Case Report

Structural failure of Canopy

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Rapid decompression in a fighter aircraft results in physical and physiological effects on the aircrew. A case of inflight shattering of canopy during a dive from 3 km altitude is discussed. Since the rapid decompression occurred at lower altitude, the physiological effects like hypoxia and expansion of trapped gases in body cavities were not significant. The physical effects were marked. Aircrew are required to be regularly indoctrinated to comprehend the emergency in time and take corrective action.

Key words : Rapid Decompression, flying clothing, pressure differential

The incidence of rapid decompression in fighter aircrafts in IAF has fortunately been relatively low as compared to the quantum of sorties being carried out at any given time. The fact that they do occasionally occur, however, presents a potential danger to the pilot that cannot be underestimated.

In high performance jets, when the primary cause of rapid decompression has been sudden loss or structural failure of the canopy; the consequent injuries to the pilot and difficulty in sustaining the rest of the flight becomes more important than the physiological effects of rapid decompression. Here, a case of inflight shattering of canopy during a dive from 3 km altitude is discussed. The superior airmanship of the pilot, consequences of rapid decompression and role of the protective flying clothing in preventing potentially serious injuries to the pilot, are highlighted.

Case Report

The Flight Commander of the Mig 21M flight, with a total of 2920 hours of flying experience with 1100 hours on the Mig 21 variants only planned for a CAP vs strike sortie. The take off at 0700h and subsequent climb to 3 km along with his No 2 was uneventful. He was then controlled by the BFC (Base Fighter Controller) and the CAP (Combat Air Patrol) controller to make contact with the strike force. He made contact with the strike and positioned behind them at a distance of about 4 km at height of 3 kms and speed of 1000 kmph IAS. The subsequent events were described by him as follows :

"I started the dive from a height of 3 kms, while I was 4 kms behind the strike with an RPM of 100% and a speed of 1000 IAS. As I was passing through a height of 2.2 kms, I heard a loud explosion and was hit on my forehead and right shoulder. The aircraft pitched nose down and steeply banked to 130 to the right. I realised that my canopy had burst and immediately bent as far forward as possible, brought the ac wings level and commenced a pull out from the dive. The air was rushing into the cockpit and the noise level had increased excessively. I gave a RT call but could not hear myself. My antiglare visor had broken and its attached pieces started fluttering. The helmet tended to lift up. The nose of the aircraft started coming up only at a height of 1.2 kms, I continued to ease up and dropped the speed to 400-450 kmph IAS. I checked and found that all systems in the ac, except the RT were functioning normally, the RT cord had got disconnected due to the airflow effect, the helmet end of the RT cord had got stuck somewhere behind the headrest, and I could not reconnect the RT or move my head because of the increased airflow. I readjusted my helmet, tightened it and turned towards base. After the initial pull out, I climbed to a height of 2.3 kms. As I was without RT communication, I then descended to a height of 1.3 kms, crossed overhead the ATC, pressed my PTT to indicate my position on the Down Wind and executed a first attempt landing. After the landing run, I connected my RT cord and informed the ATC about my emergency and requested for an ambulance as I could feel the pain in my right shoulder and I was bleeding from my forehead. During the episode, my No 2 had lost RT and

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visual contact with me and I had disappeared from the radar scope. Only after 7 long minutes was I spotted by the ATC when I was on the final approach for a landing".

Injuries Sustained by the Pilot

The 37 year old pilot, on medical examination after the episode, was naturally a little anxious, trying to control his emotionson the realisation of the fact that he had a close encounter with a potentially serious situation in the air. His pulse rate was 92/min and his BP 140/90 mm of Hg. He sustained following injuries.

(a) There was a large contusion over the right deltoid region, with bluish discolouration of skin in a 5x3 cm area. There was moderate local tenderness. There was no neurological deficit in the right arm.

(b) There was one cm long laceration above the right upper eyelid which was bleeding.

(c) There were multiple abrasions on the forehead, nose and above the right eyebrow. There was no evidence of any cerebral concussion.

The pilot recovered completely by rest, sedatives and analgesics within 5 days.

