



TSB Recommendation A08-02

Emergency fuel shut-off

The Transportation Safety Board of Canada recommends that the Department of Transport ensure that balloons carrying fare-paying passengers have an emergency fuel shut-off.

Air transportation safety investigation report	A07C0151
Date the recommendation was issued	27 March 2008
Date of the latest response	January 2023
Date of the latest assessment	March 2023
Rating of the latest response	Satisfactory in Part
File status	Closed

Summary of the occurrence

On 11 August 2007 at about 0908 central daylight time, a FireFly 12B hot air balloon, C-FNVM, attempted a landing in a field adjacent to Birds Hill Provincial Park near the northern outskirts of Winnipeg, Manitoba. The balloon was operated by Sundance Balloons International under a Special Flight Operations Certificate (SFOC) issued by Transport Canada (TC). One pilot and 11 passengers were on board, for a local sightseeing flight of about one hour's duration, originating in the southeast of Winnipeg and terminating in the northeast of Winnipeg.

The flight had been extended beyond Winnipeg as the pilot searched for a suitable landing area. The winds in the landing area were much stronger than anticipated, and the balloon touched down and skipped several times. The basket was dragged on its side for about 700 feet and tipped far enough for the burners to strike the ground. When the balloon stopped, a propane fuel leak occurred and an intense fire ensued before passenger evacuation was completed. The pilot and two passengers suffered serious injuries. Four other passengers suffered minor injuries, some with burns. Two of the propane tanks and a fire extinguisher canister exploded, and the balloon basket was destroyed. The fuel system was not equipped with an emergency shut-off valve.

On 27 March 2008, the Board released interim safety recommendations as part of its investigation (A07C0151) into this occurrence.

Rationale for the recommendation

While some commercial balloon operators in Canada have fare-paying passenger loads in the range of those of commuter and air taxi operators, their passengers are not assured of the same level of safety and oversight by regulations and standards. The inability to quickly shut off the fuel supply during landing or in an emergency increases the risk of a fire and/or explosion, compromising balloon passenger safety.

Therefore, the Board recommended that

the Department of Transport ensure that balloons carrying fare-paying passengers have an emergency fuel shut-off.

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Previous responses and assessments

June 2008: response from Transport Canada

To address the issue of the proposed emergency fuel shut-off for balloons carrying fare-paying passengers, TC is conducting a risk assessment to determine whether regulatory or non-regulatory solutions would be appropriate to address this issue. Once the review is complete, should regulatory changes be required, Notice of Proposed Amendments will be developed and submitted to the Canadian Aviation Regulation Advisory Council for consultation.

July 2008: TSB assessment of the response (Satisfactory Intent)

TC's response to the recommendation indicates that it intends to conduct a risk assessment and determine an appropriate means of addressing the issue of the proposed emergency fuel shut-off for balloons carrying fare-paying passengers. Once the review is complete, regulatory changes will be proposed should they be considered necessary. However, the Board believes that TC's proposed review and regulatory amendment process will not yield any specific course of action that, in the short term, would reduce or eliminate the deficiency identified in Board Recommendation A08-02.

The response is assessed as **Satisfactory Intent**.

January 2011: response from Transport Canada

The recommendation has been discussed at the November 2009 Canadian Aviation Regulation Advisory Council (CARAC) Technical Committee meeting. TC is considering the fuel shut-off valve recommendation and will conduct, as a next step, an early stakeholder consultation via mail survey for feedback prior to further development of a regulatory policy.

March 2011: TSB assessment of the response (Satisfactory Intent)

TC's response indicates that it continues to progress safety action that, if fully implemented, may address the deficiencies underlying Recommendation A08-02.

The response is assessed as **Satisfactory Intent**.

May 2011: response from Transport Canada

This remains an active project and is assigned a priority within the Transport Canada standards development process. Transport Canada is considering the fuel shut-off valve recommendations and will conduct, as a next step, an early stakeholder consultation prior to further development of a regulatory policy.

September 2011: response from Transport Canada

No change.

