Statens haverikommission

Accident in the airspace over Östergötland on 18 June 2025

The Swedish Accident Investigation Authority has investigated an accident on board the aircraft SE-RRF, a Boeing 737-800, in connection with an evasive manoeuvre initiated by the TCAS collision avoidance system.

12 June 2026

Final report

SHK 2026:11e

About the Swedish Accident Investigation Authority

The Swedish Accident Investigation Authority (SHK) investigates accidents and incidents from a safety perspective regardless of whether they occurred on land, at sea or in the air. The authority's accident investigations are intended to disseminate knowledge and provide a basis for actions by authorities, companies, organizations, and individuals that improve safety and reduce the risk of accidents. The activities should also contribute to people feeling secure and having trust in society's institutions and the confidence in transportation systems. The mission also includes assessing the efforts made by the rescue services in connection with an accident. However, the investigations should not assign blame or liability, whether criminally, civilly, or administratively.

The investigations by SHK aim to answer three questions:

- What happened?
- Why did it happen?
- How can a similar accident/incident be avoided in the future?

Investigations of aviation accidents and incidents are primarily regulated by Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation and the Act (1990:712) on the investigation of accidents. The investigations are conducted in accordance with Annex 13 of the Chicago Convention.

The report is also available on the Swedish Accident Investigation Authority's website: www.shk.se.

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Content

Summary

A passenger aircraft of the type Boeing 737-800 was enroute to Stockholm/Skavsta Airport at the same time as two JAS 39 Gripen fighter aircraft, flying in a two-ship formation, departed from Linköping-Saab Airport. In the airspace above Östergötland, the TCAS collision avoidance system generated a resolution advisory instructing the passenger aircraft to perform an evasive manoeuvre in order to avoid a collision with the fighter aircrafts. The passengers were seated with their seat belts fastened, but the cabin crew were in the process of securing the cabin for landing. During the manoeuvre, one of the cabin crew members was seriously injured.

All aircraft involved were being manoeuvred in accordance with the applicable regulations and procedures, and the clearances issued by Air Traffic Control (ATC) were complied with. At no time was there any actual risk of collision.

The investigation concludes that fighter aircraft and other aircraft operating with high vertical speeds cause TCAS to be triggered significantly earlier than in situations involving civil traffic only. Furthermore, neither the TCAS system, the regulatory framework nor ATC procedures are designed to accommodate the interaction between civil and military traffic.

The investigation further concludes that there is a need for additional education and training on the TCAS system.

Causes of the accident

The direct cause of the accident was that the passenger aircraft's collision avoidance system (TCAS) generated a resolution advisory (TCAS RA) for an evasive manoeuvre because the two fighter aircrafts were approaching with a high vertical speed. The Commander followed the TCAS resolution advisory, resulting in a rapid change in the aircraft's pitch attitude. This change in pitch attitude in turn caused such pronounced movements in the part of the aircraft where the cabin crew member was standing that the crew member was unable to compensate for them.

A contributing factor at system level was that the Air Traffic Management system does not take into account how the TCAS system handles fighter aircraft with high vertical speeds.

Safety recommendations

SHK submits the following recommendations:

Norwegian is recommended to

- review simulator training regarding TCAS phraseology in order to ensure correct communication (see Section 2.7.1). *(SHK 2026:11 R1)*

The Swedish Transport Agency is recommended to

- examine whether the handling of TCAS should be included in refresher training for air traffic controllers with a specified periodicity (see Section 2.7.3). *(SHK 2026:11 R2)*

- to carry out targeted information activities directed at providers of ATC services, in order to increase awareness of how military aircraft operate and the challenges this entails for the interaction with civil traffic in the airspace (see Section 2.7.3). *(SHK 2026:11 R3)*

The Swedish Armed Forces is recommended to

- examine the need to introduce training on the TCAS/ACAS system for pilots who do not normally operate aircraft equipped with these systems and, where necessary, provide such refresher training (see Section 2.7.4). *(SHK 2026:11 R4)*

The investigation

On 11 August 2025, SHK was notified of an occurrence involving the anticollision warning system TCAS/ACAS, which resulted in a cabin crew member being seriously injured. The aircraft involved in the occurrence were a Boeing 737-800, registration SE-RFF, and a JAS 39 Gripen formation from Hungary. The occurrence took place south of Hycklinge, Östergötland County, on 18 June 2025 at 10.11 hrs.

The incident has been investigated by SHK represented by Mr Johan Albihn, Chairperson, Mr Mats Trense, Investigator in Charge, Mr Håkan Josefsson, Operations Investigator.

The investigation was followed by Dr Matthew Hilscher of the European Union Aviation Safety Agency (EASA) and Mr Peter Andersson och Mr Erik Ljungkvist of the Swedish Transport Agency.

The following organisations have been notified: the International Civil Aviation Organization (ICAO), EASA, the European Commission, the Military Aviation Authority of the Swedish Armed Forces, the Swedish Transport Agency, the National Transportation Safety Board (NTSB)[1], and the Hungarian Air Force.

Investigation material

Interviews have been conducted with the Commander, the First Officer and the injured cabin crew member of the passenger aircraft.

Flight data from the Boeing 737-800 and from the JAS 39 Gripen aircraft have been collected.

Relevant information has also been obtained from Norwegian, from ATC and from the Air Force operations manuals.

A reference flight has been carried out in a Boeing 737-800 simulator.

A meeting with the interested parties was held on February 19 2026. At the meeting SHK presented the facts discovered during the investigation, available at the time.

Terminology

The TCAS/ACAS collision avoidance system is referred to in regulations and manuals either as TCAS (Traffic Collision Avoidance System) or ACAS (Airborne Collision Avoidance System). ACAS refers to the underlying technical standard and the overall concept for the airborne collision avoidance system installed on board, whereas TCAS refers to the system that implements this standard. In this report, the term TCAS is used as a collective term.

[1] The authority responsible for civil aviation safety investigations in the United States.

Final report SHK 2026:11e

Data	
Aircraft Boeing	Registration, type: SE-RRF Model: 737-8JP Airworthiness: Certificate of Airworthiness and Valid Airworthiness Review Certificate (ARC)[2] Operator: Norwegian Air Sweden AOC AB
Aircraft JAS 39 Gripen two-ship formation[3]	Operator: The Hungarian Airforce
Time of occurrence	18 June 2025, 10.11 hrs. in daylight Note: All times are given in Swedish daylight-saving time (UTC[4] + 2 hours)
Place	South of Hycklinge, Östergötland County, position 57˚53'N, 15˚54'E
Type of flight	Commercial and military
Weather	According to SMHI's analysis: Scattered to broken stratocumulus cloud with bases between 2,000 and 3,000 feet and tops between 4,000 and 5,000 feet, 18/11 ˚C, QNH[5] 1010 hPa.
Persons on board the Boeing 737	In total: 125 Crew members including cabin crew: 6 Passengers: 119
Injuries	To persons: A cabin crew member sustained a broken foot, which constitutes a serious injury Damage to aircraft: None
Commander Boeing 737	Age: 49 years Licence: ATPL[6] Total flying hours: 8,994 hours, of which 8,794 hours on type Flying hours previous 90 days: 96 hours Number of landings previous 90 days: 42
First Officer Boeing 737	Age: 32 years Licence: CPL[7] Total flying hours: 443 hours, of which 262 hours on type Flying hours previous 90 days: 199 hours Number of landings previous 90 days: 45

[2] ARC (Airworthiness Review Certificate).

[3] Two-ship formation means that two aircraft fly in formation together and constitute a single unit.

[4] UTC (Coordinated Universal Time).

[5] QNH (The atmospheric pressure adjusted to the mean sea level).

[6] ATPL (Airline Transport Pilot License).

[7] CPL (Commercial Pilot License).

1. Factual information

1.1 Description of the Course of Events

1.1.1 Preconditions

The flight was a commercial air transport passenger flight from Palma de Mallorca Airport (LEPA) to Stockholm/Skavsta Airport (ESKN). It was operated with a Boeing 737-800 under the callsign Rednose 8CM, and the pilots had commenced the approach to Stockholm/Skavsta.

At the same time, a JAS 39 Gripen two-ship formation was conducting a flight from Linköping-Saab Airport (ESSL) to Kecskemét Air Base in Hungary, under the callsign Hungarian Air Force 32 Two-Ship.

The Boeing 737 aircraft was equipped with an on-board Traffic Collision Avoidance System (TCAS).

TCAS is a safety system that uses aircraft transponders to exchange flight data between nearby aircraft. This information is used to calculate the respective aircraft flight paths and identify potential collision risks. When a collision risk is identified, the system warns the pilots by means of a Traffic Advisory (TCAS TA), which provides information on nearby traffic. If the risk of collision increases, the system issues a Resolution Advisory (TCAS RA), which is displayed on the pilots' instruments and accompanied by an aural warning. TCAS RAs are limited to vertical manoeuvres.

In contrast to the commercial passenger aircraft, fighter aircraft are not equipped with TCAS. However, the JAS 39 Gripen aircraft were equipped with a Mode S transponder, which transmits flight data to nearby TCAS systems, and these data are used in their collision avoidance calculations.

If both aircraft are equipped with TCAS, the resolution advisories are automatically coordinated between the systems to ensure that each aircraft performs evasive manoeuvres.

1.1.2 Sequence of events

The passenger aircraft had started the approach to Stockholm/Skavsta Airport and was flying on a north-easterly heading. From ATC, the crew received clearance to descend to FL[8] 240. The fasten seat belt sign had been switched on, and the cabin crew were preparing the cabin for landing.

At the same time, the two Hungarian JAS 39 Gripen aircraft were climbing south-east towards PENOR.[9] ATC had cleared them to climb to FL 220. As the Hungarian JAS 39 Gripen formation constituted military traffic, the air traffic controller cleared them to a level that provided 2,000 feet of separation, instead of 1,000 feet, which is the requirement under the regulations.

[8] FL (Flight Level) – A flight level is the aircraft's altitude expressed in hundreds of feet with reference to the standard pressure setting 1013 hPa.

[9] PENOR – A navigation waypoint marking the transition over the Baltic Sea into Polish airspace.

The formation climbed with an initial climb rate of approximately 9,000 feet per minute and, passing FL 180, gradually began to reduce its rate of climb in order to level off at its cleared level, see Figure 1.

