REPORT No 23U-PL0001

Tallinn, Tervise 20

13 October 2023

| | |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Investigation applicant | Karl-Eerik Unt, Aviation Casualty Senior Investigator, Safety Investigation Bureau (acting Head of the Safety Investigation Bureau). |
| Circumstances | Investigation of the wreck of M/S Estonia |
| Investigation application No | 27-2/2023/3906-1 |
| Request | Compiled on: 08.08.2023 Incoming: 08.08.2023 |
| Presented for the investigation | 1. Piece of metal cut from the edge of a hole/rupture in the starboard side of M/S Estonia; 2. Ramp of M/S Estonia (observation at the ramp storage area); 3. Drawings, 3D model, videos and photos of M/S Estonia (forwarded by email on 18 August 2023 and on hard drive on 7 August 2023). |
| Investigation type | Explosive device and explosion investigation |
| Assignment | 1. Do the objects and/or videos and photos presented show traces characteristic of an explosion? If yes, where and which ones? 2. If traces characteristic of an explosion are present, where was the centre of the explosion and what parts could the exploded object have been comprised of? 3. If traces characteristic of an explosion are present, what could have been the amount of explosives in TNT equivalent? |
| Expert | Forensic expert Allan Juhe Tel 6636640, email allan.juhe@ekei.ee |

Description of the investigation and evaluation of the results

The presented piece of metal cut from the edge of a hole/rupture in the starboard side of M/S Estonia was inspected by an expert at the Chemistry Department of the Estonian Forensic Science Institute on 10 August 2023. The piece of metal was corroded, elongated in shape, with one longer and one shorter straight cut edge. The other edges showed signs of tearing, but no traces characteristic of an explosion were detected on the piece of metal.

The ramp of M/S Estonia was inspected by an expert at the ramp storage area on 7 August 2023. The ramp showed signs of corrosion and numerous different deformations (crushing damage, ruptures), but no traces characteristic of an explosion were detected.

Nor were any traces characteristic of an explosion found in the photos or videos presented for the investigation. Therefore the objects of the investigation and other materials presented could not be used to confirm the occurrence of an explosion, nor to estimate the centre of the explosion, the potential exploded object or the amount of explosives in TNT equivalent.

(signed digitally)

Investigation deliverables

1, 2, 3. As a result of the investigation, no traces characteristic of an explosion were found in the objects, photos or videos presented. Based on the investigation objects and other materials presented, it was not possible to confirm the occurrence of an explosion, estimate its centre, the potential exploded object or the amount of explosives in TNT equivalent.

Note: The hard drive presented for the investigation will be returned in one package.

(signed digitally) Allan

Juhe
Expert