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Australian Transport Safety Bureau

Interrupted engine start and evacuation involving Saab 340B, VH-ZRK

Melbourne Airport, Victoria, on 5 April 2022



ATSB Transport Safety Report

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Addendum

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Executive summary

What happened

On 5 April 2022, a Saab 340 aircraft, registered VH-ZRK and operated by Regional Express, was being prepared for an air transport flight from Melbourne, Victoria. On board were the captain, first officer, one flight attendant, and 23 passengers.

During the engine start, the ground power unit was disconnected prematurely from the left engine by ground crew, which resulted in an interrupted start. The flight crew initiated the interrupted start checklist which included motoring the engine to purge residual fuel. During the motoring procedure, the ground crew signalled to the flight crew (using gestures) that they observed flames and smoke coming from the left engine and to shut down the engine. In response, the crew shut down both engines and discharged the left engine fire extinguisher and ordered an evacuation.

During the evacuation, 2 passengers sustained minor injuries. A subsequent inspection found no indication of an engine failure or damage prior to or at the time of the occurrence.

What the ATSB found

The ATSB found that, due to repeated non-standard signals from the ground crew about smoke and flames from the left engine, the motoring cycles were not completed which resulted in a tailpipe fire.

The captain, based on the continued signals from the ground crew, and a rising interstage turbine temperature (ITT), decided that an emergency evacuation was required. However, the captain had not communicated their observations or actions to the first officer prior to making this decision which limited their opportunity to contribute to the identification and management of the situation. The captain did not use all available information to positively confirm the severity of the situation prior to ordering the evacuation and did not communicate their intent to the first officer.

The decision to evacuate occurred while the flight attendant was using the public address system to brief passengers. As a result, the captain did not initially use the primary method (an announcement over the public address system) to alert the cabin that an evacuation was required, instead using a secondary method (4 chimes). The secondary method was not recognised by the flight attendant, so they were unaware that an evacuation was required until the captain opened the flight deck door to communicate directly.

When the flight attendant then ordered passengers to evacuate, there were limited instructions provided to them. As a result, the passengers in the emergency exit row did not open a useable exit which delayed the evacuation of the aircraft.

During the evacuation, some passengers took their baggage which increased the risk of injury and delays exiting the aircraft. The response to the situation by the aviation rescue and firefighting service was initially delayed by 2 minutes due to the nature of the problem not being communicated directly to air traffic control from the aircraft.

On an organisational level, the ATSB found that Regional Express did not provide flight crew or ground crew recurrent training to review the hand signals required to communicate with each other, including those used in an emergency. In addition, although flight crew were required to notify ground crew if an evacuation had occurred as necessary, the operator did not provide awareness to ground crew on the actions to be taken in the event of an evacuation.

What has been done as a result

Regional Express developed an additional hand signal to indicate an interrupted engine start and included this in training content for both ground and flight crew. The operator also provided additional training and guidance to ground and flight crew about marshalling and dispatch

procedures (including all hand signals) and reviewed all related operational manuals. To maintain awareness, posters detailing hand signals were placed in crew high traffic areas.

Safety message

The use of all available resources, including seeking input from other crew members, particularly in abnormal or emergency situations, assists in being able to positively identify the nature of a problem. Undertaking an informed and coordinated approach to decision-making ensures that the most appropriate action can be taken.

This occurrence also highlights the importance of the use of standard communications (including hand signals) to be able to effectively convey information, particularly in a potentially time-critical situation.

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The occurrence

Interrupted engine start

On 5 April 2022, a Saab 340 aircraft, registered VH-ZRK and operated by Regional Express, was being prepared for an air transport flight from Melbourne, Victoria to King Island, Tasmania. The scheduled departure time was 1445 local time. On board were the captain, first officer (FO), one flight attendant, and 23 passengers.

Following door closure, the flight attendant briefed the emergency exit row passengers and commenced the passenger safety briefing using the public address system. In accordance with the normal procedure, the aircraft was connected to a ground power unit (GPU),¹ and a marshaller (ground staff member) was positioned at the front of the aircraft to monitor the engine start. Closed-circuit television (CCTV) and the cockpit voice recording showed that at 1444:15 the flight crew had completed the engine start checklist and the right engine was started.

At 1444:53 the flight crew initiated the start sequence for the left engine, and the propeller began to rotate. Shortly after at 1445:11, and before receiving a signal from the flight crew to do so, a second ground staff member went to the rear right side of the aircraft and disconnected the GPU. They recalled not being sure why they disconnected the GPU without the instruction to do so, but recalled being preoccupied with the next aircraft departure.

After realising the GPU had been disconnected (as the flight deck instruments no longer had power, which at that time were selected to be receiving power from the GPU), the captain started to action the interrupted engine start memory items. The procedure included moving the condition lever to the 'fuel off' position, the ignition switch to the 'off' position, and motoring² to remove any residual fuel from inside the engine. Motoring was initiated by the captain firstly selecting the start switch to the left engine, which also returned power to the flight instruments again. By this time the left engine propeller had stopped and the engine had decelerated from the original start attempt about 30 seconds before.

Flame and smoke

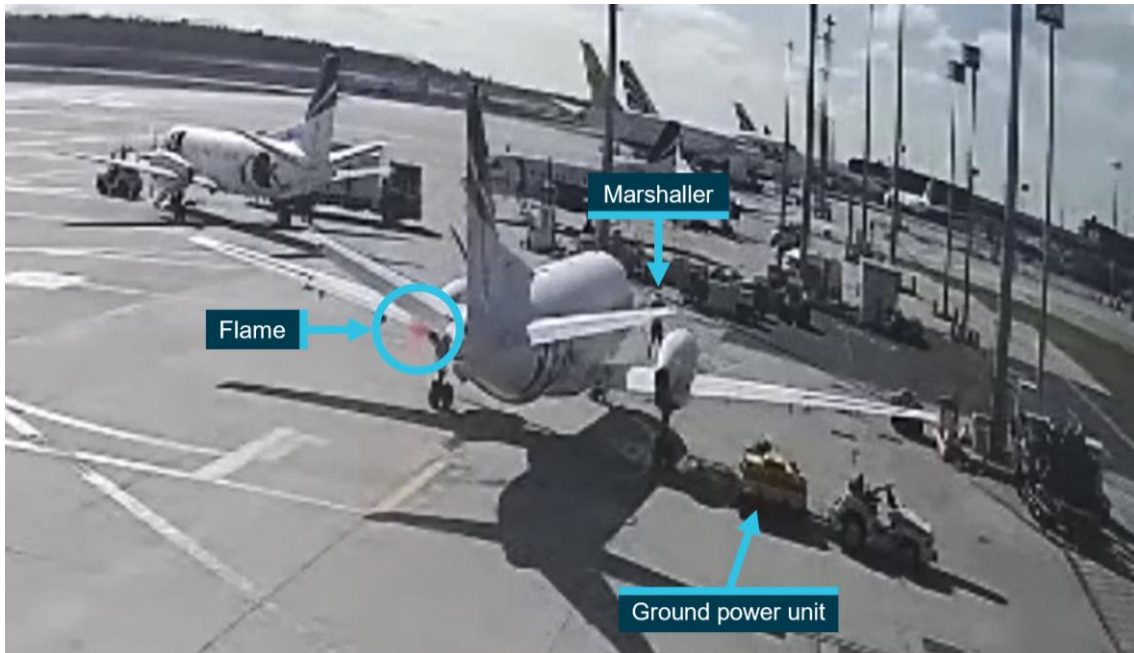
At 1445:28, as the left engine propeller began to rotate again as part of the engine motoring procedure, a tailpipe fire had developed as indicated by flame and smoke coming from the rear of the engine. The marshaller, who was still positioned at the front of the aircraft, saw a 'burst of flame' from the back of the engine (Figure 1) and began to signal to the flight crew to stop what they believed to be an additional engine start (as they were unaware of the motoring procedure). As the marshaller and flight crew were not able to communicate verbally (there was no radio and no communications headset for the Saab 340), the marshaller reported they tried to signal to the captain to shut the engine down using a 'cut-throat' hand signal. They also tried to indicate that there was a fire coming from the back of the engine, however, the marshaller could not recall the hand signal for fire and instead attempted to communicate it by mouthing the word 'fire' and gesturing to the left engine. CCTV recorded the marshaller waving their hands at this time. The captain was responding to the marshaller verbally (noting the marshaller could not hear) advising that they had to continue, however the marshaller continued to try to advise that they had seen fire from the left engine. As a result of the marshaller indicating they observed flames from the engine, the captain ceased motoring the engine and the left propeller stopped rotating.

