CANADIAN FORCES
FLIGHT SAFETY INVESTIGATION REPORT (FSIR)

FINAL REPORT

FILE NUMBER: 1010-C-FUMC SAR Tech Fouled Parachute (DFS 2-3-2)

FSOMS: 138359

DATE OF REPORT: 10 March 2014

AIRCRAFT TYPE: Shorts Skyvan

DATE/TIME: 08 1720Z May 2009

LOCATION: Comox Lake, BC

CATEGORY: "D" Category Incident

This report was produced under authority of the Minister of National Defence (MND) pursuant to section 4.2 of the Aeronautics Act, and in accordance with A-GA-135-001/AA-001, Flight Safety for the Canadian Forces.

With the exception of Part 1, the contents of this report shall only be used for the purpose of accident prevention. This report was released to the public under the authority of the Director of Flight Safety, National Defence Headquarters, pursuant to powers delegated to him by the Minister of National Defence as the Airworthiness Investigative Authority for the Canadian Forces.
SYNOPSIS

A student Search and Rescue Technician was participating in a static line parachute jump to his first water landing at Comox Lake. As he exited the aircraft, the static line extended normally; however, the Life Raft Survival Kit (LRSK) that was attached to the mid-portion of his harness rolled inverted and rode up over the main parachute compartment. The parachute’s static line began to extract the main parachute from its compartment until the parachute became fouled under the LRSK attachment strap. Parachute deployment then halted as the SAR Tech was towed through the air attached to the aircraft by the static line. The Jump Master, after acknowledging the SAR Tech’s hand signal indicating that he was okay, then ordered him to cut the static line.

Once free and clear of the aircraft, the SAR Tech attempted unsuccessfully to cut away his main parachute. He deployed his reserve parachute but noticed little deceleration. The main parachute outer deployment bag (D-Bag) with extended suspension lines became wrapped around the reserve parachute’s suspension lines, resulting in less than half the reserve canopy inflating. After the SAR Tech retrieved the D-Bag and attempted to unwrap it from the reserve parachute’s suspension lines, the reserve canopy began to inflate and slow his descent. The SAR Tech suffered minor injuries after he contacted the water, skipped, and then landed much harder than normal. He was then immediately taken aboard an on-scene water rescue boat.

The investigation concluded that the incident was caused by a poor LRSK case design that allowed its straps to become un-tensioned when the SAR Tech adopted the exit ball position. Dynamic variables during his exit then caused the LRSK to move over the parachute pack and foul the main parachute. It was also determined that original parachute acceptance trials were inadequate in that their limited scope and methodology did not identify the potential for interference between the CSAR-7 (A) and LRSK to occur. Furthermore, the CSAR-7 (A) and LRSK introductions to service were not subjected to the detailed airworthiness processes that are in place today.

The RCAF implemented ten preventive measures that included improvements to SAR equipment airworthiness processes. A further six safety concerns were also identified to improve jumper safety.
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Annex A: Photographs of Jumper 5 and Jumper 7 Exit
Annex B: Photographs of LRSK over Reserve Parachute Compartment
Annex C: Photographs of Jumper 8’s Exit
Annex D: Pictures of SAR Technician Model
Annex E: List of Abbreviations
1 FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 The Canadian Forces School of Search and Rescue (CFSSAR) at 19 Wing in Comox, BC, was conducting a QL5A training course to qualify 17 Search and Rescue (SAR) Technicians (jumpers) with their basic trade qualification. The course members had each completed over 50 freefall and static line parachute jumps, however, the parachute jump on 8 May 2009 was to be to their first jump to a water landing while wearing the SAR Life Raft Survival Kit System1 (LRSK). The parachute jump took place from a civilian-registered aircraft2 over the water drop zone (DZ) at the east end of Comox Lake, located approximately 10 nautical miles southwest of the Base.

1.1.2 At 08:00 hours local time on the day of the incident, the jumpers, a SAR Technician instructor and the Safety Person (SP) attended the Jump Master’s (JM) pre-departure briefing. The briefing identified the JM to be in charge (also known as the Team Lead), the jumpers in the first sortie and other safety and administrative information. Following the briefing, the jumpers collected their equipment and completed their pre-flight inspections. The aircraft cabin, exit area, anchor line equipment and electric static line retrieval system were inspected with no discrepancies noted.

1.1.3 In preparation for the water landing, the jumpers attached their LRSKs to the V-Rings on their CSAR-7 (A) parachute harnesses. The students then inspected one another’s equipment before the SAR Technician instructor, SP and JM completed a further pre-departure dress inspection as described in the CC115 Standard Manoeuvre Manual3 (SMM). The attachment straps on Jumper 8’s (J8) LRSK were pulled tight while the LRSK was pushed close to his body. No discrepancies were noted.

1.1.4 The jumpers boarded the aircraft in reverse order of the planned exit sequence. The aircraft departed the Comox airport at 09:46. The weather at the DZ was scattered clouds above the planned exit altitude with light winds noted at the water surface. When the aircraft climbed through 1,500’ above ground level (AGL) the JM ordered the jumpers to stand up and hook their static line clips to the anchor line cable inside the aircraft. At this time, the JM began working from the rear of the aircraft to inspect the security and configuration of all the jumpers in accordance with (IAW) the SMM JM Safety Check - Static Line Checklist4.

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1 SAR Life Raft Survival Kit System (LRSK): comprised of an orange coloured case with two attachment straps, a one man CO2-inflated life raft, a flotation pad, survival kit and an attachment lanyard.
2 C-FUMC, a Shorts Skyvan aircraft, was a civil contracted air service to DND.
3 CC115 Standard Manoeuvre Manual, Chapter 12, Section 2, page 12-2-1. Note: The community accepts this publication as directive for any fixed wing parachuting operations.
4 CC115 Standard Manoeuvre Manual, Chapter 12, Section 2, page 12-2-1.
The SP proceeded to the front of the aircraft cabin area and began the same procedure working towards the JM until all the jumpers had been inspected. The SP inspected J8, the incident jumper, and noted that J8’s equipment was in good order. The SP observed that all of J8’s ejector fasteners were connected and all of his straps were tight. Since the cabin area is confined, J8 sat down following his inspection to make space for an adjacent jumper’s inspection.

1.1.5 The aircraft levelled at 3,000’ AGL over the DZ. The aircraft’s rear ramp door was raised and wind drift indicators were dropped to determine the ideal location for the jumpers to exit. The JM used a handheld video camera to record each jumper leaving the aircraft.

1.1.6 A review of the video indicated that J5 and J7 experienced significant movement of the LRSK on exit such that the LRSK momentarily rode up over the main parachute compartment just prior to full static line tension and the subsequent extraction of the outer deployment-bag (D-Bag). Both of these jumps were otherwise without incident (See Annex A for photographs of J5 and J7 exit).

1.1.7 The video also showed that once J2’s and J4’s main parachute began to deploy, their LRSK inverted and floated over the empty main parachute pack tray. Still pictures of the video also showed that the LRSK sometimes floated up over the reserve parachute compartment after the main parachute had deployed (See Annex B for photographs of J2 and J4).

1.1.8 The SP and the JM visually inspected J8 as he advanced to the “ready” position. The JM provided a 90 second warning prior to commanding the exit. A review of video and testimony indicated that J8 exited the aircraft with the proper body position. As J8 began to exit, the LRSK started to rotate forward around its lateral axis until it was inverted. This action created slack in the LRSK attachment straps allowing it to float up on top of the parachute pack. J8’s static line continued to pay out as he began to rotate slightly to his left. The LRSK was now fully inverted and well over the parachute pack as the static line was pulled tight. The static line extracted the parachute’s outer D-Bag from the main parachute compartment and was caught in a bight formed by the right LRSK attachment strap and the tensioned static line. This action prevented any further deployment of the main parachute and caused J8’s rearward exit motion to stop. J8 was now suspended behind the aircraft, predominately from his right side, while his initial left rotation continued; this caused him to face back towards the aircraft rear ramp door (See Annex C for photographs of J8’s exit).