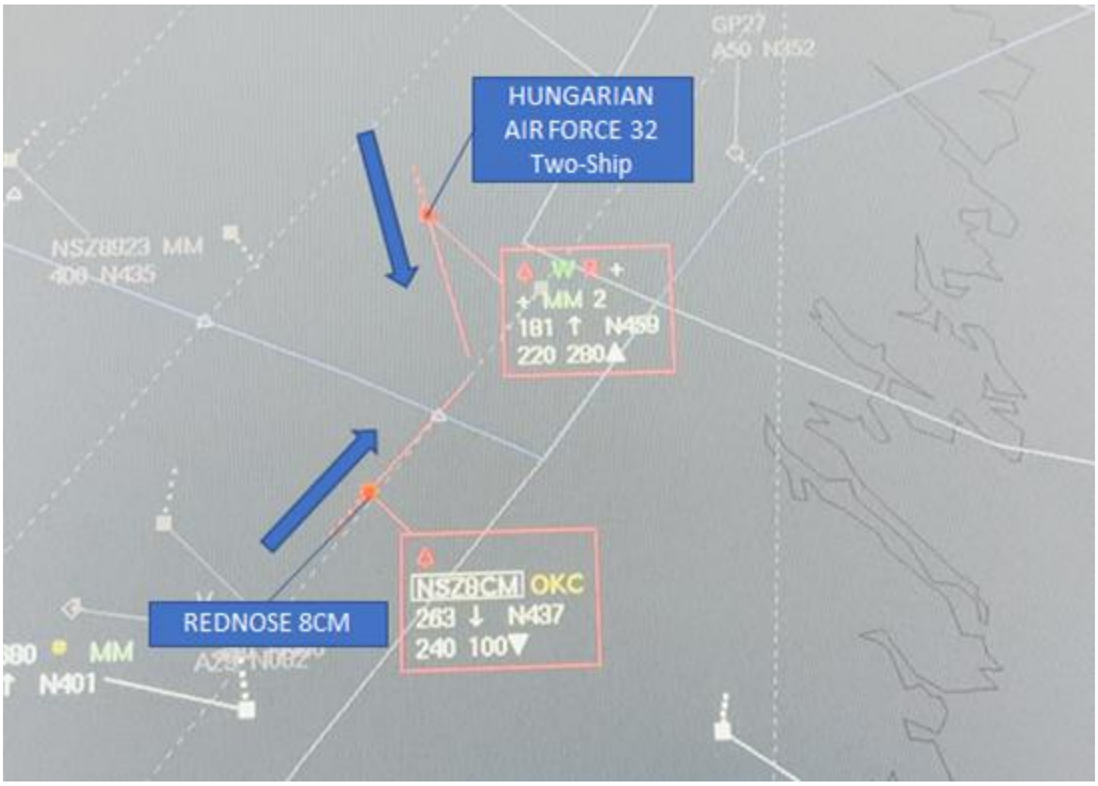

Figure 1. The radar image shows the point in time when the aircraft received their respective Fight Level clearance. The radar display shows among other things current level, cleared level, next cleared level and speed for each aircraft. The red marking indicates that the ATC Short Term Conflict Alert (STCA) warning system has been activated, see Section 1.18.1. The blue annotations added by SHK indicate the callsigns, and the arrows show the direction of flight for each aircraft. Source: Air Traffic Control Centre (ATCC).

At FL 300, the First Officer in the passenger aircraft handed over control to the Commander in order to address the passengers via the PA system. Shortly thereafter, the pilots received a TCAS TA warning. The Commander reduced the aircraft's rate of descent and attempted to establish visual contact with the aircraft for which the collision avoidance system had issued the warning. At the same time, he instructed the First Officer to switch on all external lights.

At a standard pressure altitude[10] of 25,025 feet and with a rate of descent of 1,000 feet per minute, the passenger aircraft received a TCAS RA instructing a climb. The Commander disconnected the autopilot, increased the pitch attitude and applied more engine thrust in order to discontinue the descent and initiate a climb. The aircraft reached a minimum altitude of 24,991 feet before it began to climb.

During the TCAS manoeuvre, one of the cabin crew members was positioned at the very rear of the cabin. Suddenly, the aircraft moved in such a way that the person felt that contact with the floor was lost and experienced a sensation of floating. When the floor then quickly came up again, both feet struck the floor, causing the cabin crew member to sustain a fracture to one foot. The aircraft made three more similar movements before the cabin crew member

[10] Altitude given with reference to the pressure setting 1013 hPa.

was able to sit down in a passenger seat. Another cabin crew member then came to assist the injured person.

The Commander of the passenger aircraft continued to follow the TCAS resolution advisory and climbed to a standard pressure altitude of 25,601 feet. Thirty-nine seconds after the first RA message, the TCAS system indicated that the risk of collision had ceased by announcing Clear of Conflict.

After the aircraft had passed each other, all aircraft continued their flights to their respective destinations. During the course of the occurrence, the required separation according to the regulations were never infringed, and the minimum vertical separation was more than 3,400 feet.

The accident occurred at position 57°53′N 15°54′E.

1.2 Injuries to persons

	Crew members	Passengers	Total on-board
Fatal			
Serious	1		1
Minor			
None	5	119	124
Total	6	119	125

1.3 Damage to aircraft

None.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Qualifications and duty time of the pilots of the passenger aircraft

Commander

The Commander was 49 years old and had a valid EASA ATPL license with flight operational and medical eligibility. At the time the Commander was PF.[11]

Flying hours – latest	24 hours	7 days	90 days	Total
All types				8,994
Actual type		6	96	8,794

Number of landings on type during the last 90 days: 42.
Type rating concluded on 28 October 2005.
Latest PC[12] (proficiency check) conducted on 28 April 2024.

[11] PF (Pilot Flying).

[12] PC (Proficiency Check).

When the certificate was completed after the PC, the date of 28 October 2024 was inadvertently entered as the date on which the check had been carried out, instead of the correct date in April. As a result, the expiry date of the PC was incorrectly calculated on the basis of October. The operator entered the incorrect date in its system, which did not have any function to highlight the discrepancy. There was also no administrative procedure in place to ensure that correct dates were entered. This in turn meant that the actual period of validity of the PC in accordance with Commission Regulation (EU) No 1178/2011[13], Annex I (Part-FCL), had expired before the occurrence in question, without this being noted.

Latest OPC[14] was conducted on 9 May 2025.

First Officer

The First Officer was 32 years old and had a valid CPL license with flight operational and medical eligibility. At the time First Officer was PM[15].

Flying hours – latest	24 hours	7 days	90 days	Total
All types				443
Actual type	3	16	199	262

Number of landings on type during the last 90 days: 45.
Type rating concluded on 16 January 2025.
Latest PC conducted on 16 January 2025.

1.5.2 Cabin crew

There were four cabin crew members on board. The cabin crew member who was injured had more than 15 years of experience in commercial air transport operations and had been employed by several major airlines. The employment with Norwegian commenced in March 2024.

1.6 Aircraft information

1.6.1 The Boeing 737-800 aircraft

The passenger aircraft was a Boeing 737-800, registration SE-RRF. Its maximum take-off mass is 78,999 kg and it is powered by two CFM56-7B turbofan engines. The aircraft is 39.5 metres in length, has a wingspan of 35.8 metres, and has capacity for 189 passengers.

[13] Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council.

[14] OPC (Operator Proficiency Check).

[15] PM (Pilot Monitoring).

Figure 2. The aircraft. Photo: Airplane Pictures.

The Aircraft	
TC-holder	The Boeing Company
Model	737-8JP
Type	Boeing 737
Serial number	39004
Year of manufacture	2010
Gross mass, kg Max take off/landing mass Current, kg Max take off/landing mass	78999/66360 63432/55728
Centre of gravity	Within limits

Deferred remarks
Three remaining remarks related to the cabin

The aircraft had a Certificate of Airworthiness and a valid ARC[16].

Description of the collision avoidance system

The aircraft was equipped with TCAS II version 7.1.

TCAS is an onboard collision avoidance system used in aircraft to reduce the risk of mid-air collisions. The system continuously monitors surrounding air traffic using transponders and analyses the position, altitude and heading of other aircraft in order to identify potential conflicts. In the event of a collision risk, the system provides both warnings, TCAS TAs, and resolution advisories, TCAS RAs, enabling coordinated manoeuvres to avoid collisions. TCAS RAs provide vertical guidance only.

A warning is issued when another aircraft equipped with a transponder penetrates the protected airspace around a TCAS-equipped aircraft. In the Figure 3 the protected airspace is illustrated using different colours for TCAS TAs and RAs respectively. The time indication shows the time remaining until the aircraft are at their closest point of approach. The system is more sensitive at higher altitudes and therefore issues an earlier warning in the event of a conflict, see Figure 3.

[16] ARC (Airworthiness Review Certificate).

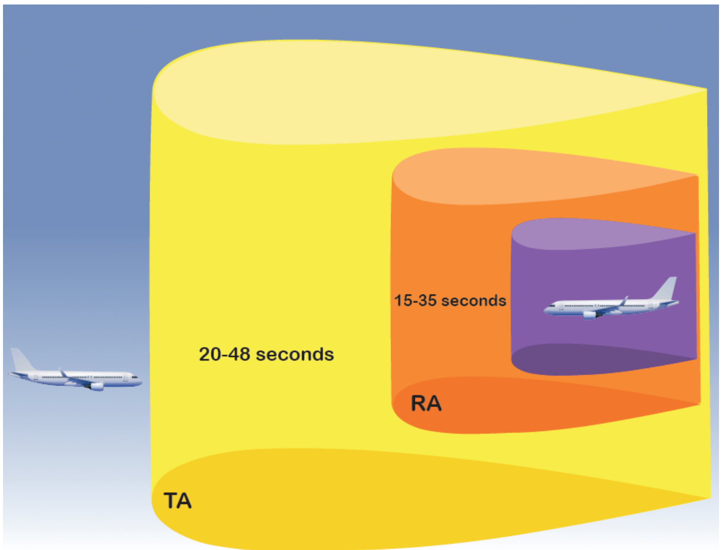

Figure 3. The protected airspace for TCAS TAs and TCAS RAs.

The following pilot response is expected in the case of a TCAS RA:

- The pilot is expected to respond within five seconds of the initial TCAS RA.
- The vertical acceleration should be 1.25 g[17] until the required vertical speed has been achieved.

The system is designed for aircraft operating in accordance with civil flight operating procedures. It is not intended for use on tactical military fighter aircraft or other aircraft that may fly in formation or otherwise operate in clusters. There are certain limitations in the TCAS system that affect its performance when an aircraft penetrates the airspace around a TCAS-equipped aircraft. These limitations are as follows.

- ACAS may not always issue advisories against aircraft having vertical rates in excess of 50.8 m/s (10 000 fpm).
- The design implementation may result in some short-term errors in the tracked vertical speed of an intruder during periods of high vertical acceleration by the intruder.

TCAS presentation in the aircraft

TCAS TAs and TCAS RAs are presented on the pilots' flight instruments. The presentation differs between aircraft types. In a Boeing 737-800, TCAS information is displayed on the Navigation Display (ND) and the Primary Flight Display (PFD) together with an aural warning. The information is presented using different symbols, together with altitude information relative to the own aircraft. The presentation is shown in Figures 4–6. The images in these figures were taken during SHK's reference flight in a Boeing 737-800 simulator.

