

REPORT

ROAD 2014/02



REPORT ON OVERTURNING ACCIDENT INVOLVING A TRUCK ON FV 12 BY ALTEREN WEST OF MO I RANA ON 3 OCTOBER 2013

The Accident Investigation Board has compiled this report for the sole purpose of improving road transport safety. The object of any investigation is to identify faults or discrepancies which may endanger road transport safety, whether or not these are causal factors in the accident, and to make safety recommendations. It is not the Board's task to apportion blame or liability. Use of this report for any other purpose than for road transport safety shall be avoided.

*This report has been translated into English and published by the AIBN to facilitate access by international readers.
As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.*

Photos: AIBN

REPORT

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This investigation has had a limited scope, and the AIBN has therefore chosen to use a simplified report format. The report elucidates the findings made, and presents the assessments and conclusions of the Accident Investigation Board.

Date and time:	3 October 2013, 0022 hours.
Accident location:	Alteren, Rana Municipality, Nordland County.
Road no., HP, km:	Fv 12, HP 2, km 2.34 (final position).
Accident type:	Overturn in a right curve with the truck subsequently driving off the road on the left-hand side of the road.
Type of transport:	Freight transport, licence required.
Injuries:	Fatal for driver.
Road conditions:	Two-lane road without centre line. Broken edge lines. Signposted speed limit 60 km/h. Tarmac. Yearly average traffic load per day: 2000.
- Road characteristics:	Three successive curves (right, left and right curve) without a straight line between the curves. The accident happened as the truck entered the last right curve. Road width approximately 6 metres. Guardrail on the right-hand side, seen from the truck's direction of travel. The minimum curve radius of the curve where the truck started to topple over has been stated as 63 ¹ metres.
- Weather and driving conditions:	Cloudy, dry weather and 8 °C. Dark and no road lighting at the site. Nevertheless good visibility. Wet and clear road.

¹The AIBN has been informed that there is some uncertainty relating to the measuring methodology for this value. The AIBN has not carried out its own measurements of the curve radius.

Vehicle and cargo:	Semi-trailer truck transporting fish.
- Type/combination:	DAF XF105 2011 model, 3-axle truck, with HFR 65 2003 model, 3-axle semi-trailer with cooling/freezer unit.
- Damage to vehicle:	Truck's driver cab deformed, especially on the left-hand side. No survival space in the driver's seat. Semi-trailer cabinet deformed as the truck toppled towards the terrain on the side of the road.
- Load, type, amount, safety equipment:	891 cases of fresh salmon covered by ice. The gross weight of the cargo was 24 540 kg. Of this, 3 600 kg was ice. Any containment/securing of the cases is unknown.
Road user:	Norwegian male.
- Age:	64.
- Driver's licence class:	A1 BE CE DE S T
- Driving experience:	Licensed to drive a heavy truck/bus since 1 January 1979. Worked as a bus driver for approximately 20 years, driving both locally and long distance. Drove heavy trucks for various companies for a total of 1 – 1.5 years.
- Conditions of employment:	Retired, working part-time on individual assignments only.
Transport company:	Elvrum transport AS.
Client:	Nova Sea AS, Lovund.
Planned route:	Lovund, via Mo i Rana to Ålesund.
Key sources of information:	The Norwegian Public Roads Administration, the Police, Nova Sea AS, Elvrum transport AS, other drivers transporting fish who are familiar with the road section, DAF, AIBN's own investigations.

FACTUAL INFORMATION

Notification and investigations

The Accident Investigation Board Norway (AIBN) was notified of the accident on 3 October 2013 at approx. 0130 hours. The AIBN was informed that the accident involved an overturned semi-trailer truck and that the driver had died in the accident. Over the next few days, AIBN gathered information about the accident continuously. Two accident inspectors travelled to the accident site on 24 October 2013 to conduct inspections and obtain further technical and other relevant information.

Course of events and accident site

On 2 October 2013, a heavy semi-trailer truck from Elvrum Transport AS was loaded with fresh salmon packed in cases by Nova Sea AS on the island of Lovund in Lurøy Municipality. After a 3.5-hour ferry journey, the truck left Stokkvågen ferry quay at 2330 hours.

After approximately 50 minutes, the truck arrived at a road section with multiple curves. The speed limit in the area was signposted as 60 km/h. The truck performed a continuous right, left and right curve. The truck toppled over in the last right curve and ended up off the left side of the road, seen from the driver's direction of travel. Data from the truck's tachograph showed a speed of approx. 63 km/h² the last second before the semi-trailer truck overturned. Figure 1 shows the overturned truck immediately after the accident. Figures 2 and 3 are overview pictures of the curve where the truck toppled over.