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5 Ejector Fastener: A special compact yet secure connection fitting that allows for easy connection and quick disconnection when the friction feature is overridden.

6 Wind Drift Indicators: Highly visible paper banners that are dropped from the aircraft to assess the overall downwind drift effect of the wind on a parachutist.

7 Outer Deployment Bag (D-Bag): A cloth bag that holds the inner deployment bag, which houses the main canopy and suspension lines.
1.1.9 J8 was unaware of the reason for his hung exit, though he was conscious and he believed his safest action was to be cut away in order to use his reserve parachute. He signalled this information to the JM by placing his hand on his helmet. The JM advised the pilot of the situation and, after a quick assessment and assurance that J8 would remain over water, gave the order to the SP to cut J8’s static line. Once free, J8 tried to stabilize in a belly-down\(^8\) free fall attitude before he pulled his cut away pillow in an attempt to release his main parachute from his harness. He then deployed what he thought was his reserve ripcord handle but determined he had inadvertently grasped his life preserver yoke (LPY) oral inflation tube. He then correctly identified and pulled the reserve ripcord handle but noted that his reserve parachute deployed more slowly than expected. J8 observed that less than half the reserve canopy was inflated and that his suspension lines appeared twisted. He immediately grabbed the risers and kicked in an attempt to untwist them. He then realized that the main parachute outer D-Bag with extended suspension lines had wrapped around the reserve parachute suspension lines. Next, he grabbed the D-Bag and swung it in a direction to unwrap it from the reserve parachute suspension lines. This action then allowed the reserve canopy to inflate and slow his descent. Noticing the water approaching, he prepared to land. On initial contact with the water, he skipped laterally and was then thrown forward before coming to rest much harder than normal water landing. A water rescue boat was immediately on scene and the operators assisted him into the boat.

1.2 Injury to Personnel

1.2.1 19 Wing medical staff examined J8 and determined that he received minor injuries.

1.3 Damage to Aircraft

1.3.1 There was no damage to the aircraft.

1.3.2 Damage to Equipment

1.3.2.1 The LRSK had a 1 cm perforation at the base of the left attachment strap where it attached to the case. The stitching was torn at the left and right edge reinforcement areas of the attachment straps where the strap was secured to the case.

1.3.2.2 The CSAR-7 (A) parachute assembly was recovered undamaged from Comox Lake. The reserve pilot parachute, reserve ripcord handle, and cutaway handle were not recovered.

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\(^8\) Belly-Down: This is a known stable position for the parachutist; his body is face-down parallel to the earth’s surface, arms and legs outstretched.
1.4 Collateral Damage

Nil.

1.5 Personnel Information

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Jump Master</th>
<th>Safety Person</th>
<th>Jumper 8</th>
</tr>
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<tbody>
<tr>
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<td>Valid</td>
<td>Valid</td>
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<tr>
<td>Total Parachute Jumps</td>
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<td>357</td>
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<tr>
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<td>184</td>
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</tr>
<tr>
<td>Free Fall</td>
<td>179</td>
<td>173</td>
<td>42</td>
</tr>
<tr>
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<td>3 hours</td>
<td>3 hours</td>
</tr>
<tr>
<td>Last 24 hours</td>
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<td>11.5 hours</td>
<td>11.5 hours</td>
</tr>
<tr>
<td>Last 48 hours</td>
<td>19 hours</td>
<td>21 hours</td>
<td>21 hours</td>
</tr>
</tbody>
</table>

Table 1: Personnel Information

Table 1 Note: The JM is tasked with directing and supervising the dispatch of all jumpers and complying with regulations, procedures and safe practices. The JM qualification is considered current following a ‘fixed wing aircraft’ Team Leader check ride9. The minimum qualification to perform this duty for the CFSSAR QL5A course is ‘fixed wing aircraft’ Restricted Team Leader (RTL)10. Alternatively, a more senior qualification would be ‘fixed wing aircraft’ Operational Team Leader (OTL). The JM was awarded a ‘rotary wing aircraft’ OTL qualification at his previous unit but had not attempted the ‘fixed wing aircraft’ RTL check ride at CFSSAR; therefore, while he was qualified to perform JM duties on a rotary wing aircraft; he was not qualified to perform JM duties on a fixed wing aircraft.

1.6 Aircraft Information

1.6.1 The Department of National Defence (DND) contracted Sustut Air, a civil air service operator, to provide an aircraft and crew to conduct static line parachute jumps for CFSSAR. The aircraft provided was a Shorts Skyvan (SC.7 Series 3, variant 200). It is a twin-engine, turboprop, all metal aircraft featuring high mounted wings, square fuselage sides, rear cargo ramp and twin rudders. The cargo compartment is configured with austere side bench seating and safety restraints for 12 jumpers. A static line system is installed on the right side of the cabin compartment complete with an electric winch static line retrieval system. An intercom headset is provided at the rear of the cabin for communication with the pilot. The aircraft is also equipped with a static line elevator guard. Maximum take-off weight for parachute jumping operations is 13,500 pounds.

9 Specified in 1 Canadian Air Division Orders, Volume 5, article 5-503, Annex E, paragraph 1.
10 Specified in 1 Canadian Air Division Orders, Volume 5, article 5-503, Annex E, paragraph 5.
1.7 Meteorological Information

1.7.1 The Comox Lake DZ is located approximately 10 nautical miles southwest of the Comox Airport. Witnesses reported that the weather at the DZ was consistent with the weather at the airport, which was suitable for the planned operation and a flight IAW visual flight rules. The Comox Airport METAR at the time of the incident is as follows:

CYQQ 081700Z 12003KT 20SM FEW012 BKN050 10/07 A3041 RMK SC2SC5 SLP298 SKY88=

1.8 Aids to Navigation

Not applicable.

1.9 Communications

1.9.1 The JM and J8 communicated via hand signals IAW established procedures11. Communication between the JM and the pilot was accomplished via the aircraft intercom system. The JM was required to wear an aircraft-specific headset for this communication.

1.9.2 Communication between the JM and the DZ party was via a hand-held radio. The JM used the hand-held radio to inform the DZ party of the situation and that J8 would land approximately 1 km west of the intended DZ.

1.10 Aerodrome Information

Not applicable.

1.11 Flight Recorders

1.11.1 The aircraft was neither equipped with recording devices nor was it required to be. The jumpers’ exits from the aircraft were recorded on a hand-held video camera operated by the JM. The recorded video was utilized to analyse the jump exit and associated equipment state for each of the 17 jumpers.

1.12 Wreckage and Impact Information

Not applicable.

1.13 Medical

1.13.1 Toxicological samples were obtained from J8 and sent to the Armed Forces Institute of Pathology for analysis. Results were negative.

11 Hand Signals. CC115 Buffalo SMM (Change 1, 15 March 2009), Annex C: hand on the head (jumper to safety person) jumper wishes to be cut away.
1.14 Fire, Explosive Devices, and Munitions

1.14.1 J8’s life vest and single man life raft were each equipped with a CO2 cartridge. The CO2 cartridges were not activated.

1.14.2 None of the jumpers were equipped with (AP Day/Night) flares as required by CC115 SMM 60-115-1003 (Ch 1, 15 Mar 2009), Chapter 12, Section 3, paragraph 1. c. (7).

1.15 Survival Aspects

Not applicable.