¹ Ground power unit: an external generator that provides power to the aircraft.

² Motoring: rotating an engine (usually gas turbine) by means of its starter for a purpose other than starting.

Both flight crew recalled that at about that time the left engine interstage turbine temperature (ITT)³ was still rising and in response the captain decided to make a second attempt at motoring. At 1446:02 the captain began to motor the engine again. Almost immediately, the marshaller again thought the flight crew were trying to start the engine and signalled to them to stop which prompted the captain to check outside their window. The captain could not see any flame or fire (noting that only the front of the engine is visible from the flight deck). Other than the rising ITT and the signals from the marshaller, there were no other indications of fire. There were no master caution warnings or indications on the central warning panel for either an engine fire or tailpipe overtemperature.

Figure 1: Still image of CCTV showing flame during first motoring attempt



Source: Melbourne Airport, annotated by the ATSB

Engine fire checklist

The captain reported that, based on the signals from the marshaller and the rising ITT which was observed to be 850 °C, they decided to cease motoring the engine and action the *engine fire* emergency checklist. At 1446:42 the captain stated, ‘all right mate, fire’ and instructed the FO to pull the fire handle for the left engine which discharged the left engine fire bottle. At 1446:51 following the activation of the fire bottle and as the propeller was slowing, flame and smoke could again be seen coming from the left engine tailpipe. The right engine was shut down and the propeller started to slow down. At 1447:17, the captain instructed the FO to discharge the second fire bottle, around 30 seconds after the first. The captain later recalled that they omitted 2 engine fire checklist items relating to the power and condition levers (see *Engine fire procedures*) due to the stress at the time.

Evacuation

While still actioning the engine fire checklist, the captain ordered an evacuation at 1447:03 by cycling the seatbelt sign, creating 4 chimes. Although the primary method for the captain to communicate that an evacuation was required was by making a public announcement (PA) using

³ Interstage turbine temperature: the temperature of the gases between the high-pressure and the low-pressure turbines.

the public address and intercom system, the captain incorrectly believed they would be unable to use it as the flight attendant was already using the system for the passenger safety briefing. The captain had not yet verbalised their intent to evacuate the aircraft or called for the evacuation drills to the FO.

The flight attendant did not initially recognise the chimes as a signal to evacuate and continued with the briefing.⁴ At 1447:33, about 30 seconds after the initial order, the captain opened the flight deck door and instructed the flight attendant to commence an evacuation, specifying the use of the 'FO side' (right side) exits only.⁵ Prior to the captain opening the flight deck door to order the evacuation, the flight attendant and the FO were still unaware that an evacuation was required. At 1447:36, the captain made a PA to the cabin to advise passengers to evacuate. At 1447:56 the flight attendant began shouting evacuation commands and opened the R1 exit, discarding it outside the aircraft (see *Emergency exits*). Passengers were instructed to 'evacuate', 'leave everything behind', and 'sit and jump'. The passengers seated in the exit row, at row 6, discussed opening their exit, but decided to instead evacuate through R1.

The first passenger at the R1 exit hesitated due to the height of the door sill (1.68 m without steps or escape slide) but was encouraged by the flight attendant to exit. This passenger received a minor injury. The FO exited the aircraft after the first passenger, and a refueller and ground staff assisted the remainder of passengers to evacuate. The flight attendant continued to instruct passengers to evacuate and to 'sit and jump'. Some passengers attempted to bring their bags during the evacuation and the flight attendant and the captain (after exiting the flight deck) instructed them to leave everything behind. After receiving these instructions, a small number of passengers still exited the aircraft with their bags.

At 1447:56, as the flight attendant first started issuing the evacuation instructions, the captain radioed a Regional Express duty officer to advise that there was a fire and evacuation. The captain then attempted to directly contact the aviation rescue fire fighting (ARFF) service by radio to advise of the fire. The captain was unsure of the frequency for ARFF and did not receive a response. At this time, it was unknown whether the emergency checklist was completed as no items were verbalised by the captain. The FO can be heard saying 'torch, fire extinguisher'. The captain then contacted the ground air traffic controller at 1449:58 to request assistance, stating 'we've got a fire on the bay, can we get the fire chief please'. At 1450:17, the controller advised the flight crew via radio that they had activated the crash alarm,⁶ the fire vehicles would be dispatched and asked the captain the nature of the problem. The flight crew did not respond.

During the evacuation, the ground crew attempted to help the passengers exiting the aircraft but also recalled being unsure of how they should assist. By 1451:24 all passengers and crew had evacuated through the R1 exit, with the evacuation lasting about 4 minutes. There were 2 reported minor injuries sustained during the evacuation: one passenger with a knee injury and another passenger with a grazed elbow. Following the evacuation, the passengers were transported by bus to the terminal, with one passenger undergoing medical treatment. At 1452:42 the ARFF vehicles were dispatched and at 1453:44 the first vehicle arrived.

A subsequent examination of the engine and aircraft did not identify any engine defects, or any fire damage.

⁴ The flight attendant later indicated that they knew that 4 chimes was an evacuation signal, but that it did not 'register' at the time because bells and chimes are common during flight preparation.

⁵ R1 was an emergency exit. The main door, used for normal boarding and disembarkation, as well as emergencies, was Left 1 (L1).

⁶ Crash alarm: an emergency is declared when an aircraft is experiencing problems and there is a reasonable certainty of a threat to the safety of the aircraft.

Context

Personnel information

Flight crew

The captain held an air transport pilot's licence (aeroplane) with 8,852 hours of aeronautical experience, 5,058 of which were on the Saab 340. The captain's last emergency procedures training (which included passenger evacuation) was completed in September 2021 and their last cyclic simulator check was completed in January 2022.

The first officer (FO) held a commercial pilot's licence (aeroplane) with 4,725 hours of aeronautical experience, 952 of which were on the Saab 340. The FO's last cyclic simulator check was completed in February 2022 and last emergency procedures training (which included passenger evacuation) was completed in March 2022.

Flight attendant

The flight attendant had 12 months' experience with the operator on the Saab 340 aircraft and had completed their emergency procedures training (which included passenger evacuation) in September 2021.

Ground crew

The marshaller completed their marshalling and receipt and dispatch training in September 2019. This training included GPU connection and disconnection and performing hand signals, including the signal for fire. The second ground crew member completed their training in October 2019 and had been with the operator for 2.5 years.

Aircraft information

General information

VH-ZRK was a Saab 340B, serial number 340B-397. The Saab is a twin turboprop aircraft fitted with 2 General Electric CT7-9B turboprop engines and is capable of carrying up to 38 passengers (including infants). VH-ZRK was configured with 34 passenger seats.

Engine start

Usually, an engine start is achieved using either the aircraft battery or by using an external GPU. The starting sequence required a flight crew member to engage the engine's starter, and then to introduce fuel at the appropriate time. The fuel was then ignited (light-off), and the engine would begin to accelerate. When the engine reached self-sustaining speed,⁷ the engine's starter would disconnect and the flight crew would select the generator 'on', and the engine would be ready for normal operation.