² The margin of error for the registered speed is +/- 6 km/h.



Figure 1: The overturned semi-trailer truck. Photo: the Police



Figure 2: Overview picture of the curve where the truck toppled over. Shows the area where the overturning starts and the side terrain where the truck ended up on the left-hand side of the road. Picture: The Norwegian Mapping Authority, Geovekst and municipalities, ill.: AIBN



Figure 3: The curve the truck entered as it toppled over. The photo was taken on 25 October 2013. The tracks on the road were not made by the truck that overturned. Nor does the loading strap in the road belong to the truck that overturned. Photo/ill.: AIBN

After the truck toppled over, it skidded along the road and ended up in the ditch. The driver's cab hit the side terrain with its left-hand side and the roof. The cab was heavily deformed, particularly near the driver's seat. The driver's survival space³ was considerably reduced. The semi-trailer cabinet also sustained major damage, and the fish cargo was scattered across the side terrain.

Examination of the vehicles

The truck was examined by the AIBN's accident inspectors together with representatives from the truck manufacturer DAF, who contributed by downloading electronic data, etc.

Truck

The truck passed the periodic roadworthiness test (EU inspection) on 22 May 2013. The AIBN's investigation of the truck following the accident did not identify any faults or defects that may have contributed to the accident.

Semi-trailer

The semi-trailer passed the periodic roadworthiness test (EU inspection) on 27 September 2013 (about a week before the accident).

³ The available space, after deformation or intrusion of chassis sections in a collision, which the driver and passengers have available in the compartment to survive the accident.

The AIBN's investigation of the semi-trailer revealed the following:

1. A draw spring on the left-hand side on the second axle was broken just by the axle's fastening point (see Figures 4 and 5). The picture in Figure 4 was taken during the Norwegian Public Roads Administration's inspection of the semi-trailer after the accident. The photo shows partly corroded sections on the fracture surface. This may indicate that there was previous fracture formation in the draw spring, and that the breakage occurred as the semi-trailer toppled over.
2. The rear axle on the semi-trailer was steerable (friction-controlled⁴). Findings from the investigation indicate that this was in the open position prior to the turnover.



Figure 4: Sheared axle draw spring. Photo: Norwegian Public Roads Administration, ill: AIBN

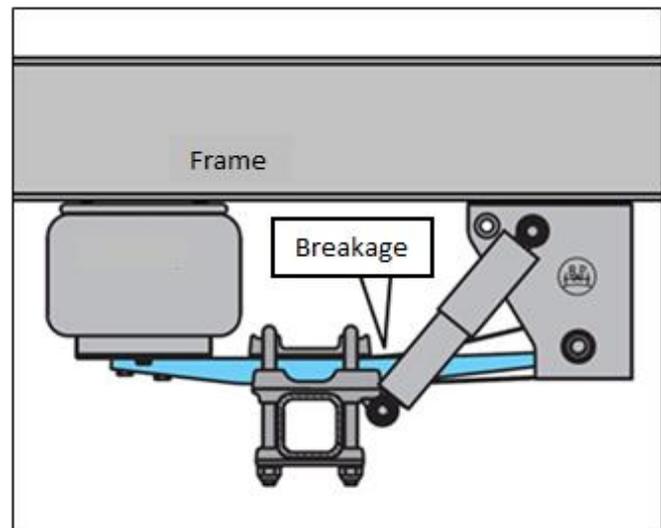


Figure 5: Schematic diagram of the axle's wheel suspension. Source: BPW Bergische Achsen, Ill.: AIBN

Human factors

The AIBN has been informed that the driver had asked for help during loading as he had said that he was feeling unwell and in bad shape. The autopsy report concluded that indisposition cannot be ruled out. The toxicological examination did not show any signs of the driver having used intoxicants.

According to information obtained by the AIBN during the investigation, the driver was in no rush to deliver the goods. Nor were any breaches of the driving and resting time rules uncovered. During the last 24 hours before the accident, the driver had a registered continuous resting period of 9 hours and 4 minutes, and a total rest/break period of 20 hours and 4 minutes during the 24-hour period.

Critical speed prior to overturning

The AIBN has conducted calculations of the critical speed as the vehicle overturned. This means that a theoretical limit value was determined for the speed the truck in question can maintain through the curve before it will topple over. The calculations are based on the given curve radius and the centre of gravity height, which was determined based on the available information about the transport. The calculations show that the theoretical overturn speed in the curve was about 60 km/h for the truck in question.