1.16 Test and Research Activities

1.16.1 To assist with the investigation’s analysis of this incident, a live model was dressed in equipment identical to that used by J8. Serviceable equipment was installed and tightened by a qualified JM. The JM performed the same Safety Check – Static Line that would have been performed in-flight before the incident. The model was asked to assume positions similar to the ones used by J8, primarily the exit ‘ball’ position, to determine the LRSK’s positional security (See Annex D for photographs of the model).

1.17 Organizational and Management Information

1.17.1 CFSSAR

1.17.1.1 CFSSAR is an integral unit of 19 Wing and is composed of approximately 20 Reserve and Regular Force personnel. It functions as the primary learning center for all aspects of the SAR Technician trade, to include mountain climbing, diving, arctic survival, medical training, bush craft, sea skills and parachuting. Subjects are either taught directly at the school or coordinated as exercises off-site at various locations in North America. CFSSAR also provides sea survival training to all CF aircrew.

1.17.1.2 The CFSSAR Commanding Officer, a Lieutenant Colonel, also functions as the 19 Wing Operations Officer. His office is located on the flight line, separated from the SAR training facility. The CFSSAR Commandant is a SAR Technician Chief Warrant Officer whose office is located at the SAR training facility. The CFSSAR Commandant is in practice responsible for the overall coordination of school personnel, activities and resources. He is assisted by a deputy, a Master Warrant Officer, and a Warrant Officer (WO) in charge of Training and a WO in charge of Standards.

1.17.1.3 The SAR Technician QL5A course requires the assistance of many staff; however, overall course coordination is designated to a specific instructional staff member.
1.17.2 Contracted Air Services – Airworthiness Oversight

1.17.2.1 In 2003 the Director General for Civil Aviation in Transport Canada advised DND that civil-registered aircraft performing DND missions could no longer do so under a Transport Canada Civil Aviation (TCCA) issued Air Operator Certificate (AOC) and that DND would have to assume this responsibility. The circumstances of that decision were further refined such that a formal Memorandum of Understanding (MOU) between DND and TCCA\textsuperscript{12} stated specifically when DND and/or TCCA have airworthiness responsibilities for civil air service aircraft conducting DND missions. Annex C, paragraph 3 b. of the MOU stated that DND is required to issue an authorization to a CAR 702 air service operator in order to conduct military missions. The Director General Aerospace Engineering Program Management (DGAEPM) Technical Airworthiness Authority (TAA) staff and 1 Canadian Air Division Headquarters (1 Cdn Air Div) Operational Airworthiness Authority (OAA) staff provide this authorization as supplementary to the TCCA AOC. The DND-issued authority is called a Temporary Authority to Operate (TAO). A TAO is produced after the contract is awarded but prior to the conduct of DND missions. To issue the TAO, the TAA, OAA and AIA representatives obtain and review information from the air service operator and the supported unit (in this case CFSSAR) to regulate the air activity and thereby ensure compliance with the MOU and airworthiness IAW the Aeronautics Act. At the time of incident, DND had not yet issued a TAO to the contracted civil air service operator.

1.18 Additional Information

1.18.1 CSAR-7 (A) Parachute Assembly Description

1.18.1.1 The CSAR-7 (A) parachute assembly is an integrated pack and harness assembly. It weighs approximately 45 pounds and measures 24 inches long, 18 inches wide and 8 inches thick (less the harness). Both the main and reserve canopies are worn on the back with the reserve pack container above the main. The tangerine-coloured main canopy is a semi-elliptical, nine cell, ram air canopy. The gold-coloured, rectangular shaped reserve canopy is a seven cell ram air canopy with a flying surface of 335 square feet.

1.18.1.2 An advantage of the parachute assembly is its ability to be configured for a variety of deployment modes. On the day of incident, the main parachute was deployed by static line and the reserve canopy was deployed by reserve ripcord. Alternatively, the Military Cypres Automatic Activation Device (AAD) can automatically deploy the reserve parachute. The AAD senses barometric pressure and can be preset to deploy the reserve parachute automatically at a specific altitude. The AAD was not carried IAW the SMM due to the planned water entry.

\textsuperscript{12} MOU between DND and TCCA, 19 June 2006, DND Identification number 2004072851.
1.18.1.3 The static line is 14 feet 8 inches long and made of yellow nylon webbing. Extension of the static line pulls the pin from the main closure loop allowing the side, top and bottom flaps to separate. This allows the outer deployment bag to be pulled from the main parachute compartment. Pulling the outer deployment bag from the main parachute compartment extracts the suspension lines from the outer deployment bag elastic stowage bands. When the suspension lines are at full stretch, removal of the last four suspension line stowage bands unlocks the outer deployment bag; causing extraction of the inner deployment bag. A drogue/slider control line is extracted from the inner deployment bag elastic stowage bands. The removal of the last six stowage bands unlocks the inner deployment bag. Next, full extension of the drogue/slider control line releases the main canopy from the inner deployment bag. The drogue parachute is then pulled from the outer deployment bag, breaking the drogue break tie. The parachutist is now free from the static line. The drogue parachute fills with air and assists the deployment and inflation of the main canopy.

1.18.1.4 The reserve canopy is activated by pulling the reserve rip cord handle. The reserve canopy compartment flaps open and the reserve pilot chute extends due to the release of spring tension. The pilot chute extracts the reserve bridle (line) which pulls the free bag, housing the reserve canopy, from the reserve canopy compartment. The reserve canopy suspension lines extend from the stowage bands on the free bag. The free bag is then pulled away from the reserve canopy by the pilot chute and extended suspension lines. The reserve canopy then begins to inflate.

1.18.1.5 The harness assembly is made of 1 3/4 inch black nylon webbing. There are two main lift webs composing the front harness running vertically up the body. A horizontal crossing chest strap connects the two vertical lift web straps. At chest level, on each main lift web, are two SARPELS attachment rings. The rings are used to attach SAR equipment the technician will use once he has landed. A belly band (at waist height) is also fitted (below the chest strap) running horizontally from the main parachute pack tray to the front of the harness where it is connected with an ejector fastener. On each side of this harness, just below the armpit, is a V-Ring which is used to attach the LRSK attachment strap ejector fasteners.

1.18.1.6 The CSAR-7 (A) parachute assembly was granted technical airworthy clearance and operational airworthy clearance for operation from the CC130 and CC115 aircraft in 2003. A modification to the reserve parachute deployment system\textsuperscript{13} (called Skyhook modification) was approved in February 2007.

1.18.2 CSAR-7 (A) Parachute Assembly Evaluation and Clearance History

1.18.2.1 The Airborne Trials and Evaluation Section (ATES) at the Canadian

\textsuperscript{13} CSAR-7 Sky Hook Mod, see file number 11670-22622-40 or RDIMS# 912375.
Parachute Centre conducted an operational test and evaluation of the proposed new CSAR-7 (A) parachute assembly in 2002. The Project Report, dated 2 July 2002, assessed the compatibility of the parachute with existing SAR equipment and clothing; however, the detailed list of evaluated SAR equipment provided did not include the incident LRSK, which succeeded the older LRSK in use at the time. The report indicated water testing was not conducted.

1.18.2.2 The CSAR-7(A) parachute system received Technical Airworthiness Clearance (TAC) from the Directorate of Technical Airworthiness (DTA) on 18 February 2003\textsuperscript{14}. The message specified numerous conditions under which the parachute could be operated to include authorized clothing and equipment configurations, but the LRSK (or equivalent device) was absent from the approved equipment configuration list.

1.18.2.3 The CSAR-7(A) parachute was granted Provisional Operational Airworthiness Clearance on 3 April 2003\textsuperscript{15} for limited daytime use on the CC130 and CC115 aircraft to evaluate the CSAR-7 (A) with existing drills and procedures. There is no mention of a trial of the LRSK with an actual static line jump.