March 2012: response from Transport Canada

On 28 March 2012, TC submitted an update stating the following:

This remains an active project. By fall 2012 discussions will be held to review the project to decide on what the next steps will be.

March 2012: TSB assessment of the response (Satisfactory Intent)

In its 18 June 2008 response, TC had indicated that it was conducting a risk assessment to determine whether regulatory or non-regulatory solutions would be appropriate to address the deficiency identified in Recommendation A08-02. To date, TC has not provided the TSB with any information regarding the results of this risk assessment project or any decisions on how they plan to address the deficiency identified in Recommendation A08-02.

In its 21 January 2011 response, TC indicated that Recommendation A08-02 had been discussed at the November 2009 CARAC Technical Committee meeting. It then indicated that it would conduct, as a next step, an early stakeholder consultation via mail survey for feedback prior to further development of a regulatory policy. To date, TC has not provided the TSB with any information to indicate whether or not the planned survey has been conducted, or any survey results.

In its latest response, TC is vague as it simply indicates that addressing Recommendation A08 02 remains an active project. It then reiterates comments from last year's response, that as a next step, it will conduct an early stakeholder consultation. It does not indicate a timeframe as to when this stakeholder consultation will be taking place, nor does it provide any information regarding the other planned actions.

In an email dated 06 February 2012, TC stated the following:

The CARAC Working Group for Balloons with Fare-Paying Passengers will be submitting a final report containing the WG's recommendations at the fall 2012 CARAC Technical Committee meeting.

On 28 March 2012, TC submitted an update stating the following:

A Working Group meeting will be held in April/May 2012. The final report containing the Working Group recommendations are expected to be presented at the 2012 fall CARAC Technical Committee meeting.

The response is assessed as **Satisfactory Intent**.

December 2012: response from Transport Canada

TC will review the recommendations associated with balloon operations in early 2013 along with our past responses to determine what other steps can be taken.

March 2013: TSB assessment of the response (unable to assess)

TC did not provide details regarding the progress of the CARAC Working Group for Balloons with Fare-Paying Passengers and its recommendations expected to be presented at the fall 2012 CARAC Technical Committee meeting; nor has TC provided any indication of what recommendations it states it is continuing to consider. The Board is very concerned about the lack of concrete plans to address the underlying safety deficiency which supports this recommendation.

The response is considered as **Unable to Assess**.

November 2013: response from Transport Canada

Balloon accident statistics have been reviewed and analyzed. The findings of the analysis and the overall favourable safety record of balloon operators, indicate that the need for regulatory intervention to achieve higher levels of safety is not apparent. TC will not require that balloons carrying fare-paying passengers have an emergency fuel shut off given the practical and technical problems with the implementation of the recommendation. TC will continue to work cooperatively with the FAA, EASA and other authorities, as appropriate, in the ongoing development of design standards for aeronautical products. No additional regulatory or advisory material is planned at this time and no further updates will be provided.

April 2014: TSB assessment of the response (Unsatisfactory)

TC has now rejected the recommendation citing certain unspecified practical and technical problems with the implementation of the recommendation.

Therefore, TC's response is considered as **Unsatisfactory**.

December 2021: response from Transport Canada

Transport Canada (TC) agrees in principle with the recommendation.

At the time of the publication of the recommendation in 2007, TC committed to conduct a risk assessment and determine an appropriate means of addressing the issue of the proposed emergency fuel shut-off valves (FSOV) for balloons carrying fare-paying passengers.

In 2013, TC produced an issue paper for the Civil Aviation Regulatory Committee.¹ The purpose of the paper was to clarify TC's position with respect to mandating emergency fuel shut off valves in balloons carrying fare-paying passengers and to report on what other aviation authorities had concluded on this issue.

The issue paper recommended not implementing the TSB recommendation stating: "Given the overall favourable safety record of balloon operations in Canada, the need for regulatory intervention to achieve still higher levels of safety is not apparent. If the TSB recommendation to implement the emergency fuel shut-off valve were implemented, it is possible that additional failure modes may be introduced into the design that may negate the intended safety benefit."² The issue paper also included a review of other civil aviation authorities plans and noted that none were considering implementing a requirement for fuel shut off valves.