In Figure 4, the left-hand image shows the ND during a TCAS TA, where the other aircraft is represented by a solid amber circle. The figure "-07" indicates that the other aircraft is 700 feet below the own aircraft. The right-hand image shows the ND during a TCAS RA,

[17] g-force (acceleration due to gravity) is a unit of measurement for the acceleration force acting on a body, expressed in relation to the Earth's gravitational acceleration (1 g is approximately 9.82 m/s²).

where the other aircraft is depicted by a solid red square, indicating that it is 800 feet below and descending (marked by a red arrow).

Figure 4. On the left, the Navigation Display is shown during a TCAS TA, and on the right, the Navigation Display is shown during a TCAS RA. The symbols are marked by the SHK with a red dashed circle.

In addition to the information displayed on the ND, resolution advisories are also presented on the pilot's Primary Flight Display (PFD) during a TCAS RA, see Figure 5.

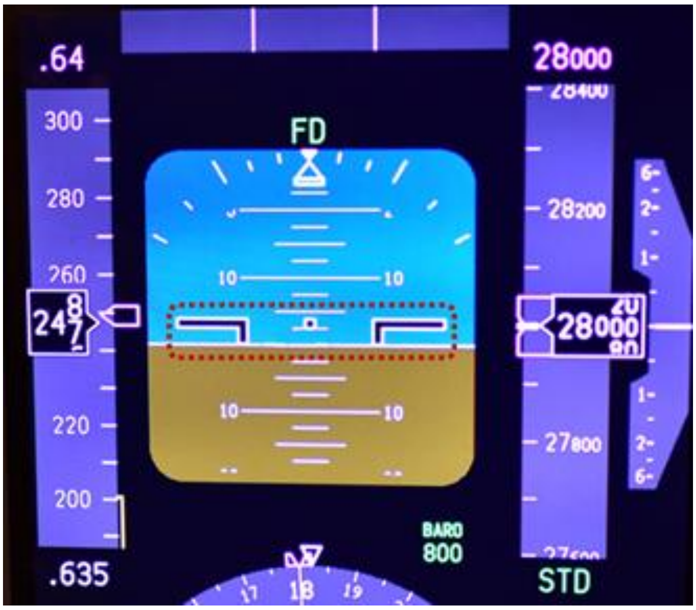

Figure 5. PFD with the aircraft symbol marked by SHK with a red dashed line.

On the Attitude Indicator, a red area is displayed showing the pitch attitudes in which the aircraft symbol must not be during a TCAS RA. In addition, a red band is shown on the vertical speed indicator for those vertical speeds that are to be avoided. This is illustrated in Figure 6. In the image on the left, a TCAS RA has just been activated; the aircraft symbol is within the red area and the rate of descent is within the red band. The image on the right shows the situation when the pilot is following the TCAS RA, i.e. the aircraft symbol is outside the red area and the vertical speed lies outside the red band.

Figure 6. On the left, the pilot's Primary Flight Display is shown just as a TCAS RA has been activated, and on the right, the TCAS RA is shown when the pilot is complying with the advisory. The aircraft symbol and the Vertical Speed Indicator have been marked by the SHK with a red dashed circle.

Quick Reference Handbook

The Quick Reference Handbook (QRH) is a separate manual issued by the manufacturer, but forms part of OM-B (see Section 1.17.1). The QRH contains checklists for emergency situations, abnormal situations and in some cases also for certain other procedures. The QRH describes the actions to be performed in the event of a TCAS TA and a TCAS RA, see Figures 7 and 8.

For TA:

Pilot Flying	Pilot Monitoring
Look for traffic using traffic display as a guide. Call out any conflicting traffic.	
If traffic is sighted, maneuver if needed.	

Note: Maneuvers based solely on a TA can result in reduced separation and are not recommended.

Figure 7. Actions in the event of a TCAS TA in accordance with the QRH. Image: Boeing 737 Flight Crew Operations Manual, 737 Quick Reference Handbook. Image: Copyright © Boeing. Reproduced with permission.

For RA, except a climb in landing configuration:

WARNING: Do not follow a DESCEND (fly down) RA issued below 1000 feet AGL.

Pilot Flying	Pilot Monitoring
If maneuvering is needed, disengage the autopilot and disengage the autothrottle. Smoothly adjust pitch and thrust to satisfy the RA command. Follow the planned lateral flight path unless visual contact with the conflicting traffic requires other action.	
Attempt to establish visual contact. * Call out any conflicting traffic.	

Note: *Visually acquired traffic may not be the same traffic causing an RA. The visual perception of an encounter may be misleading, particularly at night.

Figure 8. Actions in the event of a TCAS RA in accordance with the QRH. Image: Boeing 737 Flight Crew Operations Manual, 737 Quick Reference Handbook. Image: Copyright © Boeing. Reproduced with permission.

1.6.2 JAS 39 C Gripen

The JAS 39 C Gripen is a single-engine fighter aircraft manufactured by Saab AB. The aircraft is 14.1 metres long and has a wingspan of 8.4 metres. The maximum take-off weight is 14,000 kg.

Figure 9. JAS 39 C Gripen. Photo: Swedish Armed Forces.

Description of the JAS 39 C transponder

The transponder has two antennas, one on the dorsal spine and one on the underside, to provide maximum coverage in all directions. In order to operate in peacetime airspace and to coordinate with other traffic, the aircraft is equipped with a transponder that uses Mode A, Mode C and Mode S ELS.[18]

1.7 Meteorological information

According to SMHI's analysis: scattered to broken stratocumulus cloud with bases between 2,000 and 3,000 feet and tops between 4,000 and a maximum of 5,000 feet, 18/11 °C, QNH 1010 hPa.

No turbulence was reported in the weather forecast.

The accident occurred in daylight.

1.8 Aids to navigation

Not applicable.

1.9 Communications

The aircraft were within the same area control sector and on the same frequency. SHK did not become aware of the occurrence until some time had passed, which meant that the audio recordings were no longer stored by LFV (Luftfartsverket). The radio communications have therefore been obtained from data recorded on board the JAS 39 Gripen aircraft. These data also included the radio communications between the air traffic controller and the passenger aircraft. The radio communications are presented in Figure 10.

[18] Mode A, Mode C and Mode S ELS are different types of aircraft transponders, where Mode A transmits an identity code, Mode C transmits both an identity code and altitude, and Mode S ELS also enables more detailed and selective communication between aircraft and radar.

Tid	Frekvens	ATC	Hungarian Air Force 32	Rednose 8CM
08:07:28	118.405			
08:12:26				Rednose 8CM TCAS RA climbing
08:12:31		Was that 8CM		
08:12:33				Rednose 8CM leveling off TCAS RA
08:12:38		8CM the traffic maintaining 220		
08:12:43				Maintaining, say again for Rednose 8, maintaining 220 Rednose 8CM
08:12:48		Ja, the traffic below is maintain FL 220, maintain 240 I call you back shortly for lower		
08:12:56				Negative we have to follow TCAS RA so we are keeping a level of 256 Rednose, we are now clear of traffic.... clear of traffic Rednose 8CM
08:13:07		8CM no problem call you back shortly for lower		
08:13:10				And descending to 240 as cleared Rednose 8CM confirm

Figure 10. Communication between the air traffic controller and Rednose 8CM. The communication has been transcribed from an audio recording by SHK.

During the occurrence, no traffic information was provided to either of the aircraft prior to the TCAS TA.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

1.11.1 Boeing 737

On board the Boeing 737 aircraft, there was a digital flight data recorder (DFDR) from Honeywell, model 980-4700-042 SSFDR, and an Astronics Solid State WebFB Wireless Electronic Flight Bag QAR[19] from Astronics, which records and stores the same parameters as the DFDR. QAR data are used to present the flight data.

The Cockpit Voice Recorder (CVR) audio recordings were never retrieved because SHK did not become aware of the occurrence until some time had passed, by which time the audio files had been overwritten.

[19] QAR (Quick Access Recorder).

1.11.2 JAS 39 Gripen

The JAS 39 Gripen is equipped with several units that record data during flight. Through the Swedish Defence Materiel Administration (FMV), SHK has been able to access data from the Hungarian JAS 39 Gripen aircraft.

Data have been downloaded from the Maintenance Ground Support System (MGSS[20]) and analysed. Furthermore, SHK has obtained flight data that have been played back in the Mission Support System (MSS).[21] The audio data from the MSS have been separated from the other data and analysed separately.

1.11.2 Compilation of data from the aircrafts

In Figure 11, a compilation of flight data from the passenger aircraft and the fighter aircraft is presented. The X-axis shows the TCAS RA commands. The Don't Descend parameter has been replaced by Level Off in TCAS version 7.1.

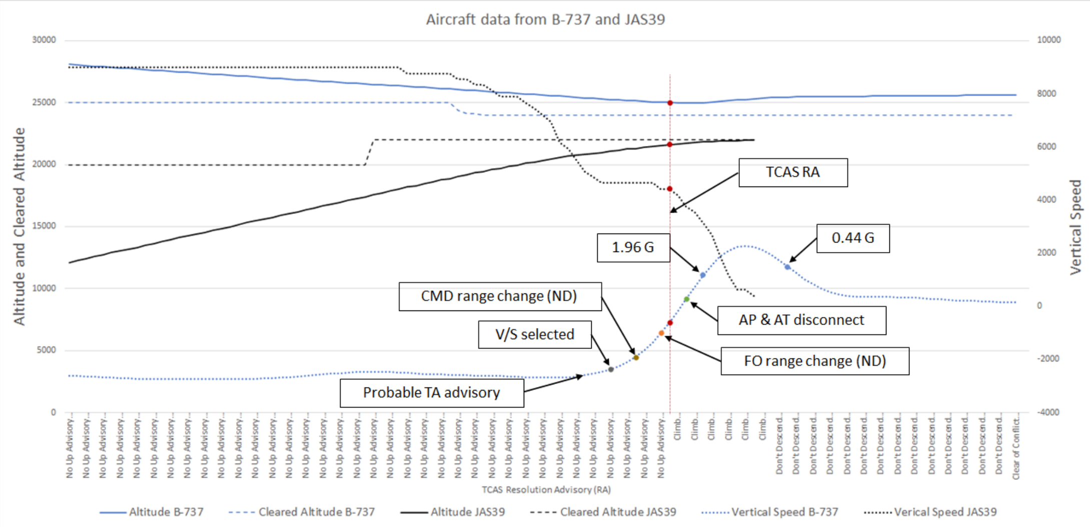

Figure 11. Compilation of the aircrafts' flight data, with annotations added by SHK.