1.18.2.4 In June 2003, a combined report\textsuperscript{16} from ATES and Transport Operational Test and Evaluation Flight (TOTEF) detailed the tests conducted to assess CSAR-7 (A) parachute static line drills and procedures on the CC130 aircraft, including validation of water parachuting. The report describes water parachuting drills as assessed on paper only. CSAR-7 (A) harness removal was evaluated in water but not after an actual water jump (with an LRSK).

1.18.2.5 1 Cdn Air Div granted Operational Airworthiness Clearance\textsuperscript{17} (OAC) for the CSAR-7 (A) parachute operations in both static line and freefall mode on the CC115 and CC130 aircraft on 11 August 2003 without specific reference to or authorization to use the previous model LRSK.

1.18.3 LRSK Description

1.18.3.1 The LRSK is designed to enhance SAR technician survivability in water. It is comprised of the container assembly, a one person life raft, a flotation pad and a small survival kit; it weighs 12 pounds. The container assembly comprises an integrated closing lid with four snap fasteners on each side and a hook and pile fastener along the front. The container is fabricated from low temperature resistant, double-coated orange polyester fabric and measures 15 inches by 12 inches by 4 inches. An attachment strap is sewn across the bottom of the container with attachment straps extending 27 inches beyond the container on each side. Each attachment strap is fitted with an adjustable quick release.

\textsuperscript{14} Message UNCLAS DTA74201 181928Z Feb 03 & UNCLAS DTA74201 Supp191400Z Feb 03.
\textsuperscript{15} Message UNCLAS A3 FE 039 032257Z Apr 03.
\textsuperscript{16} ATES/TOTEF Project Report Sept 2003, ATES 10081 02/05, TOTEF 2002-008.
\textsuperscript{17} Message UNCLAS A3 FG 088 110826Z Aug 03.
ejector snap for quick attachment and release.

1.18.3.2 The LRSK is inspected, maintained and packed by Para Riggers and SAR Technicians. The LRSK is to be inspected once per year when in storage, before use by operators and post-operation. The annual periodic inspection consists of checking for stitching defects, tears, deterioration, cracks, contamination, metal corrosion, function, and dirt. Internal components have additional specific equipment inspections. Maintenance is limited to cleaning, sewing repairs and component replacement and is to be recorded on form CF363. There is no service life imposed on the LRSK aside from the contents of the survival kit.

1.18.3.3 The LRSKs in use on the incident day were deemed to be for “training use only” and therefore not subject to formal inspection, functionality checks, or record keeping. The contents were not expected to be used and as long as the container was closed and not ripped, it would only be attached to the parachute to provide the experience of handling the equipment.

1.18.4 LRSK Evaluation and Clearance History

1.18.4.1 The current model LRSK was approved for service in 2006. It is similar in size to the older model it replaced. The previous container was made of nylon, which became worn and prone to attachment strap separation from the case. The previous model LRSK was more difficult to pack. The attachment strap was similar; however, it was worn against the buttocks instead of being placed around the outside of the case, as in the current model. The Life Cycle Maintenance Manager (LCMM) initiated action to replace the case when the original ones could no longer be repaired and insufficient stock remained. A Statement of Capability Deficiency report (SOCD) was also submitted to DTA7 from CFSSAR on the previous model LRSK in 2002/2003 concerning the unsatisfactory position of the case. The SOCD stated that the kit hung behind and below the jumper in such a way that it interfered with and made a proper exit ‘ball’ position from the aircraft potentially dangerous.

1.18.4.2 TOTEF was tasked by 1 Cdn Air Div on 27 January 2005 to conduct an evaluation of the (new) current model LRSK; at that time, the case was called a survival kit container, SKC. The tasking message stated the device was not an aeronautical product and did not require technical air worthiness clearance.

1.18.4.3 The TOTEF test plan used two LRSKs for the trial and called for one sortie each on the CH146 and the CC130 aircraft to evaluate the equipment. The test was designed to determine if the fit, form and function of the new LRSK

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18 C-22-165-000/MF-001 CH 1-2007-06-18, Part 2, Section 1, paragraph 4.
19 Message Unclas A3 FG 004, 271605Z Jan 05.
20 The term LRSK has been adopted for consistency of use in this report although some messages use the term SKC.
21 TOTEF Test Plan: file number - Project TOTEF 2005-004.
would be similar or adequate when compared with the previous model.

1.18.4.4 The TOTEF LRSK report\textsuperscript{22}, dated 28 February 2005, described the plan as a limited test program. Test subjects wore the main SAR Technician orders of dress with the LRSK and noted good compatibility. The LRSK was deemed satisfactory and TOTEF recommended OAC.

1.18.4.5 On 7 February 2006, DTA7 (now DTAES7) released a message to 1 Cdn Air Div providing Technical Clearance\textsuperscript{23} for the current LRSK and stipulated that it shall only be used when parachuting by static line. No record of OAC from 1 Cdn Air Div HQ could be found.

1.18.5 LRSKs Designated as Training Use Only

1.18.5.1 A “training use only” designation makes effective use of equipment that is relatively durable, simple, and repeatedly used. “Training use only” equipment is usually used for ground-based familiarization training in benign environments. A major operational advantage of “training use only” equipment is the reduction in man hours needed to maintain the equipment and the reduced cost for replacing repeatedly used operational equipment for training requirements and familiarization.

1.18.5.2 A review of several of the “training use only” LRSKs at CFSSAR showed them to look similar to serviceable LRSKs. The major differences noted were minor tears in the attachment strap to case stitching, the uncertainty of the contents and the integrity of all fasteners.

1.18.5.3 The LRSKs used by the jumpers on this sortie were designated “for training use only.” This means the LRSK cases were not maintained IAW Canadian Forces Technical Order (CFTO) C-22-165-000/MF-001. Furthermore, because of this designation, the contents were believed to be serviceable but were not required to be inspected or certified as operable. The CFTO concerning the LRSK does not specifically indicate that LRSKs can be designated “for training use only.” It is believed that the authority for the designation of this equipment was erroneously taken from other documents concerning Aircrew Life Support Equipment (ALSE) such as CFTO B–22–050–278/FP–000, Part 1, paragraph 6, which permits aircrew equipment to be withdrawn from operational service and be designated for “training use only”\textsuperscript{24}.

1.18.6 LRSK and Parachute Quarantine Procedures

\textsuperscript{22} Message Unclas CO 02/05 281255Z Feb 05.
\textsuperscript{23} Message Unclas 74018 DTA743C1 071543Z Feb 06.
\textsuperscript{24} “Training Use Only” ALSE is equipment that shall only be used for ground–based initial or refresher training and shall not be issued to or used by aircrew or passengers in support of normal air operations. Such equipment shall be marked in a prominent fashion to indicate this designation.
1.18.6.1 The water rescue boat at the drop zone recovered J8 and his equipment. Photographs of J8’s parachute and LRSK were taken once the gear was carried ashore. The parachute and an LRSK were quarantined at CFSSAR but only after being disassembled and dried. Disassembly resulted in the parachute being untangled, destroying evidence concerning the interaction of the harness, LRSK and both parachutes. In this case, it would have been preferable to leave the equipment wet, in a container as recovered. Had there been a concern for corrosion or water damage, the equipment should have been rinsed and re-immersed in clean water or frozen until it was ready to be examined.

1.18.7 JM Head Protection

1.18.7.1 The JM wore a personal restraint harness instead of a seat belt when the aircraft’s rear ramp door was open, which is permitted by orders.25 The restraint harness allowed the JM to move about the cabin to perform his duties and to peer outside to direct the aircraft onto the DZ. The aircraft was equipped with a headset at the rear of the cabin for communication. For similar duties on the CC130 and CC115, all personnel are required to wear a helmet26 although the JM may wear a headset and goggles for communication if there is an intercom compatibility issue. The use of a helmet is desirable to reduce the chance of head injury whenever an individual is unrestrained, turbulence is likely, equipment is loose, or the aircraft is manoeuvring. In this particular case, there was no stipulation in the contract for the aircraft to be equipped with a compatible intercom system that would have allowed the JM to wear his purpose issued helmet.