An interrupted start occurs when, during the start sequence, prior to the engine reaching self-sustaining speed, power is lost or not supplied to the starter. When this occurs, the engine will begin to decelerate and fuel will continue to be sprayed into the combustion chamber of the engine, until the condition lever is moved into the 'fuel-off' position. From the available information, the left engine start was interrupted when the GPU was disconnected prematurely.

⁷ Gas-turbine rpm at which, during start cycle, external cranking (battery or GPU) is no longer needed.

Interrupted start

The steps normally taken to manage an interrupted start would be conducted from memory by the flight crew using the *interrupted start* procedure. The objective of the procedure was to prevent engine exceedances and subsequent damage (which can include a tailpipe fire). The required actions stopped fuel being fed to the engine removing its ignition source, and purged any residual fuel from the turbine and tailpipe area by motoring the engine.

Engine and tailpipe fires***Difference between engine and tailpipe fires***

There are two main types of fire associated with engines in the Saab 340B: an engine fire and a tailpipe fire. An engine fire is an external fire, outside of the engine casing. When this occurs the ENGINE FIRE warning is triggered, and the nacelle temperature rises. The appropriate crew action is to shut off the fuel supply, isolate the engine and, if necessary, discharge the nacelle fire extinguisher.

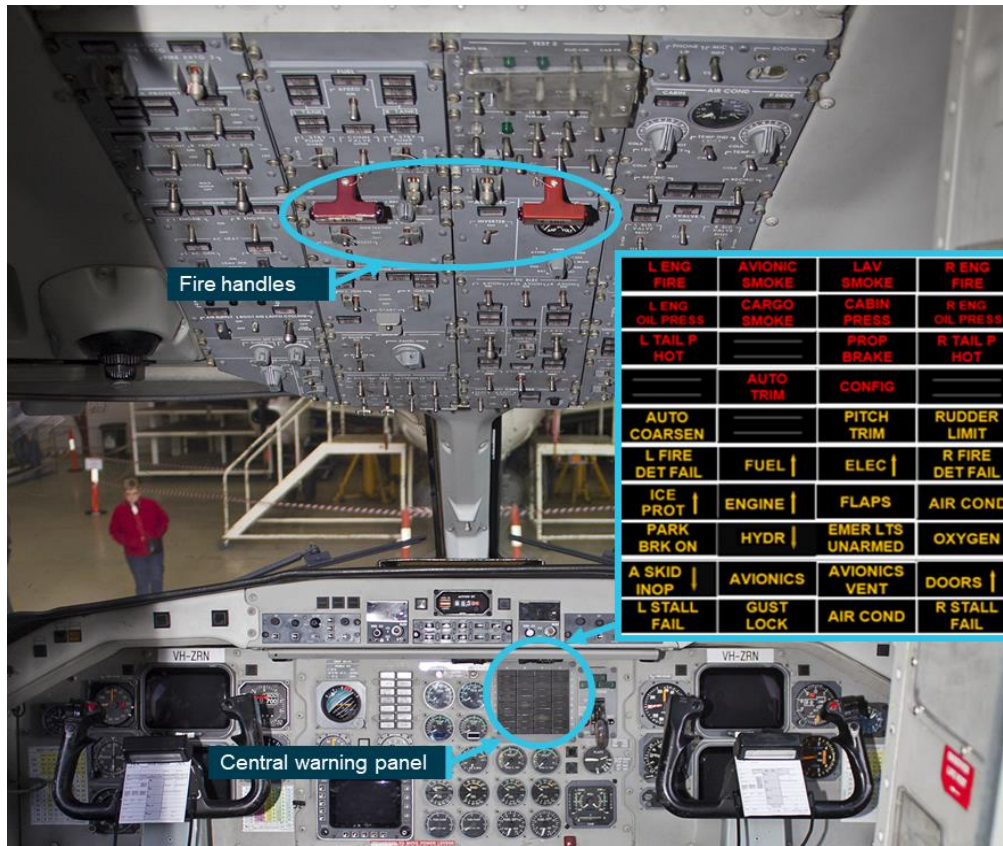
A tailpipe fire is an internal fire that is contained within the engine casing, usually when on the ground. It is due to an excess of fuel in the combustion chamber or in the turbine and may be associated with an engine that is not running (self-sustaining). It causes a rise in interstage turbine temperature (ITT) (which measures temperature inside the engine) but does not trigger a fire warning. It can be visually detected when the engines are in line of sight. The nacelle fire extinguishers cannot extinguish a tailpipe fire; ground fire extinguishers can be used if motoring (to purge residual fuel) does not extinguish the fire. A tailpipe overtemperature would be managed by reducing power on the affected engine.

Engine fire and tailpipe overtemperature detection

Engine fire detection was provided by a continuous loop detection circuit mounted under each engine, outside of the casing when the temperature reaches approximately 300 °C. Proximity of fire to this loop would change its characteristics and trigger multiple types of warnings in the flight deck. These warnings consisted of a fire bell, master warning lights, a caption for each engine on the central warning panel, and lights in the fire handle for the relevant engine (Figure 2).

Each engine also had tailpipe overtemperature sensors that triggered the master warning lights and a caption for each engine on the central warning panel (CWP) in the flight deck if the temperature in the tailpipe reached approximately 235 °C. The lights would extinguish after the temperature had reduced.

Figure 2: Saab 340B flight deck



Source: Bidgee (Wikimedia commons), annotated by the ATSB

Public address and intercom system

The public address and intercom system has multiple functions. It can be used to make a public announcement (PA) to the cabin from either the flight deck or flight attendant station and is also used for normal or emergency inter-crew communication between the flight crew and the flight attendant.