The injured crew member was in the aft galley at the time of the accident. Figure 12 illustrates the accumulated displacement of the floor in the aft galley of the passenger aircraft as a function of the change in pitch attitude over time.

[20] MGSS (Maintenance Ground Support System).

[21] MSS (Mission Support System).

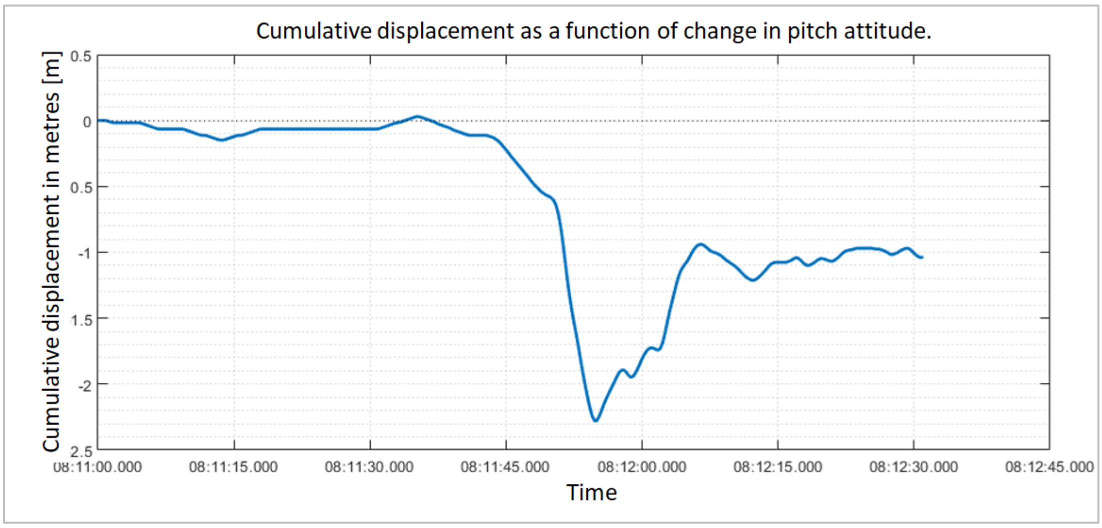

Figure 12. The accumulated displacement of the floor in the aft galley of the passenger aircraft as a function of the change in pitch attitude over time.

1.12 Site of occurrence

The occurrence took place just south of Hycklinge, Östergötland County, see Figure 13.

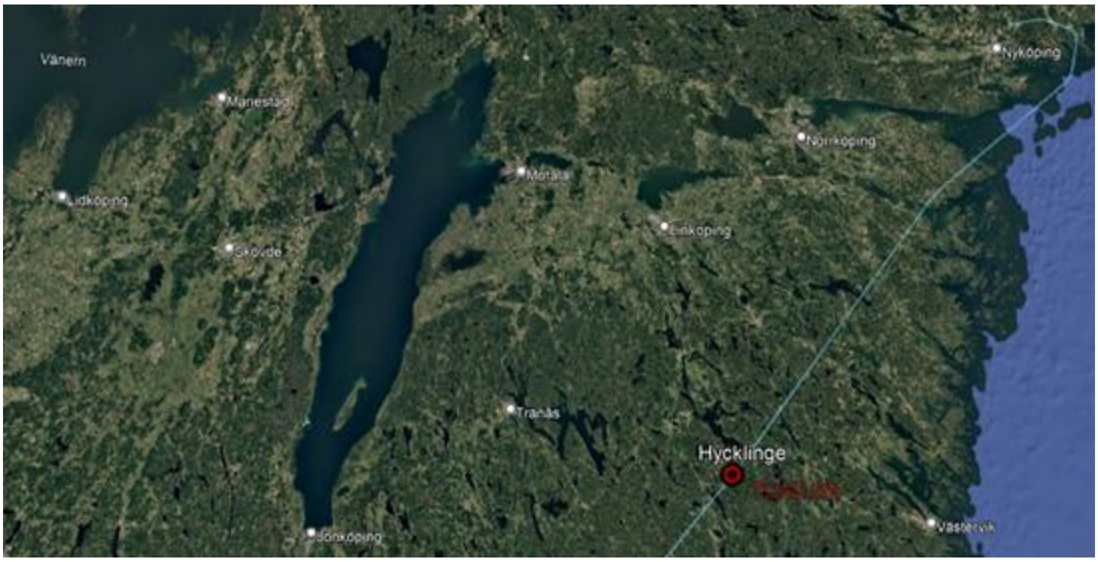

Figure 13. The location of the occurrence has been marked in red by SHK. Image: Google Earth © Lantmäteriet.

1.13 Medical and pathological information

Nothing has emerged to indicate that the pilots' mental or physical condition was impaired before or during the flight.

1.14 Fire

Not applicable.

1.15 Survival aspects

1.15.1 Rescue operation

No rescue operation was initiated.

1.15.2 Position of crew and passengers and the use of seat belts

At the time of the accident, the passengers were seated with their seat belts fastened. The cabin crew members were securing the cabin for landing and were not wearing their seat belts.

1.16 Tests and research

1.16.1 Reference flight in simulator

SHK has carried out a reference flight in a Boeing 737-800 simulator. The purpose of the reference flight was to observe and understand how TCAS is presented in the aircraft and what forces arise during TCAS manoeuvres. In addition, the intention was to gain a better understanding of the human–machine interaction during a TCAS RA. No TCAS scenarios involving military traffic were available in the simulator. Instead, scenarios with civil aircraft were used, which have lower closure rates than the fighter aircraft involved in the accident. The following observations were made:

• There may be a perceived time pressure in interpreting and responding to a TCAS RA.

• It was easy to generate higher g-forces than those for which the TCAS system is designed.

• During the simulation of an event similar to the TCAS event in the accident (where the flight path changed from descent to climb), similar transient g-forces to those in the occurrence were achieved.

1.16.2 Information from ATC

When SHK was informed of the occurrence, it was not possible to retrieve data on the occurrence from ATC. However, the occurrence could be replayed on the displays normally used by the air traffic controller. SHK has therefore reviewed and recorded the air traffic controller's view of the sequence of events and the actions taken.

1.17 Organisational and management information

1.17.1 Norwegian

The Norwegian Group consists of the parent company, Norwegian Air Shuttle ASA, and its subsidiaries. The company is headquartered in Norway. Norwegian holds two Air Operator Certificates (AOC), one issued in Sweden and one in Norway. The occurrence concerns Norwegian Air Sweden, which holds the Swedish AOC.

The aircraft fleet consists of Boeing 737-800 and Boeing 737-MAX 8 aircraft.

The aircraft registrations determine which AOC is used for each flight, which means that crew members operate under both AOC. The crew are based at various stations from which the company conducts operations. At the time of the occurrence, the Commander and the cabin crew were based in Spain, while the First Officer was based in Norway.

Safety Management System

The Safety Management Manual (SMM) describes Norwegian's Safety Management System (SMS). The company applies a model with a single safety management system for both AOCs, with a joint Safety Review Board (SRB) which regularly handles Air Safety Reports (ASRs) received under both AOC. Where necessary, the reports may be divided into separate cases if this is requested by the Swedish or Norwegian supervisory authority.

Manual structure and TCAS

Norwegian's manual structure consists of several Operations Manuals (OM) that describe the company's principles and are intended to establish a uniform operational culture within the organisation. The OM is divided into four parts. Part A (OM-A) constitutes the general part and governs the company's operational principles. It includes, among other things, descriptions of the company management, the duties and responsibilities of nominated persons, limitations on flight time and rest periods, the responsibilities of the Commander, and safety measures.

OM-A also specifies, among other things, limitations for climb and descent rates. It states that the aircraft may climb or descend at a maximum rate of 1,000 feet per minute when it is within 1,000 feet of a newly assigned level, unless otherwise prescribed.

OM-A also describes the actions to be taken in the event of a TCAS TA. When an advisory is received, the pilot flying is to place his thumb near the autopilot disconnect button, identify other traffic and reduce the vertical speed towards the newly assigned level. In the event of a TCAS RA, the change in pitch attitude in accordance with the advisory is to be initiated within five seconds and any further corrections are thereafter to be carried out within 2.5 seconds. In addition, the following applies:

- Evasive manoeuvres must be limited to the minimum required to comply with the RA because of other potential traffic and ATC consequences.
- When required pitch change has been obtained, cross-check the vertical speed.
- Do not change the selected MCP altitude.
- Expect an altitude alert if deviating from the selected altitude.
- Return to original altitude/level when "Clear of conflict" is announced.
- Inform ATC by using the standard phraseology.

The standard phraseology is described in the manual.

Part B (OM-B) contains the operational procedures for the company's aircraft types and describes normal and abnormal procedures for flight crews.

For TCAS, OM-B refers to the Quick Reference Handbook (QRH), which is a separate manual but forms part of OM-B. The QRH contains checklists for emergency situations, abnormal situations and, in some cases, for certain other procedures. The QRH sets out the actions to be taken in the event of a TCAS TA and a TCAS RA, see Section 1.6.4.

Part D (OM-D) is a training manual that contains qualification requirements for flight crew, training procedures and training-related instructions. The manual covers course structure and training phases and addresses training methods and student progression. Skill tests, initial training, recurrent training and refresher training, as well as requirements for performance evaluation, are also addressed.

Evidence-based training and TCAS

The purpose of Evidence-Based Training (EBT) is to identify, develop and assess the competencies required of pilots in order for them to operate safely, effectively and efficiently in commercial air transport. This is achieved by managing the most relevant threats and errors, based on evidence collected from both operational activity and training. The training is divided into six modules conducted over a three-year period, a so-called EBT cycle.

Each module comprises two simulator sessions of three hours each. The first session focuses on evaluation (EVAL) and validation of manoeuvres (MV) in order to meet the requirements for a proficiency check in accordance with the authority's PC or the company's OPC. Regardless of the type of check, it is always ensured that the requirements for the PC are met. The second session deals with scenario-based training (SBT) and instructor-supervised training in the simulator (ISI).

The ability to handle TCAS is to be practised and assessed at least once every three years in accordance with the EBT cycle. The training consists of ground-based instruction covering system function, thresholds, limitations and inhibitions, as well as simulator training focusing on operational procedures and manoeuvres.

1.17.2 Hungary and JAS 39 Gripen

Since 2006, the Hungarian Air Force has leased 14 JAS 39 Gripen aircraft (twelve single-seat Gripen C and two two-seat Gripen D) from the Swedish state. The agreement was originally concluded as a lease-purchase contract with an initial term of twelve years, but was later extended to remain in force until 2026. By December 2007, all aircraft had been delivered to Hungary. To ensure continued operational capability and development of the Gripen system, Sweden and Hungary have also agreed to extend an existing support and logistics agreement by ten years, until 2036. This agreement covers upgrades of the aircraft, technical maintenance and training.