1.18.8 Contracted Air Services

1.18.8.1 The Department of Public Works and Government Services Canada – Pacific Region (PWGSC) awarded the air services parachuting contract after considering the CFSSAR Statement of Work (SOW). The SOW did not identify a requirement for the contracted air service provider to be in possession of a TAO prior to commencing DND missions. Likewise, PWGSC’s contract clauses did not indicate the requirement for a TAO prior to the delivery of services. A review of over-arching orders such as Canadian Forces Administrative Orders (CFAOs), Defence Administrative Orders and Directives (DAODs) and 1 Cdn Air Div Orders also did not identify the need for DND units contracting civil air services to obtain a TAO.

1.18.9 Flight Authorization

1.18.9.1 All flying undertaken in the Canadian Forces (CF) shall be authorized and documented as described in B-GA-100-001/AA-000 Book 1, Chapter 3. On the incident flight, the names and position of sortie members were identified prior to the flight on a white board in erasable ink; however, a record resembling a

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25 CC115 SMM Chapter 7, Paragraph 21.
26 CC115 SMM Chapter 7, Paragraph 21, see Note.
CF773 form or paper manifest did not exist. Subsequent to this incident, the Commandant CFSSAR directed that flights on civilian aircraft will be authorised on paper, personnel on-board will be manifested and the JM/TL for each flight will be designated.

1.19 Useful or Effective Investigation Techniques

1.19.1 CFSSAR staff recently began video taping student static line jumps as the jumpers exit an aircraft in order to provide feedback to the students in their employment of proper technique and procedures. This was the first year a static line jump to a water-DZ (employing the LRSK) was video taped. This exercise only happens once per course (once per year). The JM used a hand-held (1 lb) Sony HDR-CX12 camcorder and observed the jumpers on the 2.7 inch video display screen during each jump. The video file provided re-playable evidence of each jumper’s exit and the interaction of the LRSK with the parachute, the static line tensioning, parachute deployment and initial descent sequence which took less than five seconds per jumper.

1.19.2 Multiple reviews of each jump sequence played back in slow motion allowed investigators to review each jump and to observe equipment interaction. The video showed that the LRSK moved up over the main parachute pack tray on two additional jumpers preceding the incident jump and over the reserve parachute compartment following extraction of the outer D-bag. However, individual exit orientation, static line tensioning and D-bag extraction were such that the other jumpers avoided the problems encountered by J8. The video tape was invaluable as an analytical tool in support of the investigation.
2 ANALYSIS

2.1 General

2.1.1 The investigation evaluated the capabilities and decisions of the JM, SP and J8 together with the equipment clearance history of the LRSK and the CSAR-7 (A) parachute assembly. In addition, a number of safety-related CFSSAR operating issues were examined.

2.2 JM Qualifications

2.2.1 The JM was not qualified to perform JM duties on a fixed wing aircraft at the time of the incident. He did hold a valid rotary wing aircraft OTL rating issued by his previous unit. The JM was never scheduled for a fixed wing TL qualification check ride at CFSSAR because he believed his previous rating was suitable upon transfer to CFSSAR. On the day prior to the incident, he was the Safety Person for a similar parachute mission in the Skyvan aircraft. Recent log book entries indicated he had experience parachuting from fixed wing aircraft and testimony showed him to be very capable of directing parachuting operations from the Skyvan aircraft.

2.2.2 Five days after the incident and without subsequent formal training, the JM successfully completed a fixed wing RTL check ride on a CC115 aircraft, during which he demonstrated excellent ability and was found to be procedurally proficient.

2.2.3 Therefore, the investigation concluded that, while he was not qualified to perform the duties of a JM or TL on a fixed wing aircraft at the time of incident, the JM's lack of formal qualification was not consequential to the outcome of the incident.

2.3 Cut-Away Decision

2.3.1 A review of the Flight Safety Occurrence Management System database showed there have been no other static line deployment hang-ups involving the CSAR-7 (A) parachute. The most likely cause of a hang-up was previously thought to have been a misrouted static line; however, evidence indicated the static line was properly routed and not causal to this incident.

2.3.2 Once a hang-up occurs there are basically two options: (1) the jumper is retrieved or (2) the jumper is cut away. Sufficient direction regarding the retrieval or cut-away of a hung-up jumper exists in the SMM and the JM and SP were cognisant of the relative advantages and disadvantages of each option. In this case, J8 was conscious, a student with limited experience and unaware of what had caused him to become hung-up. Although the JM and SP had not seen this situation before, they reacted quickly to consider their options.

2.3.3 The JM decided against retrieving J8 as white suspension lines were
visible, indicating inadvertent deployment of the main parachute was possible with J8 still attached to the aircraft. Had this occurred, J8 would have been injured from the opening shock of the main parachute and the aircraft could have suffered a reduction in or loss of control; he still would have eventually been cut-away. Furthermore, air turbulence in the vicinity of the aircraft ramp would have either caused him to impact the ramp area, further deploy his main parachute, or inadvertently deploy his reserve parachute. Since the JM believed the reserve parachute to be uninvolved with the hang-up and that there existed sufficient height to deploy it, he chose the cut-away option. The investigation concluded that this was an acceptable practice and sound decision.

2.4 CSAR-7 (A) Parachute and LRSK Interference

2.4.1 The current model LRSK was in service for 27 months before the incident and is intended for use whenever SAR Technicians parachute to a water rescue and a safety boat is not available to retrieve them. The LRSK is not required to be worn during annual water training jumps as a safety boat is typically available.

2.4.2 There are two separate circumstances that can result in CSAR-7 (A) parachute and LRSK interference. Following main parachute deployment, the LRSK is no longer tensioned below the main parachute pack tray. Video footage indicated that the LRSK (even without inverting) is free to float-up over the reserve parachute after the main parachute pack tray is emptied. In the event of LRSK inversion, the attachment straps increase in available length and allow the LRSK to float-up over the main parachute during deployment, as occurred in J8’s hang-up. Video footage also indicated that either of these two circumstances may occur within the first five seconds following exit. LRSK movement following exit is undetectable in real time by an observer due to the short time interval.

2.4.3 A static line parachute exit is a harsh and dynamic activity. While predictability is desirable for a consistent outcome, in practice a number of variables, such as equipment location, shape and mass, body position and localized airflow, affect the strength and direction of generated forces, making every exit unique. Ultimately, these variables result in harness strap tension changes during the exit and parachute deployment. Parachutists attempt to minimize harness strap tension changes by tensioning their straps. Despite this action, variables experienced during the exit and parachute deployment alter their harness strap tension and position.

2.4.4 The testimony of multiple witnesses indicated all the jumpers (including J8) had properly attached and tensioned their LRSK attachment straps. Video evidence indicated that although the LRSK did not rotate to the inverted position on every jump, multiple jumpers did experience inversion of the LRSK during the exit despite tensioned LRSK attachment straps. J8’s LRSK became sufficiently inverted to cause a hang-up.
2.4.5 Video evidence and live model analysis demonstrated the LRSK’s tendency to rotate about its attachment straps and to become inverted with the application of minimal force when a jumper moves from standing erect to the exit ‘ball’ position. The tension in J8’s LRSK attachment straps reduced as his body position changed during his exit. Reduced attachment strap tension allowed the LRSK to become inverted, to float-up over his main parachute pack tray and to foul his main parachute deployment.