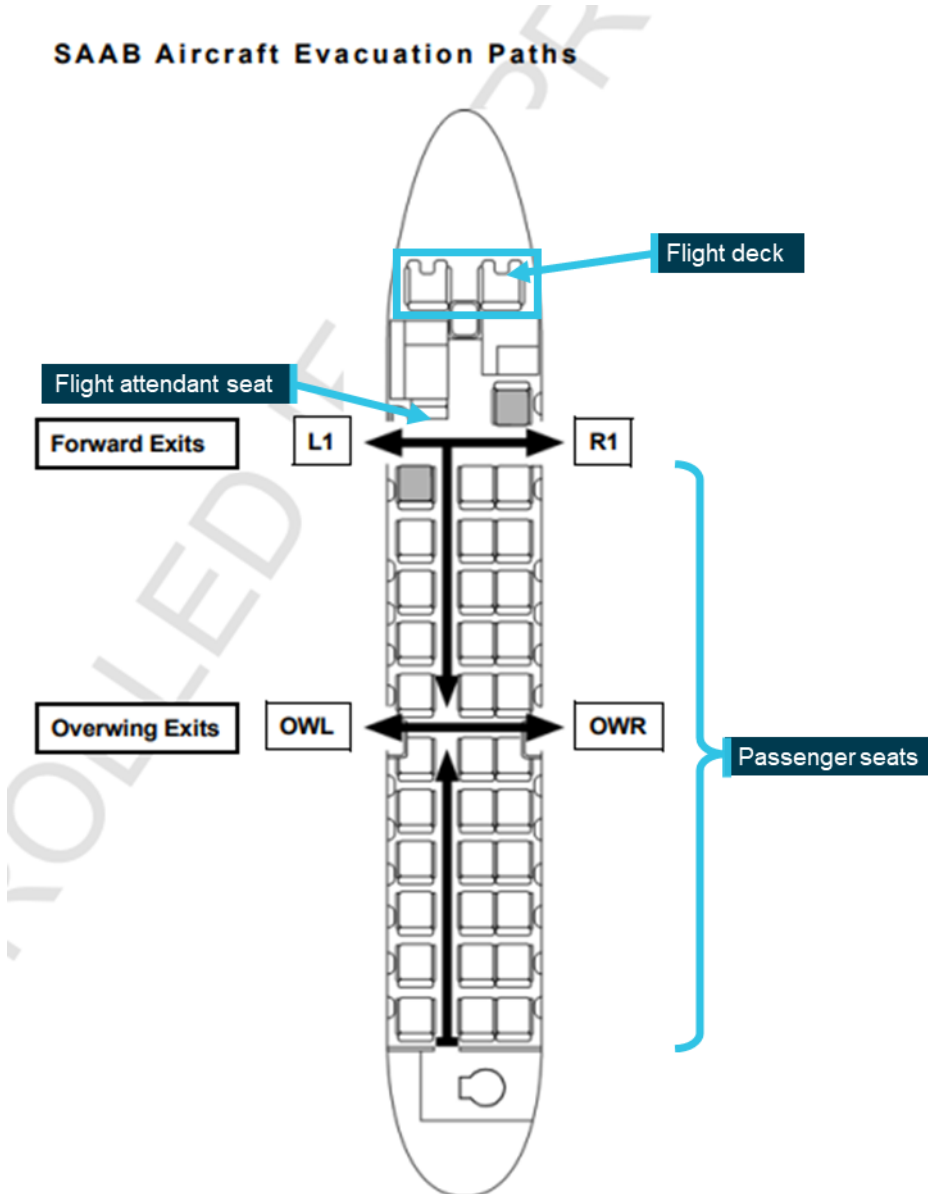
The air crew emergency manual stated that a PA from the flight deck will override those being made in the cabin. The aircraft manufacturer conducted testing of the public address system at the request of the ATSB. They reported passenger announcements are prioritised firstly by the flight crew, followed by flight attendants.

The testing also identified that if the emergency button was pressed in the flight deck while a PA was being made using the cabin interphone, aural and visual emergency indications would be present however the PA would not be interrupted.

Emergency exits

There are 4 emergency exits on the Saab 340 type aircraft. There are 2 exits at the front of the cabin in row 1, and 2 overwing exits in row 6. The sill height of the 2 forward exits is 1.68 m, with no emergency escape slides fitted (Figure 3).

Figure 3: Emergency exit locations



Source: Regional Express, annotated by the ATSB

The flight attendant was responsible for opening the 2 forward exits in an evacuation, one being the entry door, a type I exit at row 1 on the left side of the aircraft (L1), and a type II exit on the right side of the aircraft (R1). In contrast to L1, the R1 exit is not hinged and when operated for an evacuation will fall inwards and be discarded outside the aircraft (**Error! Reference source not found.**). The overwing exits in row 6 are type III exits (also referred to as self-help exits). These exits fall inwards when operated and must also be discarded outside the aircraft. The operator's procedures required that passengers in row 6 be briefed about exit use, with the expectation that they will be able to operate the exits in an evacuation when directed (see *Passengers seated in exit rows*).

The air crew emergency manual stated that all useable emergency exits must be used in an evacuation. It also stated that any evacuation requiring the utmost speed should be completed in 90 seconds. While an aircraft with less than 44 seats is not required to demonstrate evacuation

procedures during certification, the expectation for larger air transport aircraft is that an evacuation can be completed within 90 seconds, under simulated conditions, using only half the available exits.

For this occurrence, the evacuation, from when the evacuation announcement was made until all passengers and crew had evacuated, was completed in about 4 minutes utilising one of the 4 exits.

Figure 4: R1 emergency exit on the Saab 340B



Source: Melbourne Airport, annotated by the ATSB

Operational information

Flight crew procedures for interrupted start

Ground power units (GPU)

The flight crew operations manual (FCOM) outlined that ground power units are desirable for engine starts and are to be used whenever possible. A caution was included that the ground power switched must not be intentionally selected to 'off' during the start procedures. The manual further outlined if there were problems with the GPU during the start, then the interrupted start sequence procedures/checklists would need to be completed.

Interrupted start procedure

If the start sequence had been interrupted prior to light-off, the memory items required the crew move the condition lever to the 'fuel off' indent, the ignition switch to 'off' and the engine was required to be motored for at least 10 seconds, but no more than 30 seconds. If the start sequence had been interrupted after light-off, the engine was required to be motored until the ITT had reduced to less than 175 °C.

Engine fire procedures

Flight crew procedures

The air crew emergency manual stated:

A fire is classified as an emergency. If fire or smoke is observed outside the aircraft, or there is heat radiating from behind bulkheads or panels, the Captain must be advised immediately. Continual surveillance by air crew is essential at all times.

Fires managed by flight crew may include an engine fire... The Flight Attendant must be advised of the intended plan of action regardless of the type of fire.

In the event of an engine fire, the flight crew would undertake memory item actions. They included reducing the power lever to 20–30% torque, moving the condition lever to 'fuel off', pull either the left or right fire handle, and then discharge the fire bottle in that engine's nacelle with a switch adjacent to the handle. If an engine fire warning was still present 30 seconds after the first bottle was discharged, the flight crew could discharge a second fire bottle (located in the opposite engine's nacelle) by selecting the switch for the opposite engine. The extinguishing agent was discharged around the outside of the engine inside the nacelle.

The FCOM stated that memory items require an immediate crew response and therefore must be committed to memory. If an emergency or abnormal situation occurred and memory items was required, the pilot not flying (also referred to as pilot monitoring) would call the item and place their hand on the appropriate lever, switch and call the action to be taken. The pilot flying would confirm the item and then the pilot not flying would action it. The engine fire procedure was applicable when the aircraft was on the ground or airborne.

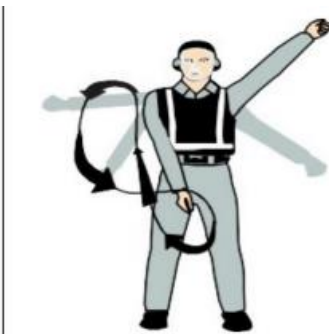
The Rex airport services manual included ground crew hand signals for fire (**Error! Reference source not found.**). The hand signals were derived from the International Civil Aviation Organization's Annex 2: Rules of the Air. The airport services manual was provided to Rex ground staff, but not to flight crew. These signals were taught to ground crew during their initial training only.

Figure 5: Hand signal for fire

Fire

Move right hand in a fanning motion from shoulder to knee, while at the same time pointing with left hand to area of fire.

Night signal, the same with wands.



Source: Regional Express

The Rex policy and procedures manual, referenced by flight crew, included the standard marshalling signals and a description for the hand signal for aircraft smoke, which was the same for fire, but no image was included. The flight crew recalled that they could not remember the signal for fire and had not covered it specifically in their training. The captain recalled learning the signal during their command upgrade through their own initiative and the FO learnt the signal in their previous employment.

Aviation Rescue Fire Fighting

The air crew emergency manual stated that in the case of an emergency situation, a national ARFF emergency frequency (131.0) was available for direct communication between the fire commander and flight crew. Before operating on the frequency, air traffic control must be advised.

The fire commander stated in interview that they initially do not respond directly to calls on the frequency. They are contacted by air traffic control and either placed on alert or the crash alarm is activated. The flight crew can then communicate with the fire commander. They also aim to respond within 3 minutes, and on the day of the occurrence arrived at the aircraft about 1 minute after being notified.