1.17.3 Air Traffic Control (ATC)

ATC services were provided by LFV at the time of the occurrence. LFV's operations manual contains information on ACAS/TCAS in the section on safety systems within the surveillance service, which is described as follows.

> *Procedures regarding aircraft equipped with an Airborne Collision Avoidance System (ACAS)*
>
> *When a pilot reports an ACAS RA (instruction to perform an avoidance manoeuvre), the air traffic controller shall not attempt to modify the aircraft's flight path until the pilot reports CLEAR OF CONFLICT.*
>
> *When an aircraft deviates from its clearance or instruction in accordance with an RA, or a pilot reports an RA, the controller's responsibility for maintaining separation between that aircraft and other aircraft affected by the manoeuvre resulting from the RA instruction ceases. The controller shall resume responsibility for maintaining separation between all affected aircraft when:*
>
> *the air traffic controller acknowledges a report from the pilot that the aircraft has returned to its current clearance.*

the air traffic controller acknowledges a report from the pilot that the aircraft is returning to its current clearance, and the air traffic controller issues an alternative clearance, which the pilot then acknowledges.[22]

Training and refresher training for TCAS

During qualification training for prospective air traffic controllers, LFV includes a training module consisting of both theory and simulation, referred to as the "Nöd och Ruff-utbildning" training. This module includes self-study in the form of web-based training (e-learning from Eurocontrol[23]), in which TCAS forms part of the course content. During the theoretical part of the training, emergencies and irregularities are also covered, including TCAS. The training concludes with a final test, which includes questions on TCAS.

LFV carries out competency assurance through refresher training, the content of which is planned on the basis of proposals and requests from the DA-kontoret[24], the operational management, the group of assessors and others. However, there is no regular, recurring activity within the refresher training that specifically concerns TCAS.

1.18 Additional information

1.18.1 Tools for Conflict Identification in Air Traffic Management

TopSky is a traffic management system used by air traffic controllers to monitor and manage air traffic. The system is developed by the company Thales and is used in many countries worldwide, including Sweden. TopSky contains several tools that assist controllers in detecting and avoiding collisions between aircraft:

MTCD (Medium Term Conflict Detection):

A planning tool based on flight plan information. It shows possible conflicts between aircraft that are within 10 nautical miles of each other.

TCT (Tactical Controller Tool):

A tool that uses both flight plan and radar information. It gives a warning up to 4 minutes before a conflict may occur. The warning is displayed as a yellow "TC" on the aircraft's label.

STCA (Short Term Conflict Alert):

A radar-based system that warns up to 90 seconds before a conflict. The warning appears on the radar screen and is sometimes accompanied by an audible signal.

BS (Blind Spot):

A tool that indicates whether the level the air traffic controller intends to assign to an aircraft is already occupied by another aircraft. The warning appears as red dots in the system.

[22] LFV Operations Manual for Air Traffic Management Services, Surveillance Service and Safety Systems. 5.10.3 Procedures regarding aircraft equipped with an Airborne Collision Avoidance System (ACAS).

[23] Eurocontrol is a European organisation that coordinates and develops European airspace in order to ensure safe and efficient air traffic management across national borders.

[24] The Flight Safety Unit at LFV.

1.18.2 Regulations for TCAS

Air operations conducted within the EU are subject to the common aviation rules laid down in Regulation (EU) 2018/1139[25] of the European Parliament and of the Council. Commission Regulation (EU) No 965/2012 on technical requirements and administrative procedures related to air operations[26] lays down common technical requirements and administrative procedures for commercial and non-commercial operations with aeroplanes and helicopters within the EU. It applies both to commercial air transport operators and to general aviation. Commission Regulation (EU) No 965/2012 in turn refers to Commission Implementing Regulation (EU) No 923/2012 laying down the common rules of the air and operational provisions regarding air navigation in the single European sky[27], in which TCAS is described.[28] This Implementing Regulation is commonly referred to as SERA (Standardised European Rules of the Air).

SERA contains, among other things, rules on how TCAS is to be used and how pilots and air traffic controllers are to act in the event of a TCAS RA.[29] Firstly, there is a general obligation, as a main rule, to use TCAS at all times during flight. Furthermore, the following applies.

When a resolution advisory (RA) is issued by TCAS, pilots shall:

1. Respond immediately by following the RA, as indicated, unless doing so would jeopardise the safety of the aircraft.
2. Follow the RA even if there is a conflict between the RA and an ATC instruction to manoeuvre.
3. Not manoeuvre in the opposite sense to an RA.
4. As soon as possible, as permitted by flight crew workload, notify the appropriate ATC unit of any RA which requires a deviation from the current ATC instruction or clearance.
5. Promptly comply with any modified RAs.
6. Limit the alterations of the flight path to the minimum extent necessary to comply with the RA.
7. Promptly return to the terms of the ATC instruction or clearance when the conflict is resolved.
8. Notify ATC when returning to the current clearance.

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[25] Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91.

[26] Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council.

[27] Commission implementing regulation (EU) No 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending Implementing Regulation (EU) No 1035/2011 and Regulations (EC) No 1265/2007, (EC) No 1794/2006, (EC) No 730/2006, (EC) No 1033/2006 and (EU) No 255/2010.

[28] In the Regulation, the term ACAS is used and defined as follows: On-board equipment that uses signals from SSR transponders, independent of ground-based equipment, to provide the pilot with advisory information on SSR-transponder-equipped aircraft which may constitute a collision risk (Article 2, point 17).

[29] Annex 1, SERA. 11014.

Furthermore, it is stipulated that when a pilot reports a TCAS RA, the controller shall not attempt to modify the aircraft flight path until the pilot reports "clear of conflict".

EASA has adopted acceptable Means of Compliance (AMC) and Guidance Material (GM) that complement SERA.[30] The rules in SERA and the associated EASA AMC and GM are compiled in EASA's publication Easy Access Rules for Standardised European Rules of the Air.

EASA has developed guidance to reduce the risk of TCAS RAs that occur due to high vertical speed when approaching an altitude or flight level, and which may be disruptive to air traffic. The guidance states the following.

> *Pilots should use appropriate procedures by which an aeroplane climbing or descending to an assigned altitude or flight level may do so at a rate less than 8 m/s (or 1,500 ft/min) throughout the last 300 m (or 1,000 ft) of climb or descent to the assigned altitude or flight level when the pilot is made aware of another aircraft at or approaching an adjacent altitude or flight level, unless otherwise instructed by ATC.*[31]

Standard phraseology shall be used in all situations for which such phraseology has been prescribed. Plain language shall be used only when standard phraseology cannot adequately serve the needs of the intended transmission.[32]

EASA has established acceptable means of compliance with the requirements for communication during a TCAS RA,[33] see Table 1.

Table 1. Standard phraseology for TCAS.

Circumstances	Phraseology pilot	Phraseology ATC
After a flight crew starts to deviate from any ATC clearance or instruction to comply with an TCAS resolution advisory (RA)	TCAS RA	Roger
After an ATC clearance or instruction contradictory to the ACAS RA is received, the flight crew will follow the RA and inform ATC directly	Unable TCAS RA	Roger
After the response to an ACAS RA is completed and a return to the ATC clearance or instruction is initiated	Clear of Conflict, returning to (assigned clearance)	Roger (or alternative instructions)
After the response to an ACAS RA is completed and the assigned ATC clearance or instruction has been resumed	Clear of Conflict (assigned clearance) Resumed	Roger (or alternative instruktions)

[30] EASA Executive Director (ED) decisions.

[31] Easy Access Rules for Standardised European Rules of the Air (SERA), GM7 SERA.11014 ACAS resolution advisory (RA) (ED Decision 2016/023/R).

[32] Section 14, SERA.14001 in Commission Implementing Regulation (EU) 2016/1185 of 20 July 2016 amending Implementing Regulation (EU) No 923/2012 as regards the update and completion of the common rules of the air and operational provisions regarding services and procedures in air navigation (SERA Part C) and repealing Regulation (EC) No 730/2006.

[33] Appendix 1 to AMC1 SERA.14001 General, Easy Access Rules for Standardised European Rules of the Air (SERA) (ED Decision 2025/012/R).

1.18.3 Refresher training for air traffic controllers

Refresher training for air traffic controllers shall be conducted by certified training organisations and approved by the competent authority.[34] The training shall cover, as a minimum, practice in standard routines and procedures, training for abnormal and emergency situations, and instruction in human factors. Particular emphasis is placed on the use of standard phraseology and effective communication, as many incidents in air traffic are caused by misunderstandings. The objective is for air traffic controllers to be able to communicate clearly and correctly in all situations, using standard phraseology and radio communication.

1.18.4 Authorisation for Hungarian JAS 39 Gripen aircraft to enter Swedish territory

For foreign military combat aircraft to enter Swedish territory, authorisation from the Government is required in accordance with Section 6 of the Access Ordinance (1992:118). The Government has granted the right of access for Hungarian State military aircraft of the type JAS 39 Gripen for the purpose of carrying out inspection, maintenance and technical upgrading during the period from 1 January 2024 to 31 December 2025, in accordance with the detailed provisions laid down by the Swedish Armed Forces.[35]

On 17 December 2024, the Swedish Armed Forces adopted more detailed provisions on access to Swedish territory for Hungarian State aircraft of the type JAS 39 Gripen for the period from 1 January 2025 up to and including 31 December 2025. The decision states, inter alia, the following:

> *The aircraft are to be operated in accordance with the rules applicable to civil aviation and in accordance with instructions from Swedish ATC.*

1.18.5 Flight plan for military flight

Military flights may be conducted under different flight plans depending on the nature of the mission. Military aircraft participating in exercises or conducting operations with special requirements outside the civil regulatory framework operate under an OAT flight plan (Operational Air Traffic). Military flights conducted in accordance with the rules applicable to civil aviation are operated under a GAT flight plan (General Air Traffic). When a flight is conducted under a GAT flight plan, the SERA provisions shall be complied with. However, the equipment requirements set out in SERA do not apply to military aircraft.

1.18.6 Swedish Armed Forces documentation regarding TCAS

In the military regulation FOM-A Combat Aviation[36], TCAS is described under the heading “Flight in the vicinity of foreign aircraft” as follows.

> *Civil and military transport aircraft are normally fitted with TCAS/ACAS. This equipment calculates a possible collision point with the help of the aircraft's own readings for altitude, heading, speed and attitude. A predicted shortfall in separation*

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[34] See ATCO.D.080, Annex I, Chapter D, Section 4 Commission regulation (EU) 2015/340 of 20 February 2015 laying down technical requirements and administrative procedures relating to air traffic controllers' licences and certificates pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council, amending Commission Implementing Regulation (EU) No 923/2012 and repealing Commission Regulation (EU) No 805/2011.