2.4.6 A review of records detailing the evaluation and acceptance of the current LRSK (see section 1.18.4) indicated the LRSK trial and evaluation process was intentionally limited because the LRSK appeared to closely resemble the previous model. However, the relocation of the attachment strap from against the buttocks to the outside of the case proved to be a significant difference between the two versions. This design change reduced the angle of applied tension to the attachment straps such that the case could easily become inverted, even when the attachment straps were tensioned while standing.

2.4.7 The TOTEF evaluation was limited in that it only used two LRSKs, only one CC130 sortie and a limited anthropometric representation. While the exact number of static line jumps with the LRSK is unavailable, it is likely to have been between two and ten. Video analysis was not utilized in the TOTEF evaluation. The trial, as it was conducted, did not identify any interference between the CSAR-7 (A) and LRSK. As the video taken during this incident indicates, a detailed video analysis of test jumps conducted with a broad representation of exit variables would have revealed the unacceptable movement of the LRSK during the exit process. The investigation recommends that the use of video analysis should be included in any future test and evaluation of parachute and associated equipment.

2.5 Regulatory Airworthiness Oversight

2.5.1 The CF Airworthiness Program Manual (A-GA-005-000/AG-001 version: 2010-02-01), Part 2, Section 3, Paragraph 1 states, “…the Airworthiness Clearance process is the back bone of the Airworthiness Program. It provides a formal comprehensive process that ensures all operational and technical airworthiness issues are reviewed, addressed and documented prior to any operational use of a new or modified aeronautical product.” This process is “…necessary to ensure that an acceptable level of safety for military aviation is achieved.” The issuance of an OAC and a Technical Airworthiness Clearance by the OAA and TAA, respectively, indicate an aeronautical product is ready to enter service.

2.5.2 In effect, the degree of engineering rigor and airworthiness oversight of aircraft and aeronautical products is governed by the designation of the item.

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27 TOTEF SAR Technician Life Preserver and Raft Container Initial Operational Test and Evaluation Test Plan 2005-004.
The CSAR-7 (A) is not recognised as an aeronautical product on its own. DTAES-7 document DTA 64-03-14 Technical Note designates the CSAR-7 (A) as an aeronautical product because it is operated from an aircraft, not because of its capability to perform like an aircraft. Similarly, the LRSK is not designated as an aeronautical product at all; it is recognised as simply mission kit requiring much less engineering oversight and airworthiness rigor. This is likely why the LRSK was never awarded an OAC.

2.5.3 The classic definition of a parachute is that it is a deceleration device used to retard the fall of a body. This was true of older style conical shaped parachutes; however, the CSAR-7 (A) parachute main and reserve canopies utilize an airfoil design that creates lift like an aircraft wing. This means that the CSAR-7 (A) both performs like an aircraft with its ability to stall, turn, glide and vary forward airspeed, and meets the definition of an aircraft as defined in the Aeronautics Act. Transport Canada has determined that modern airfoil-designed parachutes meet the definition of an aircraft though civil parachute airworthiness regulations, not unlike DND’s, are not yet similar to those applied to conventional aircraft.

2.5.4 The CSAR-7 (A) and LRSK airworthiness management processes in use at the time of the incident indicate sufficient detail was not considered in the introduction of these devices, including:

a. The lack of static line deployment testing of the previous model LRSK during the CSAR-7 (A) evaluation;

b. The lack of a documented technical review of the CSAR-7 (A) Skyhook Safety System Modification, and

c. The limited evaluation of the current LRSK with the CSAR-7 (A), following a change of the attachment strap location.

2.5.5 DTAES classified the CSAR-7 (A) as an aeronautical product because of its attachment to an aircraft during deployment. However, the Aeronautics Act Section 3 defines aircraft to be a "machine capable of deriving support in the atmosphere from reactions of the air," and, therefore, the CSAR-7 (A) should be more correctly designated as an aircraft and be subject to aircraft airworthiness management principles. This approach would subject the CSAR-7 (A) and its attached equipment to more rigorous engineering oversight than has occurred in the past. Similarly, the equipment that is attached to the parachutist

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28 Mission Kit is neither ALSE nor an aeronautical product. 1 Cdn Air Div Order 1-625, paragraph 2, states that items that enhance operational effectiveness generally fall under the category of mission kit.


30 Aviation Life Support Aerospace Modification Approval Form, EDRMS No: AEPM-#552245 Paragraph 6.

31 DAEPM (FT) 6 replaced DTAES 7 following a reorganization of DGAEP in April 2010.
or parachute harness more closely resembles an aeronautical product than mission kit, in that each item may interfere with the operation of the parachute (as in may interfere with the operation of the aircraft). Equipment attached to a CF aircraft requires a TAC and OAC, which can involve significant engineering evaluation and effort.

2.5.6 The investigation concluded that a more rigorous approach to the engineering processes regarding the CSAR-7 (A) and equipment carried by the parachutist may have detected the incompatibilities and prevented this incident. The investigation recommends that TAC and OAC processes should be applied to the CSAR-7 (A) and equipment carried by the parachutist.

2.6 Use of Designated “Training Use Only” LRSKs

2.6.1 The use of “training use only” LRSKs means that the LRSK is not maintained and inspected to a certifiable standard by an authorized technician IAW an authorized document. In this case, this means the dot fasteners, loop and pile fasteners, attachment straps or ejector fasteners may be unsuspectingly unserviceable and able to open under harsh conditions such as those encountered during a static line parachute exit. While “Training use only” equipment is acceptable for ground-based training in benign environments, parachute training is not a benign environment. The use of this equipment could interfere with safety-critical equipment such as aircraft static lines and parachutes during actual parachute operations.

2.6.2 The investigation concluded that the mix of actual parachute operations with LRSKs designated as “training use only” could result in the unexpected deployment of LRSK contents during jumper exit as well as parachute extraction, potentially fouling the main and/or reserve parachute. As such, this equipment should be subjected to proper airworthiness inspection criteria and protocols, as recommended in paragraph 2.5.6.

2.7 Equipment Concerns

2.7.1 AP Day/Night Flare

2.7.1.1 None of the 17 jumpers were equipped with (AP Day/Night) flares as required by CC115 Buffalo Standard Manoeuvre Manual (SMM) 60-115-1003 (Ch 1 15 Mar 2009), Chapter 12, Section 3, paragraph 1.c.(7). The flares are a safety device intended to increase a jumper’s visible signature when floating on the water’s surface. While good visibility and low sea states often prevail in training conditions, circumstances, such as this incident, may occur where the retrieval of some jumpers is delayed to attend to those injured. Delayed retrieval is also possible due to an unexpected reduction in visibility, reduced ambient lighting or a safety boat malfunction.

2.7.2 Video Camera
2.7.2.1 While the use of video footage was invaluable to the investigation, the manner in which the video was collected was a concern that should be addressed if video is required for such missions. During this flight the JM monitored the jumpers’ exit and parachute deployment through the viewfinder of a portable video camera. The JM’s reduced field of view and required hand coordination were felt to be an unnecessary hindrance in the execution of his duties. It is recommended that a crewmember, other than the JM, be recording the jumps using a helmet mounted camera.

2.7.3 The investigation concluded that an individual flare would be advantageous to identify the jumper’s position, need for assistance or to attract attention. In addition, proper protocol should be implemented for the safe use of video cameras during parachute operations.

2.8 Contracted Air Services – Airworthiness Oversight

2.8.1 On 17 April 2009, the TAA initiated activities with the prospective contracted air service provider and CFSSAR to collect information necessary for review, prior to the issuance of a TAO. To prevent wasted staff time, the TAA was waiting for contract confirmation before further processing. The TAA expected CFSSAR to advise the TAA once the contract had been awarded. Documents indicate CFSSAR believed the TAA would be notified by PWGSC after the contract was awarded. The contracted air service operator believed he had a suitable civil AOC and that this was sufficient. Testimony indicated some phone conversations may have referred to the TAO requirement; however, this detail was not well understood by either CFSSAR or the contracted air service provider. In the end, the TAA and OAA were not aware that the contract had been finalised and, therefore, never issued a TAO.