⁴The axle is designed in such a way that the wheels have the necessary swing radius to follow the semi-trailer's tracking around the fixed axles. The swing radius is achieved as a result of friction between the deck and the road.

The driver may affect the critical overturn speed somewhat through his choice of track. In this case, the AIBN has not determined the actual choice of track through the curve and has, consequently, used the stated curve radius as a basis for the calculations.

Cargo and securing the cargo

The slaughtering, packing and loading process follows a regular pattern at the Nova Sea AS facility in Lovund. As part of the investigation, the AIBN observed these processes, including the loading of a truck similar to the one involved in the accident.

Each case packs about 22 kg of salmon and 3 – 4 kg of ice. The number of salmon in each case depends on the size of the salmon. In cases with one or two large salmon there is some extra space. The amount of ice seems to be constant, regardless of the number of salmon in the cases. Figures 6 and 7 show fresh salmon in cases before and after having been filled with ice.



Figure 6: Approx. 22 kg of salmon in the case before it was filled with ice. Photo: AIBN

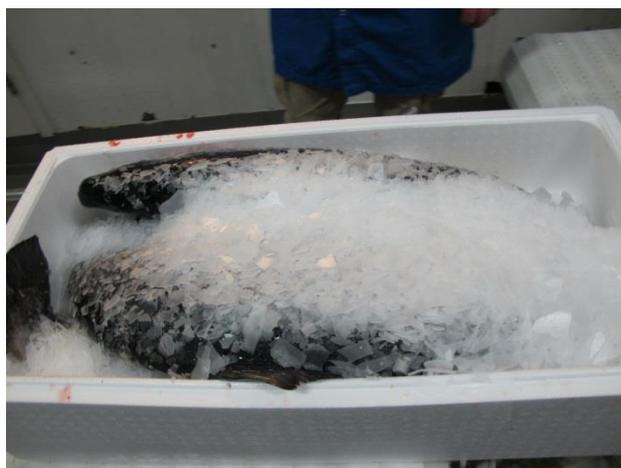


Figure 7: Approx. 2-3 kg of ice covering the salmon. Photo: AIBN

The cases are transported by truck containing insulated lockers with cooling/freezer units. According to the information we have received, the temperature in the lockers during transport must be 0 – 2 °C. During the AIBN's inspection, the temperature in the indoor loading area was approximately the same as the outdoor temperature (about 8 – 9 °C).

The pallets were transported into the hold of the semi-trailer by a forklift operated by a forklift operator from Nova Sea AS. The drivers placed and adjusted the pallets in the cargo hold themselves using a separate pallet jack (see Figure 8). The semi-trailer was loaded up to approx. 75% of the internal ceiling height. With such a cargo height in the semi-trailer, the AIBN has calculated the total centre of gravity height for the truck and cargo at 209 cm⁵ above ground level.

During interviews the AIBN has conducted with drivers with experience from transporting fish, information has emerged that the cases at the bottom of fish cargo can become deformed in transit due to the weight of the cases above. Moreover, the AIBN's observations of the loading process have shown that there is some clearance between the wall and the cargo in the cargo hold, as the cases do not fill the entire width of the cargo hold. During interviews with the drivers, information also emerged that some drivers fill in/wedge the clearance with boards on either side, between the cargo and the cargo hold wall, to prevent the cargo from shifting sideways.

⁵The value has been calculated based on a combination of measured, given and estimated data. Consequently, the value must not be considered an accurate representation of the actual centre of gravity height for the semi-trailer truck. The value nevertheless gives an indication of the centre of gravity height for the truck.



Figure 8: Loading pallets in an almost identical semi-trailer. Note the clearance between the locker wall and the cargo on the left-hand side. Photo: AIBN