Failure management principles for flight crews

The FCOM included failure management principles if a malfunction occurred. It stipulated:

Prior to actioning any procedures ensure the malfunction is **positively identified** before any action is taken, and under no circumstances shall control of the aircraft be compromised. To ensure that the correct procedure/drill is performed the [Pilot Not Flying] will identify the malfunction and the [Pilot Flying] will **confirm the identification**. (Original emphasis included).

Confusion is often a problem area when conducting [Quick Reference Handbook] procedures. Checklist procedures must not be rushed. It is important crews conduct checklists in a careful and controlled manner.

Evacuation procedures

Flight crew procedures

The air crew emergency manual stated that if smoke is evident from the engines after start up and continues to produce increasing amounts of smoke after shutting down, the captain may order an emergency evacuation. During an emergency evacuation, depending on the location of the fire, smoke or heat, the captain may advise which exits are to be used.

Further, the manual stated that the captain is ultimately responsible for determining, in consultation with the FO, an appropriate course of action. The FO must therefore ensure that any actual or impending abnormality would be brought to the attention of the captain.

If the captain believed an evacuation was likely, they must command immediately using the PA system: 'This is the Captain. Flight Attendant to your station'.

After this PA, the flight crew must perform the relevant emergency procedures, including the appropriate evacuation checklist as required.

The quick reference handbook (QRH) also included additional information about conducting emergency evacuations:

When aircraft has come to a stop and parking brake set, [pilot in command] shall use all relevant sources – such as visual observations, external communication and [flight attendant] – in judging the situation quickly: Is emergency evacuation required or not? If in doubt, always perform emergency evacuation although high risk of injury.

Once the decision to evacuate had been made, a number of memory items for flight crew were to be completed as shown in Figure 6.

Figure 6: Flight crew emergency checklist

EMERGENCY EVACUATION	
Left Pilot	
1	Parking Brake SET
2	Condition Levers (both) FUEL OFF
3	"Evacuation" ORDER
4	Tower/Ground Crew NOTIFY
5	BAT switches (both) OFF
6	End of procedure.
Right Pilot	
1	Emergency Panel switches (all)..... ON
2	Fire Handles (both) PULL
3	FIRE EXTG switches (both)..... ON
4	End of procedure.

*The left pilot refers to the captain and the right pilot refers to the first officer.
Source: Regional Express.*

For the evacuation order, the air crew emergency manual explained there was a primary and secondary method to signal to the cabin that an evacuation was required. The primary method was via a PA to the cabin, stating 'This is the Captain, Evacuate! Evacuate!' and was used whenever possible. The secondary method, where the FASTEN SEATBELTS sign would be cycled twice to give 4 chimes was only to be used in 2 circumstances:

- it was known the public address system is unserviceable (and the flight attendant had been advised of this), or
- it became known the public address system had not worked correctly or had subsequently become unserviceable.

Once the emergency checklist items were completed and an evacuation commenced flight crew were required to undertake the duties detailed in Table 1 below.

Table 1: Flight crew duties in an evacuation

Captain’s duties	First Officer duties
Don his/her cap	1. Don his/her cap
Take the torch from the flight deck	2. Take the torch from the flight deck
Enter the cabin and assist with the evacuation, as per directions from the flight attendant	3. Take the flight deck fire extinguisher
Perform final cabin check shouting final commands	4. Exit through the first available exit
Exit aircraft through the first available exit	5. Once outside, check for fire and extinguish is necessary
Meet upwind of the aircraft with fellow crew members and passengers, and	6. Assist passengers on the ground as required, and
Account for all passengers	7. Ensure passengers remain grouped, proceed upwind from the aircraft and wait for fellow crew members

The FO was to exit the aircraft as soon as they entered the cabin, and would be the first crew member evacuating the aircraft and generally the first or one of the first occupants to evacuate. The flight attendant and captain would both exit once all the passengers had evacuated the aircraft.

Flight attendant duties in evacuations

The air crew emergency manual also detailed flight attendant duties during an evacuation. Key actions and commands to evacuate passengers relevant to the occurrence are detailed in Table 2. Flight attendants were required to review emergency procedures, including signals to the cabin from the flight crew, every 7 days.

Table 2: Flight attendant actions and commands

Key actions	Evacuation commands
Shout initial commands	Evacuate Evacuate Unfasten Seatbelts Leave Everything Behind Get Out Check Outside Conditions If Safe Open Exits
Check outside conditions	
Open usable exits/guard unusable exits	
Instruct passengers not to open unusable exits (if necessary)	
Shout exit commands	Hurry Come This Way
Shout evacuation commands	Sit and Jump Move Well Away
Evacuate passengers	
Check cabin	
Shout final commands	Evacuating
Exit aircraft through first available exit, move upwind of the aircraft and report to the first officer	

The flight attendant said in their interview they were halfway through providing the initial commands when the passengers were in front of the R1 exit so they stopped. They also recalled providing evacuation commands. On the Cockpit Voice Recorder (CVR), the flight attendant can be heard saying ‘evacuate evacuate’, ‘leave everything behind’ and ‘sit and jump’. In addition, they can also be heard to be encouraging passengers to sit, and to ‘go, go, go’.

Passengers seated in exit rows

Passengers seated in emergency exits were required to assist in the event of an emergency and are asked at both check-in and at boarding if they are willing and able to accept the responsibility. After boarding passengers seated in the exit rows are provided with a specific briefing about the actions they may be required to take. The briefing included: Only if you hear the command ‘Evacuate Evacuate’ should you take action.

First check outside conditions (point to exits) for fire, water or any other obstruction.

If conditions are not safe, or there is water over the wing, do not open the exit and move to your nearest usable exit.

If the exit is safe to open, push these seats forward as far as possible (point to 5A and 5C).

Remove the cover and pull down on the handle (point to cover).

Turn the exit on its side, throw it out and evacuate the aircraft.

You must follow Crew instructions at all times.

Once again, only if you hear the command evacuate should you take action.

Do you have any questions?

The flight attendant recalled in their interview they provided the standard exit briefing to the passengers in row 6 prior to departure. In an evacuation, in addition to the command to evacuate, the flight attendant was also required to shout initial commands that instruct passengers to check outside conditions and if safe open the exits. Based on interviews, the passengers in the exit row (row 6) and the CVR, passengers did not receive this instruction, nor were they advised that the left side exits were not available based on the captain’s instructions. In interviews, the passengers in the exit row recalled they considered opening the exit but assessed it was not necessary as they did not observe any ongoing hazards and did not feel the urgency to evacuate.

Flight crew and ground crew communication

Both flight crew and ground crew had radios. The operator advised that many of the airports they used, including Melbourne Airport, did not have access to the ground-to-air VHF frequency to enable radio communication between flight crew and ground crew. Some airports, such as Port Augusta, had the infrastructure to support access to the frequency, and ground crew in those locations could directly communicate with the flight crew by radio. In locations where flight crew and ground crew could not communicate directly, they had the option to use the network operations centre to relay information.

Ground crew involvement in emergency evacuation

The emergency evacuation checklist included an item for the left seat pilot (captain) to notify ground crew. There is no further detail included in the operator’s manuals about the method of contacting the ground crew and/or any specific instructions about the information that should be relayed. The operator advised that it would be at the captain’s discretion which method they would use to contact the ground crew and what information they would relay. In Rex’s air crew emergency manual, it stated that if time is critical, requiring flight crew to proceed to an airport that does not have ARFF services, they must request company ground staff to call for the local fire service. The Rex airport services manual included procedures for brake fires which stated ground

crew were to follow instructions from air crew and to keep people away from the wheels. However, the manual did not have details on ground crew involvement in evacuations or referred to the ground crew roles included in the air crew manual. Further, no evacuation awareness training was provided to ground crew. The operator advised that the ground crew were trained for their specific role and the only regulatory requirements were providing evacuation training for flight crew and cabin crew.