2.8.2 The contract, including the SOW, sets the details to which the air service provider and CFSSAR (or any other DND/CF unit) must adhere. If additional stipulations such as the issuance of a TAO for, by way of example, the availability of compatible headsets were to preclude commencement of activities, then such activities should be stated in the contract. The inclusion of the TAO requirement in the contract would clearly place responsibility for fulfillment on all parties; however, suitable regulatory direction at DND’s interdepartmental level needs to instruct this, otherwise this oversight will be repeated in the future.

2.8.3 The investigation recommends that unambiguous direction in a national DND order, made available to all units contemplating contracted civil air services, should identify the need for OAA and TAA input regardless of the supported unit’s branch of service. Without wide ranging departmental direction, any CF unit (to include the Army and Navy) could contract and use civil air services without a TAO, counter to the MOU on airworthiness oversight between TCCA and DND.
3 CONCLUSIONS

3.1 Findings

3.1.1 The JM was not qualified to perform the duties of a JM or TL on a fixed wing aircraft; however, this was likely inconsequential to the incident’s outcome. (2.2.3)

3.1.2 There was neither a formal flight authorization for this mission nor a record resembling a CF773 form or paper manifest. (1.18.9.1)

3.1.3 J8 and the other jumpers satisfactorily completed a number of equipment checks to confirm the status of their equipment prior to their exit from the aircraft. (1.1.4)

3.1.4 J5's and J7’s LRSK rode up over the main parachute compartment prior to full static line tension and subsequent extraction of the outer D-Bag. (1.1.6)

3.1.5 J2’s and J4’s LRSK moved over the reserve parachute compartment after the main parachute had deployed. (1.1.7)

3.1.6 As J8’s exit began, dynamic variables reduced the tension in his LRSK attachment straps, allowing the LRSK to rotate forward around its lateral axis until it was inverted over his main parachute pack tray, fouling his main parachute deployment. (1.1.8) (2.4.3) (2.4.5)

3.1.7 The static line extracted the parachute’s outer D-Bag from the main parachute compartment and was caught in a bight formed by the right LRSK attachment strap and the tensioned static line. This action prevented any further deployment of the main parachute and caused J8’s rearward motion to stop. (1.1.8)

3.1.8 The JM gave the order to the SP to cut J8’s static line. (1.1.9)

3.1.9 Once free, J8 attempted to deploy his reserve parachute but the main parachute outer D bag had wrapped around the reserve parachute suspension lines, allowing only partial deployment. (1.1.9)

3.1.10 J8 was able to successfully manoeuvre the D-Bag with extended suspension lines free of the reserve parachute suspension lines. (1.1.9)

3.1.11 J8 received minor injuries during his parachute water landing. (1.1.9)

3.1.12 When a jumper moves from standing erect to the exit ‘ball’ position, video evidence and live model analysis demonstrated the LRSK’s tendency to rotate about its attachment straps and to become inverted with the application of minimal force. (2.4.5)
3.1.13 The LRSK trial, as conducted with limited scope and without video analysis, did not identify the potential for interference between the CSAR-7 (A) and LRSK. (2.4.7)

3.1.14 Lapses in the CSAR-7 (A) and LRSK airworthiness management processes indicated that sufficient detail was not considered prior to the introduction of these devices. (2.5.4)

3.1.15 The CSAR-7 (A) performs like an aircraft with its ability to stall, turn, glide and vary forward airspeed, and meets the definition of an aircraft as defined in the Aeronautics Act; therefore, it should be subject to more rigorous airworthiness management principles. (2.5.3) (2.5.5)

3.1.16 The equipment that is attached to the parachutist or parachute harness is not treated as an aeronautical product. (2.5.5)

3.1.17 None of the jumpers were equipped with (AP Day/Night) flares as required by SMM 60-115-1003 (Ch 1 15 Mar 2009), Chapter 12, Section 3 paragraph 1.c. (7). (1.14.2) (2.7.1.1)

3.1.18 The JM was required to wear an aircraft-specific headset for communication, which precluded his wearing of a helmet. (1.9.1)

3.1.19 The JM’s use of the hand-held video camera was a hindrance to the performance of his duties. (1.19.1) (2.7.2.1)

3.1.20 The contract did not identify the need for the contracted air service to be in possession of a TAO prior to commencing DND missions. (1.18.8.1) (2.8.2)

3.1.21 A review of over-arching orders, such as CFAOs, DAODs and 1 Cdn Air Div Orders, did not identify the need for a DND-issued TAO when contracting civil air services. (1.18.8.1)

3.1.22 The TAA and OAA were not aware that the contract had been finalised and, therefore, never issued a TAO. (2.8.1)

3.1.23 The mix of live parachute operations with “training use only” LRSKs could result in the unexpected deployment of the LRSK’s contents during jumper exit or parachute extraction. (2.6.1)

3.1.24 CFSSAR handling of the CSAR-7 (A) parachute assembly destroyed any evidence concerning the interaction of the harness, LRSK and both parachutes. (1.18.6.1)

3.2 Cause Factors

3.2.1 The LRSK design was such that the attachment straps became untensioned when the jumper adopted the exit ball position. Dynamic variables that
occurred during the jumper’s exit then caused the LRSK to move over his parachute pack, fouling his main parachute deployment. (2.4.5) (3.1.12) (3.1.13)

3.2.2 The TOTEF LRSK trial was inadequate in that the limited scope and methodology employed did not identify the potential for interference between the CSAR-7 (A) and LRSK. (2.4.7) (3.1.13)

3.2.3 Detailed airworthiness management processes were not employed prior to the introduction to service of both the CSAR-7 (A) and LRSK. (2.5.4) (3.1.14) (3.1.16)
4 PREVENTIVE MEASURES

4.1 Preventive Measures Taken

4.1.1 The Commandant CFSSAR directed that flights on civilian aircraft be authorised on paper, personnel on-board be manifested and the JM/TL for each flight be designated. (1.18.9.1) (3.1.2)

4.1.2 The Commandant CFSSAR directed that when parachute exit video is captured, it will be done by the SP wearing a helmet mounted camera. (1.19.1) (2.7.2.1) (3.1.19)

4.1.3 The TAO, RDIMS # AEPM 853043 v1, 14 May 2009, was issued by the OAA and TAA to the civil contracted air service operator. (3.1.22)

4.1.4 On 11 May 2009, 1 Cdn Air Div directed all SAR units to cease using the LRSK during training parachute jumps.

4.1.5 On 28 Jul 2009, 1 Cdn Air Div directed all SAR units to cease wearing the LRSK below the main parachute pack tray for operational parachute jumps.

4.1.6 Throughout summer 2009, CFSSAR completed check rides on all instructors conducting parachute operations on civil-registered aircraft.

4.1.7 In October 2009, 1 Cdn Air Div/TRSET implemented an On-Job Training Standard for parachute operations on all civil-registered aircraft.

4.1.8 DGAEPM/DAEPM (FT) 6 classified the CSAR-7 (A) parachute assembly as an airworthiness implicated product subject to technical airworthiness processes to the fullest extent practicable.

4.1.9 DGAEPM/DAEPM (FT) 6 now manages SAR mission equipment through its Divisional airworthiness processes and procedures to the fullest extent practicable to ensure a degree of engineering rigour and that safety measures are taken into consideration for the life cycle of the equipment, including and modifications, maintenance and inspection requirements, etc.

