



REASSESSMENT OF THE RESPONSE TO TSB RECOMMENDATION A93-12

Helicopter slinging equipment

Background

On 24 August 1992, a Trans North Turbo Air Ltd. McDonnell Douglas 369D (Helicopter), contracted by an exploration company to support geophysical and diamond drilling operations, was conducting slinging operations in the vicinity of Exeter Lake, Northwest Territories.

The pilot had released a sling load of diamond drill rods at a new drill site. During the eight-mile return flight to the old drill site, with an unweighted sling assembly trailing, the helicopter broke up in flight. The helicopter burned on impact and the pilot sustained fatal injuries. The Transportation Safety Board of Canada determined that the helicopter broke up in flight when the speed of the aircraft and length of the unweighted lanyard/sling permitted contact of the sling with the tail rotor.

Slinging operations in Canada are, for the most part, unregulated. Air Navigation Order (ANO), Series VII, No. 6, prescribes the standards and procedures for rotorcraft operators; there is no reference to slinging operations. Slinging procedures or guidelines are not required in company operations manuals, nor are flight or ground crew required to undergo slinging training and proficiency checks. Airworthiness requirements, such as behavioral characteristics in flight, have not necessarily been a consideration in the design or intended use of this slinging equipment.

Despite educational initiatives to reduce the incidence of helicopter rotor/sling strikes, helicopter accidents involving empty slinging equipment continue.

The Board concluded its investigation and released Aviation Investigation Report A92W0177 on 21 July 1993.

TSB Recommendation A93-12 (July 1993)

Since 1976, there have been 15 reported helicopter accidents resulting from tail rotor damage caused by contact with slings. These accidents resulted in five fatalities, four serious injuries, and in most cases, substantial aircraft damage. Seven of the accidents involved flights with an intentionally empty, unweighted sling, even though the helicopter community recognizes this to be a hazardous practice. Eight accidents resulted when loads separated from the sling during transit, causing the now-empty sling to stream aft into the tail rotor.

Over the years, there have been several initiatives to reduce the incidence of helicopter rotor/sling strikes. Transport Canada (TC) has produced an educational video on slinging, has published numerous articles in its “Vortex” newsletter on unsafe equipment and practices in helicopter operations, and is currently working on regulations to cover the operational requirements for slinging. As recently as May 1992, Bell Helicopter Textron re-issued an Operations Safety Notice to caution owners and operators of helicopters that “flights with unloaded cables extending from helicopters must not be performed.” Notwithstanding these measures, the use of unsafe slinging equipment in an unsafe manner continues.

Supplemental equipment in the aviation industry is normally designed and tested in accordance with Technical Standard Orders (TSO), or is type-approved under a Supplemental Type Certificate (STC). At present, helicopter slinging equipment is considered to be part of the load rather than the aircraft; therefore, it has not been subjected to a TSO or STC approval process.

Discussions with suppliers of helicopter slinging equipment revealed that most slings and associated hardware have been designed to the same standards used for the construction industry. Airworthiness requirements, such as behavioural characteristics in flight, have not necessarily been a consideration in the design or intended use of this slinging equipment.

In view of the continuing incidence of helicopter accidents resulting from empty slinging equipment coming into contact with helicopter rotors, the Board recommends that:

The Department of Transport coordinate the development and implementation of airworthiness standards and operational limitations for helicopter slinging equipment.

TSB Recommendation A93-12

Transport Canada’s response to Recommendation A93-12 (November 1993)

Transport Canada Aviation (TC) recognizes that the consequences of any mistake in slinging operations can be very serious, and therefore supports the Board’s efforts in finding the best possible solution to reduce these types of occurrences.

The TSB accident analysis implies that the publication of a TSO standard and the issue of airworthiness approvals and operational limitations for sling equipment could eliminate the cause or reduce the number of accidents that occur during external load operations. However, the TSB report has not taken into account the many variables (such as the number of rotorcraft types, the variety of sling equipment, types of loads and operations), which could make the solution of the problem complex, time consuming and very costly (extensive flight testing could be required). It is felt that better results can be obtained by requiring through the new Order dealing with external load operations that company Operations Manuals contain instructions about the type of equipment to be used for a specific operation, i.e. sling length, material, size, storage instructions, inspection schedules and procedures, etc.

One of the tasks of the Transport Canada Regulatory Renewal Project is to develop Aerial Work Regulations which will include operational standards and procedures related to rotorcraft external (sling) load operations. It is intended that the regulations will include a requirement for a company Operations Manual to include the information mentioned in the foregoing and an outline of crew training.

Transport Canada participates in the Rotorcraft Subcommittee of the U.S. Federal Aviation Administration's (FAA) Aviation Rulemaking Advisory Committee (ARAC), which has prepared draft rulemaking and advisory material for helicopter external load carriage. TC will comment on the draft Advisory Circular with a view to adopting its contents.