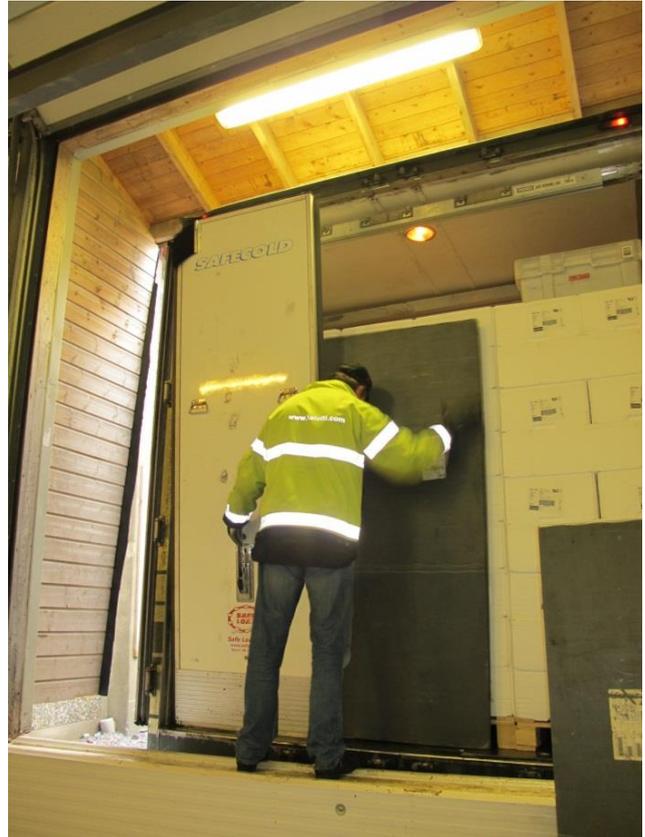


Figure 9: Loaded almost identical semi-trailer with boards to brace toward the back. Photo: AIBN

In 2010, the consignor Nova Sea AS, a major supplier in the market, initiated a project named «Trygg Trailer» (safe trailer). The project was subsequently launched as a cooperation project between the Norwegian Seafood Federation (FHL) and the Norwegian Public Roads Administration, Region north.

The objective of the project is to ensure that transportation of goods takes place in a fast, safe and efficient manner using the correct material and equipment. The Trygg Trailer project is founded on a shared understanding between private purchasers of transportation services and the Norwegian Public Roads Administration, and the purpose is for the companies to conduct simple controls of «their» trucks, based on information provided by the Norwegian Public Roads Administration. The project is based on the National action plan for road traffic safety (the Norwegian Public Roads Administration et al. 2014) and has, according to this, had positive results and will now be expanded into a national project.

THE ASSESSMENTS OF THE ACCIDENT INVESTIGATION BOARD

The AIBN chose to investigate the accident because of its severity and previous reports to the AIBN showing that this type of transport has been involved in several similar accidents. The accident happened on a road that can be regarded as part of the secondary road network, and serves a relatively high proportion of lorries loaded with fresh salmon packed in cases. There are also several other places in Norway where secondary roads of varying quality are used for such transport.

Based on the course of events and available factual information, the AIBN believes that the incident was caused by several concurrent contributing factors. The following assessments will discuss the qualities of the vehicle, human factors, road, speed and the impact of the cargo.

Vehicle

A heavy truck with a semi-trailer has a roll axis which gives it other stability qualities than a heavy truck with a drawbar trailer. This affects stability when the vehicle enters a curve where sideways forces occur.

The truck toppled over in the last of three successive curves. The truck will tilt to one side in the first curve, pressing the springs on the outer side together. When driving directly into another curve turning the opposite way, the compressed springs will cause an accelerated return movement at the same time as new sideways forces occur in the same direction. This will increase the sideways tilt and negatively impact the risk of overturning. The centrifugal forces affecting the semi-trailer will also have a negative impact on the stability when driving into one curve after the other, as was the case in this incident.

The investigation has uncovered a sheared draw spring on the left-hand side of the semi-trailer's second axle. Having examined the sheared spring, the AIBN finds it most likely that there was a fracture in the spring and that the breakage occurred as the truck toppled over. However, the AIBN cannot rule out that the breakage occurred as a result of the load whilst driving in the curves and that this contributed to the truck overturning.

The rear axle on the semi-trailer was steerable. If this is not in the locked position, the stability of the semi-trailer is negatively affected compared to fixed axles. The AIBN has discussed this in a previous report relating to two accidents: Report on truck overturn on highway 44 at Tengs in Eigersund and highway 44 near Sirevåg in Hå Municipality on 15 September 2005 ([AIBN 2007](#)). The AIBN believes that the semi-trailer's open steerable axle had a negative impact on its stability and may have contributed to the overturn.

In the AIBN's opinion, a sheared draw spring combined with an open steerable rear axle on the semi-trailer are familiar issues that must be followed up as part of maintenance and controls by the authorities.

Infrastructure

The road characteristics at the site, with several successive curves, present special challenges in terms of stability and tilting. The driver had no information about the curves except the visual impression from the driver's seat. He maintained a speed close to the signposted speed limit when the truck overturned. It can be challenging for drivers to adjust their speed in sharp curves, and this is even more difficult in the dark and when driving on unfamiliar roads.