[35] Decision of 14 December 2023, Fö2023/01801.

[36] Flight Operations Manual for the Swedish Armed Forces (1 June–30 September 2025).

entails the crew in the mentioned aircraft being altered to the conflicting aircraft and, if necessary, a command to manoeuvre to avoid collision. This means that crew is forced to follow the command even if it entails breaking the flight's clearance.

1.18.7 Statistics regarding TCAS

It is difficult to find publicly available statistics on how often TCAS events occur in relation to the number of flights operated, but Eurocontrol published an ACAS Guide in April 2025.[37] The guide is extensive and contains descriptions of the system, how it works, and certain statistics for civil aviation.

The guide presents a study based on radar data covering 9 million flights in Europe. The study shows that a TCAS RA occurs once every 7,250 flight hours. It is assumed that outside the core European airspace, the frequency of TCAS RAs is lower due to lower traffic density.

The guide also contains statistics from a number of airlines' Flight Data Monitoring (FDM) systems. These statistics show that TCAS TAs are more common than TCAS RAs and occur once every 14 flights on short- and medium-haul operations, whereas TCAS RAs occur once every 3,000 flights. This means that, on average, one out of 215 TCAS TA events escalates to a TCAS RA.

1.18.8 Actions taken

Norwegian

Following the occurrence, Norwegian has introduced a process to monitor and ensure compliance with the proficiency check (PC) requirements, both administratively and within its systems, in accordance with the applicable regulations. The company has also added a new risk to its risk register concerning the possibility of an incorrect date being entered in connection with a PC.

LFV

LFV has stated that it intends to supplement the competency assurance programme for air traffic controllers so that the existing training module on avoidance manoeuvres also covers the handling of TCAS RAs. This applies to both the Malmö and Stockholm ATCC.

1.18.9 Similar occurrences

Norwegian

During the period 2016 to 2025, six separate TCAS RA events have been reported in which military traffic was involved. All of the incidents were triggered by high rates of climb and rapid changes of heading or altitude, which led to the activation of the TCAS system. None of the events involved any actual risk of collision.

Braathen Regional Airways

Braathen Regional Airways has reported one occurrence which took place in May 2024. On that occasion, one of the company's aircraft was at FL170 when a TCAS TA indicated traffic 5,000 feet below. Shortly thereafter, a TCAS RA ("Climb, Climb") was received. The Commander looked down to the left and then saw a JAS 39 Gripen aircraft that was rolling

[37] https://www.eurocontrol.int/publication/airborne-collision-avoidance-system-acas-guide.

into an inverted attitude, i.e. upside down. The information on the Navigation Display (ND) showed -1,000 feet below, but the crew assessed that the JAS 39 Gripen aircraft was closer.

LFV

Since 1 January 2020, LFV has recorded four events in which military traffic was involved in a TCAS RA. None of the occurrences reported by Norwegian or Braathen are included in these events. The majority of these incidents have been caused by nearby military aircraft, which have often had high rates of climb and made rapid changes of heading or altitude, leading to activation of the TCAS system.

ECCAIRS

SHK has obtained information from ECCAIRS[38], which is an EU database for the reporting of accidents and incidents in the aviation sector. Through this common system, Member States and organisations can collect, store and exchange safety-related information in a harmonised manner, which facilitates analysis of trends and risks and strengthens aviation safety within Europe. The statistics have been filtered for events involving a TCAS RA in which military traffic was involved, see Figures 14–16. The statistics cover all events reported between 2000 and 2025. Years that are not shown in the figures are those for which no events were reported.

In accordance with Commission Implementing Regulation (EU) 2015/1018[39], which entered into force in 2015, TCAS RAs are to be reported by both pilots and air traffic controllers.

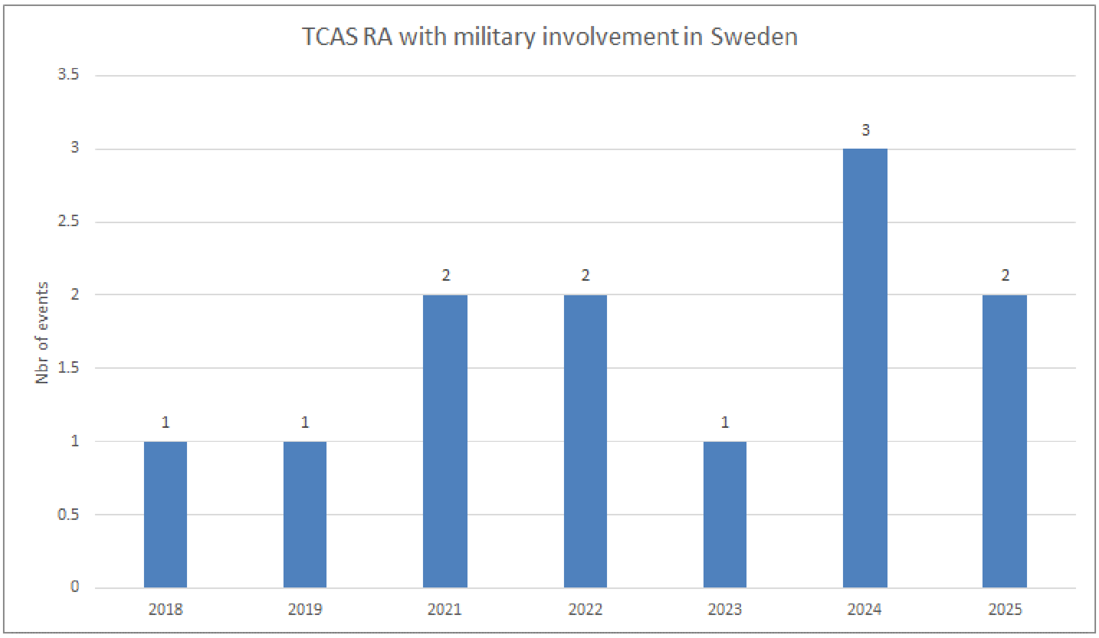

Figure 14. Number of reported TCAS RA events involving military traffic in Sweden since the year 2000.

[38] ECCAIRS (European Coordination Centre for Accident and Incident Reporting Systems).

[39] Commission regulation Implementing Regulation (EU) 2015/1018 of 29 June 2015 laying down a list classifying occurrence in civil aviation to be mandatorily reported according to Regulation (EU) No 376/2014 of the European Parliament and of the Council.

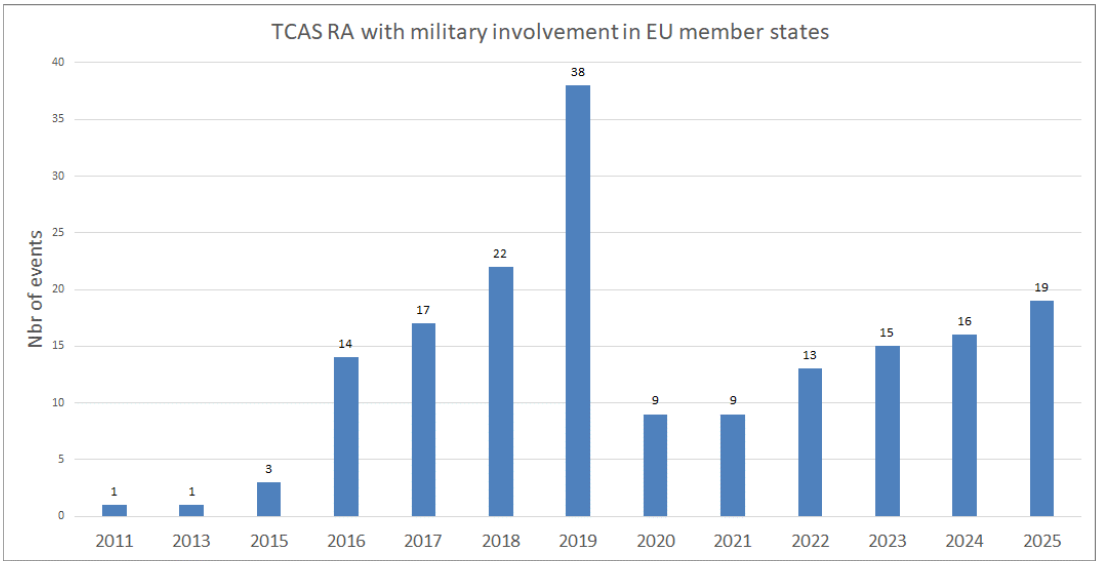

Figure 15. Number of reported TCAS RA events involving military traffic in Europe since the year 2000.

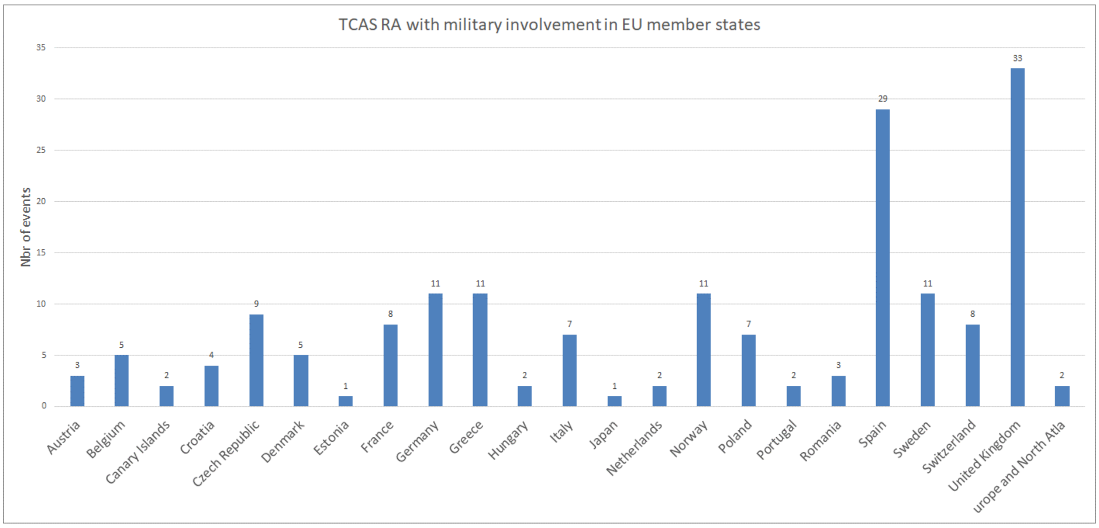

Figure 16. Number of reported TCAS RA events involving military traffic, broken down by country, since the year 2000.

1.19 Special methods of investigations

Not applicable.

