Investigation report

Investigation of broken parts of heatshields from turbocharges passenger ship MS. Love boat.

(All names of the ship in question, engines, and turbos are changed not public)

Client: ……
Chief Engineer
Office: …….. Cell: ……

MS. Love boat.

Adress: …….
……
……..

Author: J. van Duijn Cobra Consultancy
Report nr. 1-4399
Date: 07-03-2026/12-03-2026
Page: 1
Pages: 6.

Introduction:

Chief engineer of the MS. Love boat has requested Cobra Consultancy to investigate the cause of broken parts of a ring and a heat shield. See further introduction mail 07-03 -2026.

Good afternoon Jaap, (mail 07-03-2026)

As discussed on the phone, I am sending you some more information about the issues we have encountered with the heat shields of 7 out of 8 of our turbochargers. On the ……..we have 4 DG's. …engines. V12's with a turbocharger for the A- and B-Bank of 6 cylinders. What fails is a ring that is welded to a heatshield. This heatshield protects the bearing on the exhaust gas turbine side from becoming too hot. This heatshield can best be described as a "trumpet shaped dome" with a flange on the one end and a ring on the opposite side. When the turbo is mounted in the housing, the flanged side is tightened between the turbo and the housing. Therefore tight on one side. On the opposite side the ring has 3 notches which fall into a recess, just behind the turbine-wheel. The notched ring is welded into the heatshield. What we observe, is that the ring separates from the heatshield behind the weld. It separates around the full circumference of the heatshield. Exhaust gasses then blow the ring into the exhaust. Both turbos are connected with their exhaust sides to the vertical uptake but at the bottom of that uptake is a flat surface. That's where we found the rings under a heap of rubble which represent the heatshield broken up in pieces. That we found the ring under this heap of metal pieces suggests that it is the first part that fails before the rest of the heatshield cracks up. This was confirmed when we inspected the uptake of DG4 where we found only 1 notched ring, that had already separated but the rest of the heatshield was not yet in pieces. DG2 was the first where one turbo seized and parts flew into the other turbo so on that engine both turbos got replaced. Then out of curiosity we opened the inspection hatches of the uptakes on the other 3 DG's and then it became clear what the extend of the damage was. DG3 was the worst, with two heatshields disintegrated, DG1, the same and DG4 had only the one ring that we found. All turbo's have been pulled to remove the remaining pieces of the heatshields to prevent any further seizures as occurred on DG2.

Note:

The turbo company suspects that the rings of the compressor housing break because we wash the turbos at the wrong temperature compared to the turbos of the other ships of the company?

That's all from my end. If you have some thoughts about this or if there is something that comes to mind that we can have a closer look at, please pitch in at your discretion. Enjoy your trip to Greece, sail safe!

With best regards,

From: Chief Engineer ……
Sent: Tuesday, 07-03-2026 10:41 AM
Good day all,Just to give you a first update of the outcome of the vibration measurements by ……and……...

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Turbo's: vibration measurements

All in accordance with previously measured values (see table below from previous measurements).
.....claim that the vibrations on the top of the silencers are too high. However, when questioned, they admitted that the maximum limit is 75 mm/sec and measured values are well below the maximum.
.....find it strange that the highest vibration levels are measured on the A-Bank turbo's (consistent with previously collected data) but that B-Bank turbo's all failed.
Due to the a.m. observation, the firm .....does not believe that the vibrations are the main contributing factor to the failure of the heatshields.
The firm ..... believe that material specification and manufacturing procedures of the heatshield need to be looked at.
We also learned that the firm .....does not manufacture this heatshield themselves. Manufacture of these parts is sub-contracted.
.....measurements on turbo's are the same as what .....measured.