In 2014, the work to address this recommendation resulted in a Board assessment of "Unsatisfactory" and was assigned a "Dormant" status after given that "TC now rejected the recommendation, citing certain unspecified practical and technical problems with the implementation of the recommendation."

Since then, TC partnered with the Canadian Owners and Pilots Association and SmartPilot.ca to launch a General Aviation Safety Campaign (GASC) in 2017 to inform the general aviation community about how to fly safely. In June 2020, the GASC transitioned to the General Aviation Safety Program (GASP) and, as mentioned in our update for recommendation A08-01, safety enhancements have been accomplished by the GASP with respect to balloon operations since October 2020.

In November 2021, TC inspectors, including members of the GASP, met with the CBA to identify safety concerns in the commercial hot-air balloon sector. This resulted in drafting a preliminary list of potential projects moving forward which includes, working groups to establish industry best practices and regional coordination to encourage surveillance.

Finally, TC reviewed balloon accident statistics and found that there have been only 5 fatalities (all causes) over a 44-year period in Canada, during which an estimated 26,000 passengers were carried annually. The average balloon flight duration may be assumed to be about an hour. Therefore, the fatality rate may be calculated as 0.44 / 100,000 flight hours. Based on the above cursory review of the fatality rates associated with balloon operations in Canada, passenger carrying balloons are already achieving a safety record that outperforms general aviation (2.2 / 100,000) and commuter airline safety (1.2 / 1000,000). Further, balloon fatality rates approach

¹ Transport Canada (2013). Review of TSB Recommendation A08-02: Mandating Emergency Fuel Shut-Off Valves (FSOV) for Balloons with Fare-Paying Passengers. Issue Paper presented to the Civil Aviation Regulatory Committee. 28 June 2013. Available at RDIMS 8530483 v2.

² Ibid.

the very low rate of 0.4 / 100,000 flight hours observed for many years for the transport airplane operations³⁴.

TC concludes that the findings of the analysis and the overall favourable safety record of balloon operators indicated that the need for regulatory intervention to achieve higher levels of safety is not apparent and will not require that balloons carrying fare-paying passengers have an emergency FSOV, given the practical and technical problems with the implementation of the recommendation but will continue to actively engage with the balloon community to achieve the highest level of safety.

March 2022: TSB assessment of the response (Unsatisfactory)

In its latest response, Transport Canada (TC) indicated that it agrees in principle with the recommendation but maintains that, given the practical and technical problems with the implementation of emergency fuel shut-off valves (FSOVs), it will not require passenger-carrying balloon operators to install emergency FSOVs. Alternatively, TC stated it will continue to engage with the balloon community and establish working groups to develop industry best practices and regional coordination to encourage surveillance.

While the Board supports ongoing engagement between TC and industry stakeholders with the intent of advancing safety, it remains concerned about the lack of any concrete interventions, action plans and timelines to reduce the risks associated with the safety deficiency identified in the recommendation. In comparison, the Australian Civil Aviation Safety Authority (CASA) issued an updated Advisory Circular (AC 131-01 v2.0)⁵ in November 2020 on manned free balloons, providing guidance and acceptable means of compliance for operators. The AC includes a section on quick shut-off valves.

The AC was issued following an investigation by the Australian Transport Safety Bureau (ATSB) into an in-flight fire involving a hot air balloon with 15 passengers on board on 26 December 2018.⁶ The balloon crash landed and was destroyed by the fire and one of the passengers sustained a minor injury.

The ATSB found that the in-flight fire was the result of a fuel leak at the front left burner. [...] The hand-wheel valve on the liquid outlet of the fuel tank and the

³ Transport Canada (2010). Issue Paper - Regulation of Balloons with Fare Paying Passengers. Available at: RDIMS 5154209

⁴ Transport Canada (2013). Review of TSB Recommendation A08-02: Mandating Emergency Fuel Shut-Off Valves (FSOV) for Balloons with Fare-Paying Passengers. Issue Paper presented to the Civil Aviation Regulatory Committee. 28 June 2013. Available at RDIMS 8530483 v2.