2. Analysis

2.1 Initial considerations

The actions of the parties involved in the sequence of events that led to the TCAS evasive manoeuvre were in accordance with applicable routines and procedures, with the exception of the radiocommunications (see Section 2.6). The investigation shows that there was no actual risk of collision. The investigation has not identified any technical faults in the aircraft or in the TCAS system.

Despite the fact that the passenger aeroplane was operated in accordance with applicable routines and procedures, a member of the cabin crew sustained a serious injury. It can be noted that the occurrence involves military aviation, which is not fully covered by the design principles of the TCAS system. At the same time, there is reason to assume that the military presence in the airspace will increase in the future. This places further demands on cooperation between civil and military actors, as well as on understanding of the on-board technical systems. The occurrence involved the Hungarian Air Force, but SHK considers that a similar situation could equally have arisen involving the Swedish Armed Forces. For this reason, the analysis in this report also covers the Swedish Armed Forces.

The analysis initially addresses the sequence of events that led to the injury to the cabin crew member. The analysis focuses in particular on answering the questions of why a TCAS RA was triggered despite there being no actual risk of collision, what possibilities air traffic controllers and pilots have to act in a way that prevents the TCAS system from having to intervene, and the importance of correct and clear communication. The analysis also identifies and highlights possible safety-enhancing measures. In this context, it is of particular interest to identify measures that can reduce the risk of incidents between military and civil aviation in the future, for example through improved communication or enhanced training.

2.2 The aircraft were manoeuvred in accordance with regulations and clearances

When the TCAS system issued a warning of a potential collision, the commander reduced the vertical speed and both pilots adjusted the range on the navigation display in order to better identify the potential threat, in accordance with the procedures set out in the manuals.

As the fighter aircraft were climbing rapidly, the warning quickly escalated to a resolution advisory for an evasive manoeuvre. At this point, the passenger aircraft had reduced its vertical speed to 1,000 feet per minute, which is consistent both with the operator's recommendations and with the SERA provisions. When the passenger aircraft carried out the evasive manoeuvre, the fighter aircraft had begun to reduce their rate of climb from 9,000 feet per minute to 4,400 feet per minute. The vertical distance between the aircraft was then 3,400 feet.

When the TCAS system on the passenger aircraft issued a TCAS RA, the Commander immediately disconnected the autopilot and the autothrottle. As the aircraft was in descent, the pilot increased thrust and pitch attitude to initiate a climb in accordance with the advisory. When the TCAS system announced "Clear of conflict", the Commander manoeuvred the aircraft back to the cleared level.

2.3 Why was a TCAS RA triggered despite there being no risk of collision?

Taking into account that two fighter aircraft were involved, the air traffic controller had issued instructions which provided greater vertical separation than is normally used. Despite this, the TCAS system called for an evasive manoeuvre. Against this background, there is reason to examine how the TCAS system functions in the interaction between fighter aircraft and civil traffic.

On the occasion in question, the fighter aircraft were flying under a GAT flight plan, which means that they were subject to civil traffic rules under SERA. According to SERA, when other traffic is in the vicinity, an aircraft shall reduce its vertical speed during the last 1,000 feet before reaching a newly cleared level. The regulatory framework is not adapted to fighter aircraft or other aircraft with high vertical speeds. For fighter aircraft, it is often too late to reduce the vertical speed in the same way as civil aircraft only when 1,000 feet remain to the newly cleared level. This is because the vertical speed of a fighter aircraft is so high that the TCAS system is activated much earlier.

The pilots of a JAS 39 Gripen do not receive any information about when the TCAS system of a civil aircraft is activated. They are therefore unable to adjust their vertical speed on the basis of information from TCAS, and instead fly in accordance with ATC instructions and their own procedures. The fighter aircraft also lack the automatic control systems found in civil transport aircraft, which makes it more difficult to reduce the vertical speed towards a new level in accordance with the principles of the civil regulatory framework.

At the time of the accident, the vertical speed and closure rate of the fighter aircraft were so high that the TCAS system was activated significantly earlier than would have been the case had the approaching traffic been civil aircraft.

In summary, the fact that a TCAS RA was triggered was due to the high vertical speed of the fighter aircraft and to the circumstance that neither the regulatory framework, the TCAS system nor ATC procedures are designed to accommodate the interaction between civil and military traffic.

2.4 Can air traffic controllers prevent TCAS from being activated when fighter aircraft operate in proximity to civil aircraft?

Collision avoidance systems such as TCAS constitute a final safety barrier intended to intervene if other barriers fail. The system has certain limitations. Some of these limitations mean that, under certain conditions, the system does not issue a warning even when there is a risk of collision (see Section 1.6.1, Description of the collision avoidance system). Due to its design, the system may also sometimes generate warnings even when all aircraft concerned are complying with their clearances. It is misleading to refer to these as “false” warnings, since they are issued in accordance with the system design. Nevertheless, such warnings are undesirable for several reasons. A TCAS RA can create a complex situation involving multiple aircraft and thereby increase the risk of incidents, including personal injuries to crew and passengers, as in the present case. Frequent warnings may also lead to reduced confidence in the system.

In civil aviation, specific procedures therefore exist to reduce the number of undesirable warnings. However, these procedures do not have the same effect when interacting with fighter aircraft, because TCAS warnings may be issued even at large distances as a result of high closure rates.

As fighter aircraft are not equipped with TCAS and therefore cannot be warned in the same way as civil aircraft, traffic information from ATC is the primary tool when the pilots of the fighter aircraft do not themselves have visual contact with other traffic. In the case in question, ATC was aware that the fighter aircraft were approaching the same area as the passenger aircraft and therefore chose to provide greater vertical separation than normal. The purpose of this measure was probably not primarily to avoid TCAS warnings, but rather to reduce the risk of a loss of separation if the fighter aircraft did not level off at the cleared level. An air traffic controller may, in such a situation, choose to provide traffic information regarding the passenger aircraft to the fighter aircraft, if considered appropriate. Such traffic information could lead the fighter pilots to take into account the risk of triggering the TCAS and, for example, reduce their rate of climb. This may in turn reduce the risk of TCAS issuing a resolution advisory.

The occurrence took place in controlled airspace. There are indications that air traffic controllers provide preventive traffic information more frequently in uncontrolled airspace. This may be because, in controlled airspace, the controller is already responsible for the control and separation of the aircrafts and may therefore sometimes consider traffic information to be unnecessary.

Air traffic controllers have a wide range of tasks. Even if they are aware of the risk of TCAS warnings, their primary responsibility is to control and manage air traffic safely. In view of the potential risks associated with TCAS RAs, SHK nevertheless considers that there may be reason to examine how controller procedure's function when controlling fighter aircraft in the vicinity of civil traffic. For example, there may be reason to review whether measures such as preventive traffic information and increased vertical separation can prevent TCAS interventions in the interaction between civil and military traffic. There may also be a need to consider knowledge-enhancing measures to increase controllers' understanding of how TCAS functions when fighter aircraft are involved, see further Section 2.7.

2.5 Why was the cabin crew member injured?

According to the design of the TCAS system and the associated recommendations, an evasive manoeuvre is to be carried out as smoothly as possible. Under stressful conditions, it can be challenging to follow a TCAS RA while at the same time maintaining a low g-load on the aircraft. Pilots may feel that the time available to act is limited, even though the system recommends that the manoeuvre be initiated within five seconds. This becomes particularly evident when the aircraft must rapidly transition from, for example, descent to climb. During SHK's reference flights in the simulator, g-load values corresponding to those in the occurrence were recorded according to the simulator's calculations, even though the pilot conducting the reference flight perceived the control inputs as relatively small. This shows that a TCAS manoeuvre may be perceived as moderate from the cockpit, yet still give rise to significant forces in the cabin.

The cabin crew member who was injured was located in the rear part of the aircraft. The rapidly increasing pitch attitude caused the floor to move downwards. Even though the actual forces were not negative, this could create a sensation of weightlessness. The Commander carried out three changes in pitch attitude within a short period of time. The graph below shows the calculated relative displacement of the floor in connection with these changes. During the first change in pitch attitude, the floor moved just over 2 metres. It was probably at this point – when the floor quickly reversed direction upwards – that the cabin crew member was injured, which is also consistent with the crew member's own account, see Figure 17.

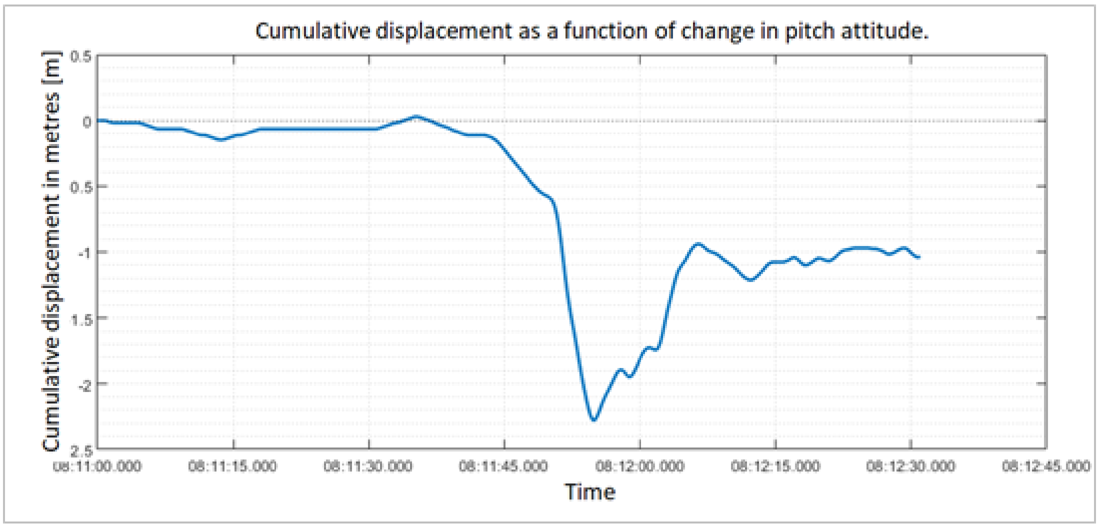

Figure 17. The accumulated displacement of the floor in the aft galley of the passenger aircraft as a function of the change in pitch attitude over time.

This movement probably coincided with other circumstances that influenced the course of events. The aircraft may also have moved to some extent laterally, which could further have impaired the crew member's ability to counteract the movement and maintain balance.

2.6 Deviations from phraseology created misunderstandings and ambiguities

In communications within air traffic, it is essential that the information transmitted by the sender is perceived and interpreted in the same way by the receiver. To ensure clarity and avoid misunderstandings, standard phraseology is therefore used. This also makes it possible to keep communications concise and informative, which in turn frees up capacity to perform other tasks.