	FC	DG1	DG2	DG3	DG4
A-bank silencer	Y	26.3	23.2	21.8	19.5
	Z	51	43	36	40.2
	X	33.5	28.8	29.1	28.2
B-bank silencer	Y	25.1	18.1	17.1	13.1
	Z	19.8	35.9	34.3	32
	X	22.4	25.4	27.6	24.9

	CAT	DG1	DG2	DG3	DG4
A-bank silencer	Y	29.3	31.9	29.2	29.4
	Z	48.1	44.4	44.6	48
	X	22.6	20.8	19	21
B-bank silencer	Y	26.7	25.5	27	23.5
	Z	30.1	35.1	30.1	32.3
	X	11.3	16.9	11.7	13.6

Alternators:

On all DG's, the DE-bearings are in resonance (as per …….). Good that we do the alignment check with …… soonest.

Control stands:

On all DG's unacceptably high vibrations and resonance values.

Reports will be submitted within the next few days.

XXXXXX XXXXXXXX
Chief Engineer
Office: xxxxx | Cell: xxxxx

Ms. Love boat

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Van: Jaap van Duijn Cobra Consultancy
Verzonden: 13:45
Aan: ……..Chief Engineer ……

Onderwerp: RE: Turbo heatshield failures ……

Hi Chief Engineer Mr. ……..
The company ……..and the company ….that supplied this …….turbo are most likely responsible for this damage. See examples of another turbocharger the turbo 73 that are well welded.
I can assume that you have already been in contact with these companies.
Most likely it is a welding problem and not tension poor annealed after welding.
It is also advisable to measure the difference in vibrations between the ships, especially because they have no problems. Since the heat shields are thicker at a later stage in your opinion indicate that the company is aware of any discontinuities. Probably the heat shields are made of stainless steel, which type I don't no. I see in your photo 53 colour differences has been blasted to the heat shield and sharpened on the blades for stabilization?

Kind regards,

Jaap

Van: Chief Engineer …….
Verzonden: Aan: Jaap van Duijn <info@cobraconsultancy.nl>
Onderwerp: RE: [EXTERNAL] RE: Turbo heatshield failures ……..

Hi Jaap,

Well I have to take my cap off to you! Unbelievable, I think you hit the nail on the head here! We were already thinking in this direction of residual welding stress. We will do a closer examination of the pieces of the heatshield. I have indeed asked for vibration reports on the KODM (I know that they did one 6 months after delivery) for comparison. Will keep you informed. As mentioned earlier, I suggest that we wait for the vibration analysis results and then we will contact again. We send you broken pieces of the rings.

Thank you very much for looking into this and this initial assessment,

I'll be in touch and I say it again…sail safe! Enjoy your trip!

Best regards,

XXXXX XXXXXXX
Chief Engineer ms xxxxxxxxxx
Office: xxxxx | Cell: xxxxx

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Start investigation:

On xxxxxxxxxxx xxx I had contact with xxxxxx xxxxxxx, the chief engineer at Ms. Love boat. We made a round made through the engine room and also being able to observe that the … engines vibrated, but whether these are within tolerances I do not make a statement about.

I received broken parts of the heat shield and had an appointment with the chief engineer to made further metallurgical research by the company Love boat.

Chemical analyses with a portable XRF analyzer to verify the type of material of the cone and ring. The result of measure of the Stainless steel material Werkstoffnr. 1.4541 or AISI 321. This is a titanium-stabilized stainless steel type.

Date 30-01-2026 See Report 3341/1. Visual, macroscopic and microscopic examination .