The AIBN has looked at what speed it is possible to drive through the turn with the relevant truck without overturning. Even though there are uncertainties associated with such calculations, the

theoretical overturn velocity is estimated at 60 km/h. In this respect, the speed limit at the accident site did not provide a safety margin against overturn of the truck in this case.

Listing and overturn risk for heavy vehicles has been discussed previously in the Report on truck overturning with subsequent collision with a passenger car on E6 in Grong on 12 August 2009 ([AIBN 2011](#)). The report also discusses the driver's assessment of the speed in relation to the speed limit as well as horizontal alignment.

The impact of the cargo

Fish cargo of this type is homogeneous from the bottom to the top of the load. This means the centre of gravity is approximately in the middle of the load. This gives a different stability than for other goods where the weight can be distributed in a more appropriate manner. A relatively high centre of gravity combined with steep curves means that the driver must compensate for this by adjusting his speed. The chosen speed in such cases should be lower than the signposted speed limit to achieve a sufficient safety margin against overturning.

Based on observations, the AIBN believes that salmon, ice and water may be able to shift sideways somewhat inside the polystyrene cases when driving through curves. If this happens in several or all of the cases, the total sideways centre of gravity may be affected.

The investigation has shown that friction between the pallets/cases in a longitudinal direction is high and that this stabilises the load. Based on observations of the loading processes and the information that the cases at the bottom sometimes become deformed, it is still a possibility that cargo moves in transit. Furthermore, the investigation has shown that it is possible for the whole cargo of fish cases to shift sideways somewhat in transit when it has not been secured with bracers. In the AIBN's opinion, these factors may, individually or together, have a negative impact on stability. This could be investigated further, but the AIBN has decided not to proceed with this in this investigation.

Human factors

Based on the information obtained about the driver, the AIBN is of the opinion that he had relatively extensive experience with heavy vehicles, particularly as a bus driver. He was not permanently employed by the company and was not used to driving on this road, nor was he used to the truck or transporting such cargo. The AIBN believes that a driver with experience in handling the above-mentioned conditions also has a better basis for choosing a safe speed.

Generally, the AIBN would like to emphasise the importance of transport companies following up their drivers and employees to create awareness of the choice of speed in connection with transporting cargo with a high centre of gravity.

The AIBN has indications that the driver was feeling unwell when loading the truck at Lovund. The course of events shows that the driver actively manoeuvred the vehicle through the curves, and data from the tachograph indicate that he took his foot off the accelerator and applied the brakes as the truck started to topple over. The AIBN believes that this manoeuvring indicates that the driver was conscious until the truck started to topple over. However, based on the conclusions in the autopsy report, indisposition cannot be ruled out.

Safety focus in Nova Sea AS

The consignor/cargo supplier Nova Sea AS initiated the project «Trygg Trailer». The initiative and documentation from the project show that the organisation has a sound safety focus.

CONCLUSION

The AIBN believes that the accident occurred as a consequence of multiple concurrent factors. The key factors in this connection are the following:

- The road characteristics at the site, with several successive curves, present special challenges in terms of stability and tilting. The driver had no information about the curves except the visual impression from the driver's seat.
- The speed of the semi-trailer truck in the curve was almost the same as the critical overturn velocity at the site. Thus, the speed limit at the accident site did not provide a safety margin against overturn of the truck.
- The vehicle had a fracture in a draw spring and an open steerable rear axle on the semi-trailer, which may have affected the semi-trailer's stability in the curves.
- The load was homogeneous and, consequently, the centre of gravity relatively high. The investigation has uncovered that there was some possibility the cargo may have shifted, which in AIBN's opinion may have had a negative impact on stability.

The driver can compensate for all the contributing factors by driving slower. However, this presupposes that the driver has the necessary information about all these factors and takes it into account whilst driving. This requires extensive experience, competence and understanding of the risks involved. The investigation shows the significance of the road keeper, transport company, consignor/loader and buyer of the transport service contributing to ensure that the driver has sufficient information to be able to conduct the assignment in a safe manner.

The AIBN has decided not to make any safety recommendations. However, we refer to the conclusion of the investigation and would like to emphasise that everyone involved in the chain of transportation can help improve safety by learning from it.

The Accident Investigation Board Norway

Lillestrøm, 2 July 2014

REFERENCES

AIBN (2007): *Report on truck overturn on highway 44 at Tengs in Eigersund and highway 44 near Sirevåg in Hå Municipality on 15 September 2005*

AIBN (2011): *Report on truck overturning with subsequent collision with a passenger car on E6 in Grong on 12 August 2009*

Norwegian Public Roads Administration et al. (2014): *National action plan for road traffic safety 2014-2017*