⁵ Australian Government, Civil Aviation Safety Authority (CASA), Advisory Circular AC 131-01 v2.0, *Manned free balloon – Continuing airworthiness*. (November 2020), at <https://www.casa.gov.au/sites/default/files/2021-08/advisory-circular-131-01-manned-free-balloons-airworthiness-and-operations.pdf> (last accessed on 20 January 2022).

⁶ Australian Transportation Safety Bureau (ATSB), AO-2019-001, *In-flight fire involving Kavanagh B-350 hot air balloon VH-ZYO* (28 June 2019), at https://www.atsb.gov.au/media/5776515/ao-2019-001_final.pdf (last accessed on 20 January 2022).

pilot burners were not shut off, which resulted in the pilot being unable to control the fire. Installation of a 90-degree valve on the liquid fuel outlet increases survivability in the event of fire and, may have assisted the pilot to recognize that the liquid fuel valve was not shut off.⁷

The key safety message of the investigation was the following: “In the event of an in-flight balloon fire, the first priority is isolation of the fuel supply at the fuel tank. [...]”⁸

Similarly, the European Union Aviation Safety Agency (EASA) issued a Safety Information Bulletin on 06 September 2018⁹ on the use of valves on liquid gas cylinders in balloon operations. In this bulletin, EASA underscored that in-service experience, as well as results of investigations of severe accidents with fatal injuries due to the outbreak of fire, have shown that an easy and quick shut-off of the main liquid gas outlet increases survivability.¹⁰

The EASA recommended “operators of hot air balloons to use already existing approved valves for propane fuel cylinders, for commercial and non-commercial balloon operations.”¹¹ The EASA further recommended “operators to include the emergency use of these valves in the pre-flight briefing of passengers.”¹²

Lastly, while the number and rate of fatalities in Canada over a 44-year period provided by TC are very low, they do not provide a contextualized level of risk of the safety deficiency and do not consider the number of injuries and severity thereof. The TSB reviewed data from its Aviation Safety Information System from 01 January 1990 to 10 January 2022 and noted there were 84 occurrences in Canada involving balloons. In over 50% (43) of these occurrences, fatalities and injuries occurred. There were 4 fatalities (between 2001 and 2013), 49 serious injuries, and 37 minor injuries.

TC’s response does not contain sufficient detail and the Board is uncertain as to how the risks associated with the safety deficiency identified in Recommendation A08-02 will be addressed.

Therefore, the response to Recommendation A08-02 is assessed as **Unsatisfactory**.

⁷ Ibid.

⁸ Ibid.

⁹ European Union Aviation Safety Agency (EASA), Safety Information Bulletin SIB 2018-14, *Use of Quarter-Turn Ball Valves on Liquid Gas Cylinders in Balloon Operations* (06 September 2018), at <https://ad.easa.europa.eu/ad/2018-14> (last accessed on 20 January 2022).

¹⁰ Ibid.

¹¹ Ibid.

¹² Ibid.

Latest response and assessment

January 2023: response from Transport Canada

Transport Canada (TC) agrees in principle with the recommendation.¹³

At the time of the publication of the recommendation in 2007, Transport Canada (TC) committed to conduct a risk assessment to determine an appropriate means of addressing the issue of the proposed emergency fuel shut-off valves (FSOV) for balloons carrying fare-paying passengers.

In 2013, TC produced an issue paper for the Civil Aviation Regulatory Committee¹⁴. The purpose of the paper was to clarify TC's position with respect to mandating emergency fuel shut off valves in balloons carrying fare-paying passengers and to report on what other aviation authorities had concluded on this issue.

