Statens haverikommission
Swedish Accident Investigation Board

SUMMARY

ISSN 1400-5751

Report RO 2004:01e

Accident involving long-distance motor-coach, registration number GKS 987, at Ängelsberg, U county, Sweden, 24 January 2003

Case O-01/03

SHK investigates accidents and incidents with regard to safety. The sole objective of the investigations is the prevention of similar occurrences in the future. It is not the purpose of this activity to apportion blame or liability.

The report is also available on our Web site: www.havkom.se

Translated by Tim Crosfield from the original Swedish at the request of the Swedish Accident Investigation Board.

In case of discrepancies between the English and the Swedish texts, the Swedish text is to be considered the authoritative version.

Statens haverikommission (SHK) Swedish Accident Investigation Board

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2004-02-27 O-01/03

Swedish National Road Administration

781 87 BORLÄNGE

Report RO 2004: 01e

The Swedish Accident Investigation Board, (SHK) has investigated an accident that occurred on 24 January 2003 at Ängelsberg, U county, with a bus serving as a replacement for a cancelled train.

In accordance with paragraph 14 of the Accident Investigation Ordinance (1990:717) the Board submits herewith a report on its investigation.

The Board will be grateful to receive, by 1 September 2004 at the latest, notice of how the recommendations in the Report are being followed up.

Göran Rosvall

Dan Åkerman Urban Kjellberg

Identical letter to

Swedish Rescue Services Agency

Report RO 2004:01 (Summary)
O-01/03

Report completed 20-02-2004
Translation completed 08-04-2004

Vehicle:	
Registration, type	GKS 987, Volvo B12 Carrus tourist coach
Owner/ operator:	Linjebuss Sverige AB (now Connex Sverige AB)
Time of event:	24-01-2003, approx. 16.23 h in darkness *Note:* All times are given in Swedish standard time (UTC + 1 hour)
Place:	Route 664 approx.1 km north of Ängelsberg, U county (pos. 5958N 01559E)
Speed limit at site of accident	70 km/h
Type of vehicle/service	Replacement coach for cancelled train
Weather:	According to Swedish Meteorological and Hydrological Institute (SMHI) analysis: rising southerly winds approx. 6 m/s, moderate-to-good visibility, overcast and light snowfall, temp/dew point –2 °C/–4 °C. According to Swedish National Road Administration automatic station route 66 north Virsbo 16.06 h: Road temperature –2.8 °C, air temperature –3.4 °C, dew point –5.6 °C, snowfall.
Road condition on route 664	Snow and ice coverage
Numbers involved:	
crew	2
passengers	47
Injury to persons:	6 dead, others injured
Damage to vehicle:	Extensive
Other damage (environment):	Electric cables torn down, damage to undergrowth
Driver: sex, age, certification:	Man, 68 yrs, A, BE, CE, DE driving licence valid up to and including 9 September 2011

The Swedish Accident Investigation Board (SHK) was informed on 24 January 2003 that an accident involving a replacement bus for a cancelled train had occurred on national route 664 in Västmanland, U county, that day at 16.23 h.

The accident has been investigated by SHK in the persons of Göran Rosvall, chair, Dan Åkerman, chief technical investigator and Urban Kjellberg, chief investigator regarding fire and rescue. SHK was assisted by Henry Lorin, Ulf Björnstig and Pontus Albertsson as medical experts and by Per Nybom, traffic safety expert regarding heavy commercial traffic.

At SHK's request the Swedish National Road and Transport Research Institute (VTI) has conducted comparative tests with tyres from the bus in question and a number of alternative tyres, and calculations of the

highest safe speed the bus could have had in the curve where it ran off the road under the conditions prevailing at the time of the accident.

The investigation was followed by the Swedish Rescue Services Agency represented by Lars Ekberg, and by the Swedish National Road Administration by Lars Carlhäll.

SUMMARY

On 24 January 2003 the regular train from Ludvika to Västerås, departure 15.14 h, was cancelled because of a technical fault. SJ AB (the Swedish State Railways – SJ), which operates the rail traffic in question, ordered up a bus from Linjebuss Sverige AB – now Connex Sverige AB (below termed Linjebuss) – under a contract between the two parties, as a replacement for the cancelled train, to transport train passengers to Västerås.