In the occurrence, the established communications procedure was only partially followed. The First Officer, who was responsible for radio communications, initially informed ATC that an evasive manoeuvre in accordance with a TCAS RA had been initiated by transmitting: "Rednose 8CM TCAS RA Climbing". According to the phraseology, such a transmission should contain only "[Rednose 8CM] TCAS RA".

The air traffic controller did not perceive which aircraft the call came from and therefore asked: "Was that 8CM?", to which the First Officer replied: "Rednose 8CM levelling off TCAS RA". The First Officer thus repeated that a TCAS RA was being followed, but added "levelling off" in order to describe the resolution advisory currently being complied with. This addition also deviated from the standard phraseology, and the call should instead have been limited to "Rednose 8CM TCAS RA".

The controller responded to this message by calling: "8CM the traffic maintaining 220". The intention was to provide traffic information by indicating that the fighter aircraft were at that time at FL 220. However, the First Officer did not perceive this as traffic information, but as an instruction for a new level for the passenger aircraft. As such an instruction is not compatible with the rules during a TCAS RA, the First Officer queried what was meant by calling: "Maintaining, say again for Rednose 8, maintaining 220 Rednose 8CM".

The controller then clarified by stating: “the traffic below is maintaining FL 220. Maintain 240 I call you back shortly for lower”. At this stage, the controller thus issued a level instruction to the passenger aircraft, even though the aircraft was still following a TCAS RA. Under the rules, the controller is not to issue any level instructions to an aircraft following a TCAS RA. However, several ambiguities in the earlier communications had created a perceived need to explain that the passenger aircraft should continue to maintain FL 240.

In accordance with the regulations, the crew of the passenger aircraft were not to follow an instruction from the controller and therefore transmitted: “negative we have to follow TCAS RA so we are keeping a level of 256”. The standard phraseology at this stage would have been “unable, TCAS RA”. Immediately thereafter, the First Officer reported that the potential conflict was resolved by calling: “we are now clear of traffic clear of traffic”. Under the standard phraseology, the call should have been: “clear of conflict returning to (assigned clearance)”.

It can be concluded that both the air traffic controller and the First Officer made several deviations from the standard phraseology in connection with the TCAS-prompted evasive manoeuvre. An evasive manoeuvre in accordance with a TCAS RA is time-critical and can be perceived as stressful. It is therefore important that communications are concise, correct and in accordance with the standard phraseology. Superfluous information can lead to misunderstandings and necessitate further clarifications. Such information also consumes time and attention on the part of both the controller and the crew. The monitoring pilot responsible for radio communications needs to maintain focus on supporting and assisting the pilot flying. Superfluous and unclear radio communications increase the workload in an already pressured situation.

The recordings of the radio communications show that both the controller and the First Officer intended to provide clear and relevant information in order to facilitate the joint handling of the situation. In hindsight, however, it is evident that the information that went beyond the standard phraseology led to several ambiguities and misunderstandings, which in turn required clarification. This meant that unnecessary time was spent and the workload increased for both the controller and the First Officer.

There is nothing to indicate that the ambiguities and misunderstandings in this case were likely to lead to any more serious consequences. Nor is there anything to suggest that they had any material impact on the sequence of events. The occurrence does, however, illustrate the importance of adhering to phraseology in order to avoid misunderstandings in critical situations. Under other circumstances, a misunderstanding between a controller and a crew could have serious consequences.

2.7 The need to expand training on TCAS

The methods and phraseology to be used in the event of a TCAS RA have been designed taking into account, among other things, that the situation involves managing a potentially hazardous event under time pressure. In such situations, training and practice are crucial to ensure correct action.

This section sets out how different actors can contribute to increasing the level of knowledge and the ability to handle TCAS, and thereby enhance safety.

2.7.1 Norwegian

Norwegian provides continuous recurrent training within the framework of Evidence-Based Training (EBT), under which TCAS training is conducted every three years in accordance with the EBT cycle. The occurrence shows that there may be reasons to introduce more frequent training in standard phraseology for TCAS. Norwegian is therefore recommended to review simulator training on TCAS phraseology in order to ensure correct communication.

During SHK's reference flights in the simulator, the pilot experienced that relatively small control inputs were required to achieve the g-loads recorded in the occurrence. In order to ensure that pilot training is appropriately designed, there may nevertheless be reason for the operator to review the situation on the basis of the available flight data. Using data from the Flight Data Monitoring (FDM) system, the operator can examine whether the g-loads and changes in pitch attitude that occurred in the accident were an isolated event, or whether there are training measures that could reduce the risk of a similar event occurring again. However, this must be regarded as a normal measure within the operator's existing Safety Management System (SMS). There is therefore no need to issue any recommendation in this respect.

2.7.2 LFV

Within the framework of the competency assurance programme for air traffic controllers, LFV provides continuous refresher training. However, this does not include regular training in TCAS scenarios or the associated phraseology. Such training is instead to be conducted as required, based on indications from the Safety Management System. There is no information to suggest that this type of training has previously been carried out. The occurrence shows that there may be reasons to train regularly in TCAS standard phraseology for air traffic controllers as well.

The occurrence also shows that there are reasons to consider increasing the level of knowledge and understanding of how the TCAS system functions when fighter aircraft with high vertical speeds are involved, in particular as regards procedures for handling traffic information. LFV should therefore consider including TCAS scenarios on a regular basis in the continuous refresher training. LFV has stated that it intends to supplement the competency assurance programme for air traffic controllers so that the existing training module on avoidance manoeuvres also covers the handling of TCAS RAs. There is therefore no reason to issue a recommendation to LFV.

2.7.3 Swedish Transport Agency

The Swedish Transport Agency is the supervisory authority and approves the syllabuses for recurrent training and the competency assurance programme for air navigation service (ANS) providers. Since, in addition to LFV, there are several ANS providers, there is reason for the Swedish Transport Agency, in its supervision of competency assurance for air traffic controllers, to review refresher training for controllers with regard to TCAS. The Swedish Transport Agency is therefore recommended to examine whether the handling of TCAS should be included in recurrent training for air traffic controllers with a specified periodicity. The Swedish Transport Agency is also recommended to carry out targeted information activities directed at providers of ATC services, in order to increase awareness of how military aircraft operate and the challenges this entails for the interaction with civil traffic in the airspace.

2.7.4 Swedish Armed Forces

The Swedish Armed Forces were not involved in the occurrence, but the investigation has examined how a Swedish military unit would have acted in a corresponding flight. Such a flight would have been conducted in accordance with the military regulatory framework. The documents governing military air traffic are contained in the FOM (Flight Operations Manual).

FOM-A Combat Aviation contains provisions on TCAS/ACAS. These provisions mainly contain information on how other aircraft may react and act when flying in the vicinity of fighter aircraft. However, the information does not provide a clear description of the system's function or operation. This means that the level of system understanding of TCAS/ACAS among military fighter crews is probably relatively low.

In view of the differences between military and civil traffic, it appears difficult to develop procedures that are suitable for all situations. An increased level of knowledge and understanding of how the TCAS system functions among fighter pilots would probably influence how a situation develops, particularly if the pilots receive information from ATC about surrounding traffic. The Swedish Armed Forces should therefore examine the need to provide training on the TCAS/ACAS system for aircrew who do not normally operate aircraft equipped with these systems, and, where necessary, to provide such recurrent training.

2.8 Other observations

During the investigation, it emerged that the Commander's qualification regarding the proficiency check in accordance with Part-FCL was not valid. This was due to the instructor having inadvertently entered an incorrect date for the check and its period of validity. Neither the Commander, the airline nor the authority that issued the licences detected this, which meant that the Commander did not hold a valid qualification at the time of the occurrence. The company conducted training in accordance with evidence-based programme, which meant that the same training was carried out regardless of whether the purpose was to meet EASA's requirements for a proficiency check (PC) or the company's own requirements (OPC). In practice, therefore, the Commander had completed the training and competency check required, even though deficiencies in the documentation meant that the Commander's proficiency had not been formally approved at the time.

SHK considers that this circumstance had no bearing on the occurrence, and Norwegian has, following the occurrence, amended its procedures in order to prevent a recurrence. There is therefore no reason for SHK to address any recommendation to Norwegian in this respect.

3. Conclusions

3.1 Findings

a) The passenger aircraft's collision avoidance system called for an evasive manoeuvre because two fighter aircraft were approaching.
b) The evasive manoeuvre resulted in a rapid change in the aircraft's pitch attitude.
c) The rapid movement of the aircraft led to a cabin crew member standing in the rear of the aircraft being seriously injured.
d) There was no risk of collision.

e) The crews of the passenger aircraft and the fighter aircraft complied with the clearances issued by the air traffic controller.
f) The communications between the air traffic controller and the crew of the passenger aircraft did not follow the standard phraseology during the evasive manoeuvre.
g) The deviations from the standard phraseology caused misunderstandings and increased the workload for both the air traffic controller and the crew.
h) The deviations probably had no material impact on the sequence of events.
i) No technical fault in the passenger aircraft or in the collision avoidance system that could have affected the accident has been identified.

3.2 Causes/Contributing Factors

The direct cause of the accident was that the passenger aircraft's collision avoidance system (TCAS) generated a resolution advisory (TCAS RA) for an evasive manoeuvre because the two-fighter aircraft were approaching with a high vertical speed. The system issued a resolution advisory which the pilot followed, resulting in a rapid change in the aircraft's pitch attitude. This change in pitch attitude in turn caused such pronounced movements in the part of the aircraft where the cabin crew member was standing that the crew member was unable to compensate for them.

A contributing factor at system level was that the air traffic management system does not take into account how the TCAS system handles fighter aircraft with high vertical speeds.

4. Safety recommendations

LFV has taken action following the accident. SHK therefore refrains from issuing any safety recommendations to that authority.

Norwegian is recommended to

- review simulator training regarding TCAS phraseology in order to ensure correct communication (see Section 2.7.1). *(SHK 2026:11 R1)*

The Swedish Transport Agency is recommended to

- examine whether the handling of TCAS should be included in refresher training for air traffic controllers with a specified periodicity (see Section 2.7.3). *(SHK 2026:11 R2)*
- to carry out targeted information activities directed at providers of ATC services, in order to increase awareness of how military aircraft operate and the challenges this entails for the interaction with civil traffic in the airspace (see Section 2.7.3). *(SHK 2026:11 R3)*

The Swedish Armed Forces is recommended to

- examine the need to introduce training on the TCAS/ACAS system for pilots who do not normally operate aircraft equipped with these systems and, where necessary, provide such refresher training (see Section 2.7.4). *(SHK 2026:11 R4)*

The Swedish Accident Investigation Authority respectfully requests to receive, **by 14 September 2026 at the latest,** information regarding measures taken in response to the safety recommendations included in this report.

On behalf of the Swedish Accident Investigation Authority,

Johan Albihn Mats Trense