Guidance on ground crew involvement in evacuations

The International Civil Aviation Organization’s ground handling manual (2019) recommended that ground handling service providers train all relevant personnel in the functions there are to perform in an emergency, including the use of any emergency equipment and their obligations during an emergency evacuation. There was no regulatory requirement for this in Australia, however the Civil Aviation Safety Authority had published *Cabin safety bulletin 25- Emergency Evacuation and Occupant Survivability* that discussed the importance of procedures and training for flight crew, cabin crew, and ground crew in the event of an emergency evacuation. A number of previous investigations worldwide have discussed ground crew involvement in evacuations, as detailed in the related occurrences section below.

Related occurrences

A review of previous investigations in Australia and overseas found the following reports that discuss ground crew training are included in Table 3Table 3 below.

Table 3: Related investigations

Investigation number	Country	Summary	Ground crew actions	Relevant finding/safety actions
200302980	Australia	After landing, the pilot in command (PIC) observed a BRAKE TEMP advisory message and a fire ignited on the right wing landing gear. The PIC ordered an evacuation of the aircraft. As a result of the evacuation, one flight crew member and three passengers were seriously injured.	When the ground crew observed passengers congregating at the base of the slides, they acted on their own initiative and directed passengers away from the aircraft. Knowing that the fire had been extinguished, both of the ground engineers moved to the base of slide and, in an attempt to stop the evacuation, waved and called to the cabin crewmember attending that door.	There was no training provided to the ground staff for aircraft emergency evacuation situations at airport terminals.
200502137	Australia	During the starting of the right engine, the aircraft dispatcher informed the flight crew that there was smoke and sparks shooting from the right engine. The PIC called for an emergency evacuation. 11 passengers sustained minor injuries.	Ground crew assisted passengers during the evacuation and directed them towards the terminal. Several passengers exited and ran towards the edge of the apron without the knowledge of ground personnel.	None of the operator’s ground personnel present had been given any awareness education about policy or procedures during an aircraft evacuation at the terminal.

Investigation number	Country	Summary	Ground crew actions	Relevant finding/safety actions
			<p>One of the ground personnel assisting passengers tried to call out to the flight attendant to 'slow down' the flow of passengers as they had congregated at the end of the slides. However, he could not see the flight attendant and did not establish communication with her.</p>	
A13q0186	Canada	<p>A belt loader caught fire under the left aft cargo door and the smell of smoke entered the cabin. The captain ordered an evacuation. Seven passengers sustained minor injuries.</p>	<p>Ground crew helped the passengers coming down the evacuation slides. Passengers who found themselves on the apron without designated staff to help them wandered around looking for instructions and direction. Some employees reacted quickly by redirecting the wandering passengers towards the door leading to the boarding gate.</p>	<p>If ground crew on the apron are not trained to manage passengers following an evacuation, there is risk of injury both for evacuated passengers and ground crew.</p>
fqa130728	France	<p>A burnt smell was detected in the aircraft. In the cockpit, the first officer saw the message 'smoke rest upper door' with an aural warning. The chief flight attendant detected a smell of sulphur in the cabin. The captain decided to evacuate the aircraft. One passenger was injured.</p>	<p>The passengers evacuated by the slides were assisted by ground personnel and taken to the terminal.</p>	<p>Training of ground personnel in emergency evacuation.</p>

Safety analysis

Introduction

During the engine start, the ground power unit was disconnected prematurely. With the engine speed now slowing, burning fuel in the combustion chamber would have accumulated. This would have caused the increase in temperature inside the engine.

The captain commenced the interrupted engine start procedure, which involved motoring the engine (running the starter motor without supplying fuel).

However, during this process burning fuel was blown through the tailpipe, appearing as a plume of flame and smoke behind the engine. As the left propeller began to rotate during this motoring attempt, the marshaller (unaware of the motoring required by the procedure) mistakenly thought that the flight crew were attempting to restart the engine. Having observed the flame and smoke, the marshaller signalled to the flight crew, which prompted the captain to stop motoring the engine. Residual fuel would have continued to burn inside the engine.

After observing the interstage turbine temperature (ITT) increasing shortly after, the captain resumed motoring the engine. However, in response to continuing signals from ground crew indicating smoke and flames, and the rising ITT, the procedure was discontinued. The captain ordered an emergency evacuation. Two passengers sustained a minor injury during the evacuation.

The following sections discuss the crew decision-making and actions following the interrupted start and subsequent evacuation, as well as the operator's procedures and training.

Ground power unit disconnection

While the aircraft marshaller was observing the left engine start process, a second ground crew member disconnected the ground power unit (GPU) prior to a signal from the flight crew. Aircraft manufacturer and operator procedures stipulated that the GPU was to be disconnected from the aircraft after both engines had been started and the flight deck ground power switch was selected off. While there was no time pressure, the ground staff member recalled being preoccupied by the next aircraft they had to prepare for departure. The left engine had not reached self-sustaining speed, and as there was no longer power to the starter, the engine began to decelerate. Fuel continued to be sprayed into the hot engine until the condition lever was moved to the fuel 'off' position.

Contributing factor

A ground crew member disconnected the ground power unit without having been signalled to do so. This happened while the left engine was starting, which resulted in an interrupted engine start, and the initial development of an engine tailpipe fire.

Ground crew signals

The interrupted start would have been surprising to the flight crew, but the captain quickly deduced the reason for it and appropriately initiated the interrupted start procedure, which would cut the engine fuel supply to the combustion chamber, purge residual fuel from the turbine and tailpipe, reduce internal engine temperature, and prevent an ongoing tailpipe fire.

As described above, the purging of residual fuel would have generated a plume of flame and smoke. Upon noticing this, the marshaller attempted to communicate the problem to the flight crew.

With the flight crew and ground crew being unable to communicate directly using the radio at this location, the only recognised method of communication available was the use of hand signals. The hand signal for fire, documented in the operator’s airport manual, was to move the right hand in a fanning motion from shoulder to knee, while at the same time pointing with the left hand to the area of fire. The marshaller could not recall the hand signal for fire so used a ‘cut-throat’ gesture to signal to shut the engine down and mouthed ‘smoke’ and ‘flames’ to the flight crew while pointing to the left engine. Although the flight crew were able to interpret to some degree the ground crew’s gestures, the use of non-standard signals can increase the risk of miscommunication.

Other factor that increased risk

The marshaller used non-standard signals when communicating indications of fire to the flight crew.

The marshaller recalled they had learned the hand signals in their initial training, but had not reviewed them since. The captain also indicated they could not recall the hand signal for fire, while the first officer (FO) was aware of the signal, but from previous employment.

For many of the airports the operator used, there was no way for ground crew and flight crew to talk directly to each other for Saab 340 operations. For some, communication could get relayed via their network operations centre, but this would be inefficient during an emergency. As the hand signals were the only method to communicate emergencies between the flight and ground crew at many locations, it is important the signals are reviewed on a regular basis. However, the training received by ground crews was during initial training only and can be forgotten over time. The flight crews did not receive such training and while there was a description in their manual about the signal, there was no visual representation, increasing the risk of misinterpretation if the marshaller had used the correct signal.

Other factor that increased risk

Regional Express did not provide flight crew or ground crew recurrent training to review the hand signals required to communicate with each other, including those used in an emergency. (Safety issue)

Interrupted start procedure

In response to the plume of flame and smoke (generated by the engine being motored), the marshaller signalled to the flight crew with hand signals that included a ‘cut-throat’ gesture, which the captain understood as needing to stop the engine. In the absence of the marshaller being able to communicate that flame and smoke was being observed, the captain would not have known the reason for being signalled to stop the engine. In response, the captain stopped motoring the engine which meant that burning fuel remained in the engine, and probably in the tailpipe. Later, following discharge of the fire extinguisher bottle, additional flame and smoke came from the left engine tailpipe which indicated that the tailpipe fire had not yet been extinguished.