TSB assessment of Transport Canada's response to Recommendation A93-12 (January 1994)

The TC response supports the intent of the recommendation, which is to reduce the incidence of accidents involving empty slinging equipment. However, they believe that the solution implied by the TSB recommendation would be complex, time consuming and costly. TC feels that better results can be obtained through a proposed new order dealing with slinging operations requiring company operations manuals to include instructions on the type of equipment to be used for specific operations, procedures, equipment inspection and maintenance.

In the development of Recommendation A93-12, the staff reviewed a draft copy of the proposed Rotorcraft External Load Operations Order (ANO Series VII, No. 9) to which the TC reply refers. It was the view of several rotorcraft-experienced TSB pilots that the new order was very general in content and did not address any aspect of the slinging equipment below the attachment hook on the aircraft. Based on previous observations of how general guidelines in ANOs can be loosely interpreted in company operation manuals (e.g. the Board's Recommendation A93-11 dealing with the "misuse" of duty and flight time limitations) it was felt that a focus on the design and limitations of the slinging equipment would be the better approach for corrective action.

It is recognized that it would not be practical to expect TC to flight test every configuration of slinging equipment. However, if TC only provides general guidelines on the slinging equipment requirements (i.e. length, weight, type, etc.), non-standard and make-do equipment and procedures will likely continue to be used in field environments. Perhaps, Recommendation A93-12 will alter TC's approach to the amount of detail required on equipment design and limitations to be included in operations manuals under the proposed ANO. However, staff are concerned that in the absence of more stringent equipment requirements, slinging occurrences will continue.

The staff support implementing the new order on slinging operations; however, it remains to be seen if the content will effectively address deficiencies associated with the actual slinging equipment.

Therefore, the response to Recommendation A93-12 is assessed as **Satisfactory in Part**.

TSB reassessment of Recommendation A93-12 (November 1996)

Transport Canada's response was to issue CARs 702 and 722 which would require the operations manual to highlight external load procedures and pilot training to include unweighted slings. Transport Canada believes that airworthiness and standards for such equipment would be inappropriate.

Therefore, the response to Recommendation A93-12 is assessed as **Satisfactory Intent**.

TSB reassessment of the response to Recommendation A93-12 (November 1997)

While CAR 722.21 requires that the Operations Manual contain information regarding operational requirements and procedures for slinging external loads. Transport Canada considers airworthiness approval of slinging equipment to be inappropriate.

Therefore, the response to Recommendation A93-12 is assessed as **Satisfactory in Part**.

As such, **Further Action is Unwarranted** with respect to A93-12 and the status is set to **Inactive**.

TSB review of Recommendation A93-12 deficiency file status (April 2014)

The Board requested that A93-12 be reviewed to determine if the deficiency file status was appropriate. After an initial evaluation, it was determined that the safety deficiency addressed by Recommendation A93-12 needed to be reassessed.

A request for further information was sent to Transport Canada and a reassessment will be conducted upon receipt of Transport Canada's response.

Therefore, the assessment remains as **Satisfactory in Part**.

Consequently, the status of Recommendation A93-12 is changed to **Active**.

Transport Canada's response to Recommendation A93-12 (October 2017)

TC agrees with this recommendation.

This item has been addressed in the CARs Part VII, Section 702 Aerial Work, as well as Chapter 527.865 of the Airworthiness Manual external loads for normal category helicopters and Chapter 529.865 of the Airworthiness Manual for transport category helicopters. These standards state the certification basis for helicopters equipped with external slinging capabilities. TC has published a video, titled "Keep your Eyes on the Hook! Helicopter External Load Operations-Ground Crew Safety", as well as articles in TC's safety publications such as the former Aviation Safety Vortex newsletter.

Specifically, CAR 702.45 states:

No air operator shall operate an aircraft carrying an external load unless the attachment device is authorized in a supplemental type certificate or in an airworthiness approval relating to the operational configuration of the aircraft.

Chapter 527.865 of the Airworthiness Manual provides the engineering guidance and standards pertaining to external loads, attachment points, and safety-related capabilities.

1. (a) [It must be shown by analysis, test, or both, that the rotorcraft external load attaching means for rotorcraft-load combinations to be used for non-human external cargo applications can withstand a limit static load equal to 2.5, or some lower load factor approved under 527.337 through 527.341, multiplied by the maximum external load for which authorization is requested. It must be shown by analysis, test, or both that the rotorcraft external load attaching means and corresponding personnel carrying device system for rotorcraft-load combinations to be used for human external cargo applications can withstand a limit static load

equal to 3.5 or some lower load factor, not less than 2.5, approved under 527.337 through 527.341, multiplied by the maximum external load for which authorization is requested. The load for any rotorcraft-load combination class, for any external cargo type, must be applied in the vertical direction. For jettisonable external loads of any applicable external cargo type, the load must also be applied in any direction making the maximum angle with the vertical that can be achieved in service but not less than 30°. However, the 30° angle may be reduced to a lesser angle if:]