Shortly after 16.20 h, while travelling along route 664, approx. 1 km west of Ängelsberg, the bus drove off the road and overturned. In the accident six passengers died. The other 41 passengers were injured to varying degrees.

The bus, a Volvo B 12 Carrus intended for 50 passengers, was fitted with winter tyres without studs, of a type (M+S) normally used on Swedish buses in winter-time. No technical faults in the bus regarding steering and brakes, etc, have been found. The bus was fitted with safety belts (two-point hip belts), but only two passengers were using these.

The bus-driver was 68 years old and retired, but was often employed by the bus company for extra trips. He had very great experience of driving heavy vehicles, having driven such vehicles since the 1950s. Nothing has emerged from the investigation to indicate that the driver's mental or physical condition was impaired before or during the journey, or that he could have been unsuitable to drive the bus for other reasons. Nor was there any indication that he drove carelessly or that he had erred as regards care and consideration during the drive.

Route 664, on which there is a speed limit of 70 km/h, is narrow and curving, with relatively large differences in height. The road was covered with snow and ice but had not been ploughed, sanded or salted during the day of the accident. It was snowing at the time of the accident and the temperature was –3 °C to –4 °C.

On the stretch nearest the site of the accident the road is approximately six metres wide. The actual site is in a left-hand bend with a minimum radius of 56 m. The right-hand edge of the road is vergeless and the embankment slopes directly from the asphalt at about 30° to ground level about 1.5 m lower down.

At SHK's request, the Swedish National Road and Transport Research Institute (VTI) conducted comparative tests with the tyres of the bus in question and a number of alternative tyres. The result of the comparative tests on smooth ice at –5 °C shows that the half-worn tyres of the accident bus had the best braking performance after the studded test tyre. Regarding steerability on smooth ice, the tyre taken from the bus was not the best but among the better of the tyres tested. Friction was, however, dangerously low for all tyres tested, including the studded test tyre.

At –2 °C and on smooth ice, all un-studded tyres are practically unusable unless the road is quite straight and flat. Studded tyres would in all probability have been better than the un-studded ones used but in view of the results of the –5 °C test with a studded tyre VTI judges that the friction would still have been unsatisfactorily low.

On rough ice at –2 °C all the tyres, according to VTI, have fully acceptable steering properties for normal, careful driving. Most new winter tyres, however, are appreciably better than the used bus tyre. The studded tyre gave a considerably better result than the un-studded with locked wheel and a 20-degree angle of deviation.

In summary, however, VTI judges that neither a better choice of tyre nor legally approved studding would have definitely prevented the accident unless the ice on the road surface had been very rough.

Calculations undertaken by VTI after a test drive along the stretch in question with a bus similar to that involved in the accident show that a safe speed through the bend where the accident took place would, under the conditions then prevailing, have been approx. 25 km/h.

In the light of the result of the VTI investigation it is questionable whether buses carrying passengers should ever be driven on roads that are not reliably sanded or salted – at least without devices that afford significantly increased friction.

According to Swedish State Railways (SJ) instructions for replacement transport the bus was, among other things, to drive along route 664, stopping at Ängelsberg and its railway station to permit passengers to alight and enter. Apart from the route to be taken and requirements as to (toilet) facilities in the bus, SJ, had not as far as SHK has been able to ascertain, made any special requirements as to the transport and how it was to be arranged, e.g. regarding traffic safety or other matters.

It has not been possible to identify any direct cause of the accident. Rather, a combination of circumstances led to the event.

The road was not sanded or salted and the tyres used gave too little friction in the prevailing conditions with the carriage way covered in ice and snow. At the site of the accident the road had a steeply sloping embankment directly bordering the carriage way, with no safety barrier. This caused the bus to overturn immediately it entered the embankment.

Road safety work in Linjebuss concentrated on technical aspects of the vehicles. There was no coherent, planned and efficient work on identifying and counteracting risk factors affecting passenger safety. There was no safety control system that could capture the road safety problems present during the journey in question.