4.1.10 DGAEPM/DAEPM (FT) 6 modified the design of the LRSK case to prevent case-to-parachute interference. (2.4.5) (3.1.13)

4.2 Preventive Measures Recommended

4.2.1 The inadvertent ruin of parachute evidence. CFSSAR should incorporate correct post-occurrence quarantine procedures within its Emergency Response Plan. (1.18.6.1) (3.1.24)
4.3 Other Safety Concerns

4.3.1 CFSSAR not operating IAW the CC115 SMM with respect to the carriage of flares while conducting water training jumps. CFSSAR should review its flying supervision processes to ensure that mandated requirements are adhered to. (2.7.1.1) (3.1.17)

4.3.2 The lack of adequate head protection with JM-pilot communications for CFSSAR JMs working in contracted aircraft. Future contracting for this service should incorporate adequate JM head protection. (1.18.7.1) (3.1.18)

4.3.3 The lack of pan-CF awareness for the need to consider DND/CF Airworthiness Program requirements during the contracting of civil air services. The AA should consider promulgation of pan-CF direction to consult both the OAA and TAA concerning TAO requirements prior to contracting civil air services. (2.8.2) (3.1.21)

4.3.4 The use of “training use only” LRSKs during actual parachute descents. 1 Cdn Air Div/TRSET should consider amending the SMM with a warning indicating that only serviceable LRSKs are to be used during live parachuting activities to preclude inadvertent deployment of LRSK contents and entanglement with the parachute. (2.6.1) (3.1.23)

4.3.5 The non-use of video evaluation during the conduct of parachute and parachute equipment testing and evaluation. TOTEF should to implement the use of video analysis in all test and evaluation trials conducted on parachutes and associated equipment deployed from aircraft. (1.18.4.4) (2.4.7) (3.1.13)

4.4 DFS Comments

The DND/CF Airworthiness Program is robust and ensures that aircraft and associated equipment interact with one another in a safe manner. When this system is not fully implemented, then the potential exists to lapse in our oversight of personnel and equipment. This D category incident highlights the need for increased airworthiness rigour when dealing with SAR equipment. Although the SAR Technician only suffered minor injuries, it could have been much worse. What is reassuring is the significant number of preventive measures that have already been implemented, greatly reducing the chance of recurrence.

P. Dittmann
LCol
A/DFS
Annex A: Photographs of J5’s and J7’s Exit

J5’s exit above

J7’s exit above
Annex B: Photographs of LRSK over Reserve Parachute Compartment

LRSK has rolled inverted over reserve parachute compartment (orange bundle over J2’s shoulders)

LRSK has rolled inverted over reserve parachute compartment (orange bundle over J4’s shoulders)
Annex C: Photographs of J8’s Exit

1. J8 begins exit

2. LRSK begins to rotate. Note position of black LRSK attachment straps.

3. LRSK rotates further. Note position of black LRSK attachment straps.
LRSK is nearly inverted. Note attachment strap position.

LRSK is inverted and floating up over main parachute pack tray.

LRSK is over main parachute pack tray. Note attachment strap position.
Static line is taught. Outer deployment bag begins to extract. Static line is routed under right LRSK attachment strap.
Outer D-Bag is pulled snug under right side LRSK strap. Static line is tight. J8 begins to rotate facing back into aircraft.
Annex D: SAR Technician Model

SAR technician model is configured to connect to aircraft static line system. V-Rings visible.
-ote LRSK attachment strap angle and compaction of LRSK case.

Model simulates ball position for exit from aircraft.
LRSK drops slightly as body position relaxes tension in LRSK attachment straps.
LRSK is less compressed than picture above.
Once LRSK rolls inverted, there is sufficient slack in the attachment straps for the case to float up over the main parachute pack tray. Note strap position.

LRSK is inverted over parachute. Note extra length of LRSK attachment straps when LRSK case is over main parachute pack tray.
Annex E: List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>1 Cdn Air Div</td>
<td>1 Canadian Air Division Headquarters</td>
</tr>
<tr>
<td>AA</td>
<td>Airworthiness Authority</td>
</tr>
<tr>
<td>AAD</td>
<td>Automatic Activation Device</td>
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<tr>
<td>AGL</td>
<td>Above Ground Level</td>
</tr>
<tr>
<td>AIA</td>
<td>Airworthiness Investigative Authority</td>
</tr>
<tr>
<td>ALSE</td>
<td>Aircrew Life Support Equipment</td>
</tr>
<tr>
<td>AOC</td>
<td>Airworthiness Operational Clearance</td>
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<tr>
<td>ATES</td>
<td>Airborne Trials and Evaluation Section</td>
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<tr>
<td>CAR</td>
<td>Canadian Aviation Regulations</td>
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<tr>
<td>CF</td>
<td>Canadian Forces</td>
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<tr>
<td>CFAO</td>
<td>Canadian Forces Administrative Orders</td>
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<td>CFSSAR</td>
<td>Canadian Forces School of Search and Rescue</td>
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<td>CFTO</td>
<td>Canadian Forces Technical Orders</td>
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<tr>
<td>cm</td>
<td>centimetre</td>
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<tr>
<td>DAOD</td>
<td>Department Administrative Orders and Directives</td>
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<td>D-Bag</td>
<td>Deployment Bag</td>
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<tr>
<td>DFS</td>
<td>Director of Flight Safety</td>
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<tr>
<td>DMCS</td>
<td>Document Management Control System</td>
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<td>DAEPM (FT)</td>
<td>Directorate of Aerospace Equipment Program Management (Fighters and Trainers)</td>
</tr>
<tr>
<td>DGAEPM</td>
<td>Director General Aerospace Equipment Program Management</td>
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<tr>
<td>DND</td>
<td>Department of National Defence</td>
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<tr>
<td>DTAES</td>
<td>Directorate of Technical Airworthiness Support</td>
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<td>DZ</td>
<td>Drop Zone</td>
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<tr>
<td>FS</td>
<td>Flight Safety</td>
</tr>
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<td>FSIR</td>
<td>Flight Safety Investigation Report</td>
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<td>JM</td>
<td>Jump Master</td>
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<td>kts</td>
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<tr>
<td>LCMM</td>
<td>Life Cycle Maintenance Manager</td>
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<tr>
<td>LCol</td>
<td>Lieutenant Colonel</td>
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<tr>
<td>LPY</td>
<td>Life Preserver Yoke</td>
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<tr>
<td>LRSK</td>
<td>Life Raft Survival Kit</td>
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<tr>
<td>METAR</td>
<td>Weather Observation</td>
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<td>MND</td>
<td>Minister of National Defence</td>
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<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
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<tr>
<td>N/A</td>
<td>Not Applicable</td>
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<td>MWO</td>
<td>Master Warrant Officer</td>
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<td>OAA</td>
<td>Operational Airworthiness Authority</td>
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<tr>
<td>OAC</td>
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<td>OJTS</td>
<td>On-Job Training Standard</td>
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<tr>
<td>OTL</td>
<td>Operational Team Lead</td>
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</table>
PWGSC  Public Works and Government Services Canada
sm    Statute Mile
RTL   Restricted Team Lead
SAR   Search and Rescue
SKC   Survival Kit Container
SOCD  Statement of Capability Deficiency
SOW   Statement of Work
SP    Safety Person
SMM   Standard Manoeuvre Manual (CC115)
TAA   Technical Airworthiness Authority
TAC   Technical Airworthiness Clearance
TAO   Temporary Authority to Operate (letter)
TC    Transport Canada
TCCA  Transport Canada Civil Aviation
TL    Team Lead
TOTEF Transport Operational Test and Evaluation Flight
VFR   Visual Flight Rules
VMC   Visual Meteorological Conditions
WFSO  Wing Flight Safety Officer
WO    Warrant Officer
Z     Greenwich Mean Time