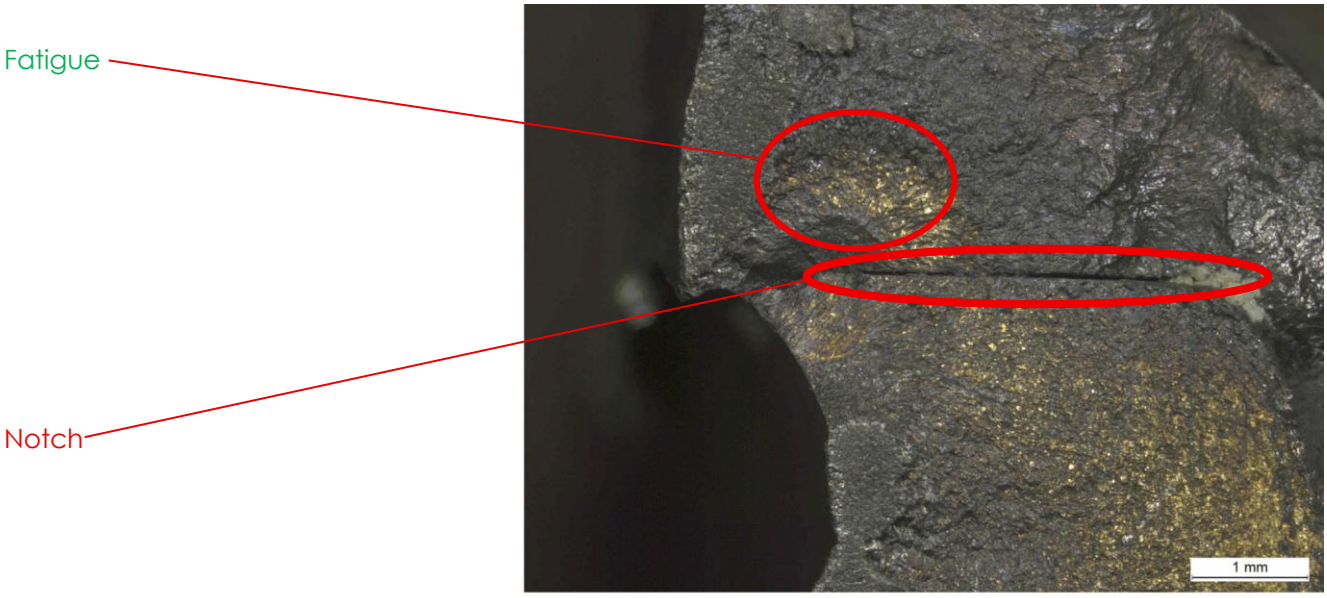

Figure 10 Macrophoto of fracture surface C in R3, location see figure 8.
Magnification: approx. 16X **After cleaning.**

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Most important part of conclusion

Many details were damaged on the circumferential fracture between the ring and the cone, and on the fractures and cracks in the cone. Microscopic examination showed trans granular crack paths, which could indicate fatigue fracture. The circumferential fracture seems to have initiated in the inner weld. A small weld penetration could have contributed to this fracture. The fractures in the cone seem to have initiated at the outer cone surface. This surface contains surface imperfections (laps) that probably originate from the spin forming process. Such laps can act as crack initiations. The transverse fractures in the ring show beach marks and the crack path is trans granular. These are in general indications for fatigue fracture. Macroscopic and microscopic examination show that the transverse fractures in the rings initiated at the inner welds. Microscopic examination showed that fracture A initiated at a sudden transition in penetration depth of the weld. Fracture C initiated on a part of the inner weld with very little penetration. In our opinion these weld imperfections could be the cause of the transverse ring cracks.

Final conclusion of Cobra Consultancy.

- The cause of the fractures of the rings is caused by fatigue, because not a total penetration or welding has taken place. See Macro photo Figure 10. Fatigue and a crack or notch.

- The vibrations of the motor accelerate the breaking of the rings.

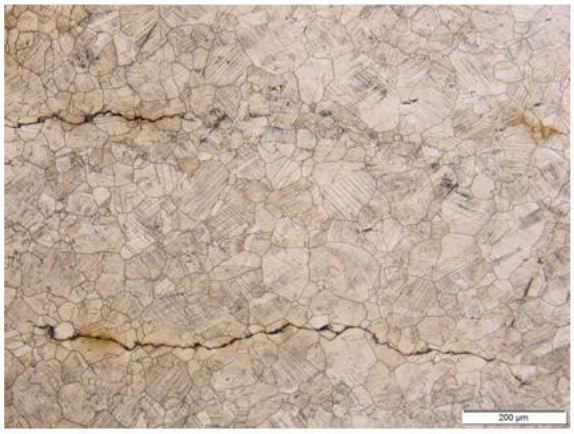

Figure 34 Micrograph of section C1-a, location see figure 22.
Transgranular cracks in the cone
Magnification: approx. 100X **Etching reagent:** HNO3 + V2A.

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