Damage to Flying Clothing

The pilot was wearing Russian flying helmet 3 W 3M inner helmet WTT-82, KM -32 oxygen mask, indigenous flying overall, anti -G suit ABEU Mk II and flying boots. The following damage was sustained by the flying clothing :-

(a) Outer Helmet : The metal bonedome had a depression on the left forehead about 1 cm deep and 3 cms in diameter. This was caused by the shattered fragments of plexiglass. There was fore to aft compression of 1.8 cms, while the shape of the helmet had become irregular.

(b) G-Loaded Antiglare Visor : This was in the down position and had shattered into many pieces. Three pieces were still attached to the bonedome. The right piece which was connected to the helmet without the locking mechanism, kept fluttering throughout, after the incident.

(c) KM-32 Mask : The clip which connects the nose bridge of the mask to the inner helmet hook had sheared off. The RT cord of the helmet had disconnected from the aircraft cord.

Material Evidence

In the ac, the canopy hood metal frame was found in fully locked position. One large piece (8cm x 5 cm) of the canopy glass and a few fragments were found in the cockpit. One visor piece was also found inside the cockpit.

The canopy life was 10 years and it was due for withdrawal in another 5 months time at the expiry of its life.

The ac fuselage had been damaged, there were multiple cuts predominantly on the starboard side, with a major 90 cm x 30 cm tear in the leading edge of the starboard stabiliser.

The cause of the canopy burst was probably due to the glue having given way, separating the frame from the left side first, thereafter disintegrating and flying off on the right side of the ac, damaging most of the stabiliser leading edge.

Aeromedical Considerations

It was very fortunate that the pilot could recover the ac in time and bring it back to Base. This innocuous looking incident with no RT communication immediately after the emergency, could have turned out to be a serious mystery accident in the IAF. This incident throws up many aeromedical issues worth considering, some of them are discussed below.

Effect of Rapid Decompression

The serious physiological implications of rapid decompression due to over distention and over pressurisation of the thorax and the

abdomen are avoided in fighter ac by restricting the cabin differential pressure to a maximum of 5 PSI.

The pressure differential at 3 km altitude in this case was 0.06 kg/cm^2 or 0.882 PSI, which is well within the safe zone. Therefore, the effect of rapid decompression experienced by the pilot were physical ones only viz loud explosion, effect of ram air pushing him backwards, lifting up of helmet, difficulty in moving the head, disconnection of RT and continuous increase in noise level.

The explosion had occurred at a very critical stage of flight i.e. during a dive from 3 km. The important thing is that the sudden and unexpected emergency was recognised by the pilot instantly and keeping his cool, he recovered the ac with exceptional airmanship. The role that regular indoctrination can play in preparing the pilot for such an emergency, especially for the lesser experienced ones, cannot be overemphasised.

The ac was recovered by losing one km height after the emergency, almost at the edge of the minimum ejection height for the speed of the aircraft. In the next few seconds, ejection would have been the next step. Had the pilot been incapacitated, which was not unlikely, looking at the impact sustained by the helmet and the visor, and with no RT communication, the ac and the aircrew could have been lost, without leaving a clue as to what happened in the air. For the accident investigation teams, looking into accidents where the ac has been lost with no RT communication, it is worth excluding pilot incapacitation due to canopy burst while forming other opinions.

Proper Use of Flying Equipment

The impact on the flying helmet was so severe that had the hit been on any other exposed part of the head, it would have led to a serious incapacitation of the pilot. Proper securing of the helmet from the beginning of the flight is as important.Had the strap been loose, the bonedome would have lifted up exposing the vulnerable area and thus losing its protective value. This fact needs wide and repeated publicity amongst aircrew.

The visor, being down, prevented serious injuries to the eyes. At present, the aircrew are flying with their antiglare visors up during night flying and also in poor visibility condition. There is a need to incorporate transparent visors for use at night. This will need a modification of the existing equipment.

Conclusion

This case highlights the following points

(a) The physiological effects of rapid decompression were within normal limits.

(b) The physical effects were marked and need regular indocrintation of aircrew to comprehend the emergency in time .

(c) Accident investigation agencies need to keep pilot incapacitation due to canopy shattering in mind in unexplained accidents.

(d) The use of a proper sized bonedome, fully secured with visor down, should be a practice for all aircrew.

(e) The RT leads of the helmet and ac can be secured betterby putting a rubber sleeve around them and fixing the two cords by clips to the shoulder strap.