The issue paper recommended not implementing the TSB recommendation stating: "Given the overall favourable safety record of balloon operations in Canada, the need for regulatory intervention to achieve still higher levels of safety is not apparent. If the TSB recommendation to implement the emergency fuel shut-off valve were implemented, it is possible that additional failure modes may be introduced into the design that may negate the intended safety benefit."¹⁵ The issue paper also included a review of other civil aviation authorities plans and noted that none were considering implementing a requirement for fuel shut off valves.

In 2014, the work to address this recommendation resulted in a Board assessment of "Unsatisfactory" and was assigned a "Dormant" status given that "TC now rejected the recommendation, citing certain unspecified practical and technical problems with the implementation of the recommendation."

Since the previous update in December 2021, TC has reviewed the safety measures from other civil aviation authorities in countries where significant commercial ballooning activities exist, specifically the Australian Civil Aviation Safety Authority (CASA) and the European Union Aviation Safety Agency (EASA). These authorities did not mandate the installation of quarter-turn shut-off valves through an Airworthiness Directive action or regulatory change. Both agencies have published advisory documentation encouraging balloon operators to voluntarily refit existing installations with quarter-turn quick shut-off valves. For example, EASA published

¹³ All responses are those of the stakeholders to the TSB in written communications and are reproduced in full. The TSB corrects typographical errors in the material it reproduces without indication but uses brackets [] to show other changes or to show that part of the response was omitted because it was not pertinent.

¹⁴ Transport Canada (2013). Review of TSB Recommendation A08-02: Mandating Emergency Fuel Shut-Off Valves (FSOV) for Balloons with Fare-Paying Passengers. Issue Paper presented to the Civil Aviation Regulatory Committee. 28 June 2013. Available at RDIMS 8530483 v2.

¹⁵ Ibid.

a Safety Information Bulletin¹⁶ stating that “[a]t this time, the safety concern described in this SIB is not considered to be an unsafe condition that would warrant Airworthiness Directive (AD) action under Regulation (EU) 748/2012, Part 21.A.3B.”

Similarly, in 2023, TC is exploring different options for publishing advisory information, such as an advisory circular, to encourage voluntary equipment.

March 2023: TSB assessment of the response (Satisfactory in Part)

In its latest response, Transport Canada (TC) indicated that it agrees in principle with the recommendation and that it is looking at different options for publishing advisory information to encourage voluntary equipment in passenger-carrying balloons.

Since the issuance of the recommendation in March 2008 and following a previous risk assessment, working group recommendations, the presentation of an issue paper to the Civil Aviation Regulatory Committee, and consultation with industry stakeholders, TC has concluded through the years that the need for regulatory intervention to achieve higher levels of safety is not apparent, and TC will therefore not require that balloons carrying fare-paying passengers have emergency fuel shut-off valves (FSOV). That said, TC will continue to actively engage with the balloon community to achieve the highest level of safety.

In November 2021, TC inspectors, including members of TC’s General Aviation Safety Program, met with the Canadian Balloon Association to identify safety concerns in the commercial hot-air balloon sector. This resulted in a preliminary list of potential projects moving forward, which includes working groups to establish industry best practices and regional coordination to encourage surveillance.

Furthermore, since its update in December 2021, TC has reviewed the safety measures from other civil aviation authorities in countries where significant commercial ballooning activities exist, specifically the Australian Civil Aviation Safety Authority (CASA) and the European Union Aviation Safety Agency (EASA). According to TC, while CASA and EASA have published advisory documentation encouraging balloon operators to voluntarily refit existing installations with quarter-turn quick shut-off valves, these authorities did not mandate the installation of the valves.

There are no indications that the safety deficiency identified has been eliminated and TC does not intend to require the mandatory installation of fuel shut-off valves for balloons but will encourage their voluntary use. Therefore, the Board considers the response to Recommendation A08-02 to be **Satisfactory in Part**.

¹⁶ European Union Aviation Safety Agency (EASA) (2018). Safety Information Bulletin (SIB) No. 2018-14 – Use of Quarter-Turn Ball Valves on Liquid Gas Cylinders in Balloon Operations. Available at: <https://ad.easa.europa.eu/ad/2018-14>

File status

This deficiency file is **Closed**.