Contributing factor

After observing the marshaller's signals, the captain stopped motoring the engine. As a result, the fire was not extinguished.

Failure management and crew coordination

The operator had failure management principles that stipulated that prior to actioning any checklists, the malfunction must be positively identified. In this occurrence, these failure management procedures were not followed as the captain did not consult with the FO the nature of the problem and their intended course of action. This meant that the FO was ‘behind’ in terms of the actions that were being taken by the captain and they probably did not share the same understanding of the situation.

Had the captain included the FO in their management of the situation, there would have been an opportunity to review available information together, recognise the fire as an expected and manageable problem, and formulate a suitable plan. Instead, with limited information being used, and while under stress, the captain’s concern about the engine fire persisted and increased.

During the second motoring attempt, the ITT was observed to be high, which can indicate that a tailpipe fire was still present. There were no warnings in the flight deck relating to an engine fire or a tailpipe overtemperature, however the flight crew then carried out the required actions for an engine fire. The tailpipe fire would likely have been extinguished at some time during the second motoring attempt.

Throughout, the FO would have been largely reliant on their own observations to understand what was happening and therefore had limited opportunity to contribute. The FO reported they only became aware of the intent to evacuate once the captain had commenced the evacuation drill. This further limited the opportunity to involve the FO in identifying and managing the problem (also see *Evacuation order* below).

Contributing factor

The captain did not coordinate with the first officer their identification of, or response to, the interrupted engine start or the later fire signals from the marshaller. This limited the opportunity for the first officer to contribute to the identification and management of the ongoing situation.

Evacuation order

The marshaller was signalling to the flight crew they could observe fire and smoke, and this likely continued for a significant period of time. The captain also observed that the ITT was rising so decided to initiate the fire drill. The signals and rising ITT were the only sources of information used by the captain to evaluate the situation. The flight attendant was not asked whether they have or could observe any problems with the left engine, and there was no consultation with the FO about what information they understood at that time.

Instead, the captain reacted immediately to what they considered to be an emergency that could endanger passenger lives. Research has shown that people under stress refer to a fewer number of cues prior to making a decision (Wickens et al., 2022). An aircraft fire is a serious situation that needs a timely response, but there is always injury risk associated with an emergency evacuation. Without being able to speak directly with the marshaller, more communication and coordination with the FO and flight attendant might have led the captain to realise that some level of fire and smoke from the tailpipe was to be expected during motoring, and that the appropriate action would have been to continue motoring in accordance with the applicable procedure. Instead, the captain misunderstood the reason for the fire and overestimated its seriousness, leading to the decision to evacuate.

Contributing factor

Likely associated with increased stress and an escalating sense of urgency, the captain ordered an evacuation without having used all the available information to positively confirm the severity of the situation.

The captain initiated the evacuation without communicating this intent to the FO, who only became aware of the situation when the captain opened the flight deck door. It was not possible to establish whether the captain had commenced the evacuation drills prior to this, as there is no verbalisation recorded on the CVR of the initiation of the procedure or performance of the individual items, which included shutting down the engines. The captain later reported that they omitted to confirm 2 engine fire checklist items, relating to the power and condition levers, which was due to the stress at the time. These items were more likely to have been completed with FO involvement. If engines are not properly shut down when an evacuation is commenced, the risk of injury when exiting the aircraft is increased. Further, as the FO was initially not aware that an evacuation was going to occur, this delayed the completion of their evacuation drills and exiting of the aircraft where they needed to check for fire and assist passengers.

The initial method of communicating the evacuation was the chimes as the flight attendant was completing a PA. This method is a secondary method of communicating the evacuation. The primary method is to communicate using the public address system to prepare the flight attendant for their evacuation procedure. However, as the flight attendant was completing an announcement, the captain (incorrectly) believed they were unable to make an announcement.

Other factor that increased risk

Before ordering the evacuation, the captain did not communicate their intent to evacuate the aircraft to the first officer or call for flight deck evacuation drills. In addition, the captain initially did not use the primary method of commanding an evacuation (through the public address system).

Although likely familiar with the use of the seatbelt chime as an evacuation signal, the flight attendant did not recognise the chimes at the time as a signal to evacuate. Flight attendants are trained to listen for the seatbelt chime, but it is not usually associated with an emergency (unlike a siren for example) and may not gain a person’s attention if they are focusing on a task, such as completing the public address. As the flight attendant recalled, it is common to hear bells and chimes during flight preparation. This method of initiating an evacuation also does not directly convey the intended message in the same way that spoken communication does, so it may be misunderstood or overlooked. Further, as the operator’s procedure only required the use of the chimes when the public address system is unserviceable, and in that situation the flight attendant may be advised, it is even more unlikely that during this occurrence the flight attendant would react to the signal.

Other factor that increased risk

When the captain signalled to the cabin to evacuate (using 4 [seatbelt sign] chimes) the flight attendant did not recognise the signal and subsequently did not react to the command.

Passenger instructions

Once the captain ordered the evacuation, they informed the flight attendant to use the right side of the aircraft (due to the expected fire on the left side). While passengers evacuated the aircraft on the right side, only the R1 (front right) exit was used. The right side also has an overwing exit, but this exit was not used during the evacuation. Passengers are not well-drilled in emergency evacuations like flight attendants, and despite a pre-flight briefing of passengers in the exit rows about what to do if an evacuation was needed, flight attendant procedures include shouting commands to passengers in the exit row to check outside and open exits. The flight attendant can also provide instructions to passengers not to open unusable exits. These instructions were not provided by the flight attendant, and passengers at the exits in row 6 had decided among themselves not to open the exit, and instead followed the other passengers to the R1 exit. As a result, the evacuation took 4 minutes although an evacuation with larger aircraft with a full passenger load would be expected to be able to be completed from one side of the aircraft within 90 seconds. If there had been a larger developing fire at the time, the 4-minute evacuation could have had negative consequences for the people towards the end of the evacuation.

Other factor that increased risk

When ordered to evacuate, there were no instructions provided to passengers to direct them to use all the available exits. As a result, the passengers in the emergency exit row did not open a useable exit which delayed the evacuation of the aircraft.

Emergency response

After ordering an evacuation and advising the operator's duty officer, the captain tried to directly contact ARFF but was unsuccessful and only then contacted air traffic control (ATC). The ARFF advised that they do not respond directly to calls and their response is initiated through ATC. Not immediately communicating the situation to ATC can delay the arrival of emergency services to the aircraft, which in some circumstances can increase risk or severity of outcome.

Other factor that increased risk

The captain did not initially communicate the situation to air traffic control, which delayed the arrival of emergency services at the aircraft by about 2 minutes.

Passengers with cabin baggage

During the evacuation, several passengers attempted to retrieve their baggage as they exited the aircraft, with some passengers refusing to leave items behind. This occurred even though the passengers were commanded to leave everything behind. Given the nature of the incident and that passengers could not see a fire, they may have determined that they were not at risk or felt urgency. However, it has been well established through numerous previous evacuations (for instance, ATSB investigation [AO-2019-073](#)), that taking cabin baggage not only increases the risk of injury while evacuating but can also delay an evacuation. Delaying the evacuation affects the individual taking the bag and also puts others at risk. In a situation where there is a potential fire, exiting as expeditiously as possible is vital. This is why, when larger aircraft are certified they must prove that they can evacuate within 90 seconds as in the case of smoke and/or fire conditions can worsen rapidly.

Other factor that increased risk

Some passengers took cabin baggage during the evacuation, which increased the risk of injury and delaying the evacuation.