1. (1) An operating limitation is established limiting external load operations to such angles for which compliance with this paragraph has been shown; or
 2. (2) It is shown that the lesser angle can not be exceeded in service.
2. (b) [The external load attaching means, for jettisonable rotorcraft-load combinations, must include a quick-release system to enable the pilot to release the external load quickly during flight. The quick-release system must consist of a primary quick release subsystem and a backup quick release subsystem that are isolated from one another. The quick-release system, and the means by which it is controlled, must comply with the following:
1. (1) [A control for the primary quick release subsystem must be installed either on one of the pilot's primary controls or in an equivalently accessible location and must be designed and located so that it may be operated by either the pilot or a crew member without hazardously limiting the ability to control the rotorcraft during an emergency situation.
 2. (2) [A control for the backup quick release subsystem, readily accessible to either the pilot or another crewmember, must be provided.
 3. (3) [Both the primary and backup quick release subsystems must:
 1. [(i) Be reliable, durable, and function properly with all external loads up to and including the maximum external limit load for which authorization is requested.
 2. [(ii) Be protected against electromagnetic interference (EMI) from external and internal sources and against lightning to prevent inadvertent load release.
 1. [(A) The minimum level of protection required for jettisonable rotorcraft-load combinations used for non-human external cargo is a radio frequency field strength of 20 volts per metre.
 2. [(B) The minimum level of protection required for jettisonable rotorcraft-load combinations used for human external cargo is a radio frequency field strength of 200 volts per metre.
 3. [(iii) Be protected against any failure that could be induced by a failure mode of any other electrical or mechanical rotorcraft system.
3. (c) [For rotorcraft-load combinations to be used for human external cargo applications, the rotorcraft must:

1. [(1) For jettisonable external loads, have a quick-release system that meets the requirements of paragraph (b) of this section and that:
 1. [(i) Provides a dual actuation device for the primary quick release subsystem, and
 2. [(ii) Provides a separate dual actuation device for the backup quick release subsystem;
2. [(2) Have a reliable, approved personnel carrying device system that has the structural capability and personnel safety features essential for external occupant safety;
3. [(3) Have placards and markings at all appropriate locations that clearly state the essential system operating instructions and, for the personnel carrying device system, the ingress and egress instructions;
4. [(4) Have equipment to allow direct intercommunication among required crew members and external occupants; and
5. [(5) Have the appropriate limitations and procedures incorporated in the flight manual for conducting human external cargo operations.
4. (d) [The critically configured jettisonable external loads must be shown by a combination of analysis, ground tests, and flight tests to be both transportable and releasable throughout the approved operational envelope without hazard to the rotorcraft during normal flight conditions. In addition, these external loads must be shown to be releasable without hazard to the rotorcraft during emergency flight conditions.]
5. (e) A placard or marking must be installed next to the external-load attaching means clearly stating any operational limitations and the maximum authorized external load as demonstrated under 527.25 and this section.
6. (f) The fatigue evaluation of 527.571 of this chapter does not apply to rotorcraft-load combinations to be used for non-human external cargo except for the failure of critical structural elements that would result in a hazard to the rotorcraft. For rotorcraft-load combinations to be used for human external cargo, the fatigue evaluation of 527.571 of this chapter applies to the entire quick release and personnel carrying device structural systems and their attachments.]

Part VII of the CARs provides the operating rules while Part V provides the technical guidance to assure the capabilities of the equipment are not exceeded. TC believe this Recommendation has been fully addressed in the CARs.

TSB reassessment of Transport Canada's response to Recommendation A93-12 (March 2018)

TC has taken a number of actions to address the safety deficiency identified in Recommendation A93-12, regarding the development and implementation of airworthiness standards and operational limitations for helicopter slinging equipment. These include the following:

- The production of educational material, including a safety video and safety publications on helicopters carrying external loads;

- The adoption of new regulations under *Canadian Aviation Regulations* (CARs) subparts 702 and 703. For helicopter operators operating under these subparts, operations manuals must now include external load requirement and procedures, and outline pilot training requirements for carrying slings;
- The adoption of CARs 702.45 – External Load Equipment, under which aerial work operators cannot carry an external load unless authorized to do so by a supplemental type certificate or an airworthiness approval;
- The adoption of CARs Standard 722.21 – Helicopter Class D External Loads, under which TC issued standards for operating a Class D helicopter while carrying external loads; and
- The publication of Chapters 527.865 and 529.865 of the Airworthiness Manual – External Loads, under which TC issued airworthiness standards, operational limitations and guidelines for external loads, attachment points, and safety-related capabilities for helicopter. These chapters also outline the certification requirements for helicopters with external slinging capabilities.

The Board considers that the actions taken by TC have substantially reduced the risks associated with the safety deficiency identified in Recommendation A93-12.

Therefore, the Board considers the response to Recommendation A93-12 to be **Fully Satisfactory**.

Next TSB action

This deficiency file is **Closed**.