The accident occurred – even though there was probably no deviation from the rules in force – by the absence of suitable prerequisites for carrying out the planned journey under the conditions then prevailing as regards road condition, road standard, vehicle and tyres.

Rescue operation and medical care

The first call came via emergency number 112 to the SOS centre in Västerås at 16.24 h. The Fagersta rescue service and a large number of ambulances from both Västmanland county and Dalecarlia were called out.

The first two ambulances, from Fagersta, arrived at the accident scene at 16.40 h, i.e. about 15 min after the accident. Some 20 minutes later ambulances from Västerås, Köping and Sala arrived. After an hour there were eleven ambulances at the accident scene.

The rescue services team from Fagersta arrived at the accident scene at 16.43 h. Subsequently, reinforcement resources requested from Virsbo, Fagersta and Skinnskatteberg arrived. At 17.06 h. twenty-five members of the rescue services were on the scene.

The medical inquiry shows that the predominant mechanisms of injury were that passengers were thrown about in the bus when it left the road or drawn partly or entirely out of the bus when it overturned. The latter caused the most serious injuries and all the fatalities.

All those alive at the time when medical care and the rescue forces reached the place of injury survived the accident. None of the deceased are judged to have died as a result of lack of early medical help.

The investigation shows that the rescue operation, the on-site medical care and the ambulance medical care functioned very well.

RECOMMENDATIONS

SHK recommends the Swedish National Road Administration

- to seek, as a condition for the granting and retention of traffic licences for bus companies conducting passenger traffic, the introduction of requirements as to safety assurance systems that will in the long-term ensure that routines for raising road safety are applied in their operations and that road safety hazards are identified and counteracted on an ongoing basis. *(RO 2004:01 R1)*

- to seek the introduction of regulations to the effect that a bus in passenger traffic may not, in winter, use a road that has not been reliably ploughed, sanded and/or salted unless the bus is equipped with tyres, or tyres with special friction-raising devices, that have a lowest stated friction value on snow- or ice-covered roads. *(RO 2004:01 R2)*

- to seek the introduction of requirements for three-point belts for all seats in all buses except those in urban traffic. *(RO 2004:01 R3)*

- to review the conditions regarding information available to bus passengers so that information is always given regarding the presence of safety belts and, if such exist, how they work, how to leave the bus if an accident should occur; and also where fire extinguishers and first-aid equipment are placed. *(RO 2004:01 R4)*

- to seek the introduction on buses of such safety details as may prevent passengers from being thrown or drawn out of a bus in an accident. *(RO 2004:01 R5)*

- to encourage bus manufacturers to install sturdy and well-marked points at which force may be applied to lift a bus without structural failure or the body giving way. *(RO 2004:01 R6)*.

- to investigate whether the recommendations applying in this case to buses should also apply to other heavy vehicles. *(RO 2004:01 R7)*

- to consider changes in the regulations for warning signs and other traffic devices such that sufficient prior warning is given in the relevant and similar bends. *(RO 2004:01 R8)*

- to consider changes in the regulations regarding embankments and railings so that such hazardous circumstances as at the accident site be dealt with either by partially levelling-out embankments or by erecting railings. *(RO 2004:01 R9)*

- to ensure that passenger road traffic by bus be given greater weight as a factor when setting priorities for winter road maintenance standards. *(RO 2004:01 R10)*

- to implement, at the bend where the present accident occurred, any measures needed to prevent any similar accident. *(RO 2004:01 R11)*

SHK recommends the Swedish Rescue Services Agency

- to seek the development of better methods and equipment for necessary heavy lifts of weak structures, e.g. in traffic accidents. *(RO 2004:01 R12)*.

- to keep municipal rescue services informed on new or developed methods and equipment for carrying out heavy lifts. *(RO 2004:01 R13)*.

- to develop existing national compilation in RIB (Integrated Decision-making Material for Protection against Accidents) of resources regarding heavy lifts in the rescue service. *(RO 2004:01 R14)*

- to consider the introduction of regional depots, or the supplementation of existing stores, with equipment for heavy lifts in rescue operations. *(RO 2004:01 R15)*