Ground crew role in evacuation

Ground crew had not been provided any awareness of what might occur in the event of an evacuation at an airport, however the flight crew's evacuation procedures included a checklist item to notify the ground crew in some circumstances and, in regional ports, there was an expectation that ground crew would initiate an emergency response.

While it was expected that the flight crew and flight attendant would complete an evacuation by themselves, ground crew, who are often in close proximity to an aircraft when at the airport, are in a position where they can potentially assist. More specifically this assistance could include helping passengers to evacuate safely from the emergency exits from outside the aircraft. In this case, had the ground crew been aware of the evacuation, they may have been in a position to assist the passenger who exited the aircraft prior to the FO, reducing the likelihood of injury.

The FO is the first crew member to exit the aircraft and they are required to check for fire and then assist passengers outside. They are also required to maintain control of the passengers, which for the Saab 340 can be up to 38 passengers (including infants), until the flight attendant and captain exit the aircraft or emergency services arrive. If an evacuation occurs at an airport, ground crew can also assist in maintaining passenger control once passengers have evacuated. Awareness of

what occurs in an evacuation is also important as their proximity to the aircraft can expose them to hazards, such as exits being discarded outside the aircraft.

Although evacuations are relatively rare and the likelihood of serious injuries or fatalities as a result of ground crew not assisting passengers is low, a number of previous investigations conducted in Australia and overseas have identified the importance of ground crew awareness of evacuations. Guidance available from the Civil Aviation Safety Authority and the International Civil Aviation Organization also recommend training for ground crew for evacuations. While it did not worsen the outcome in any way, ground crew being aware of what happens during an evacuation could be beneficial in other circumstances, particularly when they may be the only personnel around to assist such as in some regional locations.

Other factor that increased risk

While flight crew were required to notify ground crew of an aircraft evacuation in some situations, the operator did not provide awareness to ground crew on the actions to be taken in the event of an evacuation.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include ‘contributing factors’ and ‘other factors that increased risk’ (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition ‘other findings’ may be included to provide important information about topics other than safety factors.

Safety issues are highlighted in bold to emphasise their importance. A safety issue is a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the interrupted engine start and evacuation involving Saab 340B, VH-ZRK, at Melbourne Airport, Victoria, on 5 April 2022.

Contributing factors

- A ground crew member disconnected the ground power unit without having been signalled to do so. This happened while the left engine was starting, which resulted in an interrupted engine start, and the initial development of an engine tailpipe fire.
- After observing the marshaller's signals, the captain stopped motoring the engine. As a result, the fire was not extinguished.
- The captain did not coordinate with the first officer their identification of, or response to, the interrupted engine start or the later fire signals from the marshaller. This limited the opportunity for the first officer to contribute to the identification and management of the ongoing situation.
- Likely associated with increased stress and an escalating sense of urgency, the captain ordered an evacuation without having used all the available information to positively confirm the severity of the situation.

Other factors that increased risk

- The marshaller used non-standard signals when communicating indications of fire to the flight crew.
- **Regional Express did not provide flight crew or ground crew recurrent training to review the hand signals required to communicate with each other , including those used in an emergency.** (Safety issue)
- Before ordering the evacuation, the captain did not communicate their intent to evacuate the aircraft to the first officer or call for flight deck evacuation drills. In addition, the captain initially did not use the primary method of commanding an evacuation (through the public address system).
- When the captain signalled to the cabin to evacuate (using 4 [seatbelt sign] chimes) the flight attendant did not recognise the signal and subsequently did not react to the command.

- When ordered to evacuate, there were no instructions provided to passengers to direct them to use all the available exits. As a result, the passengers in the emergency exit row did not open a useable exit which delayed the evacuation of the aircraft.
- The captain did not initially communicate the situation to air traffic control, which delayed the arrival of emergency services at the aircraft by about 2 minutes.
- Some passengers took cabin baggage during the evacuation, which increased the risk of injury and delaying the evacuation.
- While flight crew were required to notify ground crew of an aircraft evacuation in some situations, the operator did not provide awareness to ground crew on the actions to be taken in the event of an evacuation.

Safety issues and actions

Central to the ATSB’s investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the aviation industry, the ATSB may issue a formal safety recommendation or safety advisory notice as part of the final report.

All of the directly involved parties are invited to provide submissions to this draft report. As part of that process, each organisation is asked to communicate what safety actions, if any, they have carried out or are planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions will be provided separately on the ATSB website on release of the final investigation report, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website after the release of the final report as further information about safety action comes to hand.

Flight and ground crew knowledge of ground signals

Safety issue description

Regional Express did not provide flight crew or ground crew recurrent training to review the hand signals required to communicate with each other, including those used in an emergency.

Issue number:	AO-2022-019-SI-01
Issue owner:	Regional Express
Transport function:	Aviation: Air transport
Current issue status:	Closed – Adequately addressed
Issue status justification:	The additional notices and training should improve knowledge retention of the correct hand signals among flight and ground crews.

Proactive safety action taken by Regional Express

Action number:	AO-2022-019-PSA-283
Action organisation:	Regional Express
Action status:	Closed

On 22 May 2022, Regional Express reported that the following action had been taken to address this safety issue.

- Airport Advisory AA46/2022 was released highlighting correct hand signals
- Airport Advisory AA47/2022 was released highlighting dispatch procedures
- Flight Crew Notice P23/22 was released highlighted marshalling signals
- A new computer-based training course was developed that included processes for 2-person dispatch, engine motoring identification and updated hand signals

- A hand signal poster has been designed and disseminated to various bases as a safety promotion initiative
- Review and alignment of hand signals in the Policy and Procedures Manual (PPM) and Airport Services Manual (ASM) has been completed.

In addition:

Regional Express developed a new hand signal to indicate an interrupted engine start which was included in face-to-face and computer-based training content.

General details

Occurrence details

Date and time:	05 April 2022 – 14:52 EST	
Occurrence class:	Serious incident	
Occurrence categories:	Fire, Emergency evacuation, Smoke	
Location:	Melbourne Aerodrome	
	Latitude: 37.6733° S	Longitude: 144.8433° E

Aircraft details

Manufacturer and model:	S.A.A.B. AIRCRAFT CO 340B	
Registration:	VH-ZRK	
Operator:	REGIONAL EXPRESS PTY LTD (REX)	
Serial number:	340B-397	
Type of operation:	Part 121 Australian air transport operations - Larger aeroplanes-Standard Part 121	
Activity:	Commercial air transport-Scheduled-Domestic	
Departure:	Melbourne Aerodrome	
Destination:	King Island Aerodrome	
Persons on board:	Crew – 3	Passengers – 23
Injuries:	Crew – 0	Passengers – 2 minor
Aircraft damage:	None	

Glossary

ARFF	Aviation Rescue and Fire-Fighting Service
ATC	Air Traffic Control
CCTV	Closed-circuit Television
CVR	Cockpit Voice Recorder
FCOM	Flight Crew Operations Manual
FO	First Officer
GPU	Ground Power Unit
ITT	Interstage Turbine Temperature
PA	Public announcement
QRH	Quick Reference Handbook
VHF	Very high frequency

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the captain, first officer, and flight attendant
- both ground crew
- Regional Express
- Saab
- General Electric
- Airservices Australia
- Melbourne Airport
- passengers.

References

International Civil Aviation Organization (2019) *Manual on Ground Handling* (Doc 10121), 1st edn, Quebec, Canada.

Wickens CD, Helton WS, Hollands JG, and Banbury S (2022) *Engineering psychology and human performance*, 5th edn, Routledge, doi: 10.4324/9781003177616.

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- captain, first officer, and flight attendant
- ground crew
- Regional Express
- Saab
- General Electric
- Civil Aviation Safety Authority.

Submissions were received from:

- Regional Express
- Saab.

The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.