

## Centrifuge training for ab - initio pilots : Overview

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Centrifuge training for ab-initio fighter pilots and Positive pressure breathing under +Gz in the centrifuge, are the two measures introduced since 1998 onwards at IAM, IAF to enhance +Gz tolerance of pilots. These measures are likely to minimise the incidence of G-LOC in our pilots. This paper gives an overview of the concepts.

**Keywords :** G-induced loss of consciousness (G-LOC), anti-G straining manoeuvre (AGSM), air superiority fighters, aerial combat manoeuvre, positive pressure breathing under +G<sub>z</sub> (PBG).

With the technological advancements, acceleration capabilities of fighter aircraft are continually increasing and so are +Gz exposures to the pilots, both in terms of its level and duration. The major threat that confronts every fighter pilot on every sortie - a threat that can abruptly result in pilot incapacitation, mission compromise, loss of the aircraft and the loss of life, is G-induced loss of consciousness (G-LOC). A mismatch of the pilot's G-tolerance with the G-envelope capability of the aircraft may result in pilot's incapacitation. Everyone has a G-tolerance limit, both in terms of peak G (G-level) and G duration, which may be exceeded with the existing G-protective methods, resulting in G-LOC. Thus, loss of consciousness caused by the acceleration that occurs during aircraft manoeuvres is basically a physiologic problem and the +Gz (and its cause) cannot be removed since it is inherent in flying high performance aircraft.

During the 1982-1990 period, at least 14 pilot lives and 18 fighter aircraft in USAF have been lost due to G-induced Loss of Consciousness (G-LOC) [1]. During the period 1982-96, USAF experienced a total of 24 accidents in which there was a fatality or loss of the aircraft and in which G-LOC was found to be a causal factor [2]. The G-LOC surveys conducted at IAF [3] and other countries [4] revealed an incidence rate of 10-19% in experienced pilots. A comparison of the most frequent causes of G-LOC as found in these surveys showed rapid G onset, being unprepared, and performing a poor anti-G straining manoeuvre (AGSM) appear to be common problems.

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conducting High-G training for fighter aircrew since Mar 1991 during which aircrew are subjected to high G runs (upto 9 +Gz) [5]. 345 aircrew have so far been trained. The successful completion of the centrifuge training is essential for the aircrew converting to air superiority fighters (Mirage 2000, MiG-29 and Su-30). Both objective and subjective evidence has established that the centrifuge training is highly beneficial to the pilots.

This paper gives an overview of the measures to increase the +Gz tolerance of the fighter pilots, which have been introduced in the Indian Air Force in the recent past.

### Centrifuge Training

Primary aim of the centrifuge training is to increase +Gz tolerance resulting from improved skill in performing an anti-G straining manoeuvre (AGSM). Encouraged by the success of the centrifuge training in experienced aircrew, a capsule of two days of centrifuge training in combination with didactic component on +Gz and Spatial Disorientation for the Stage II Alpha (fighter) pilots was started at the Institute in June 1998. All fighter aircraft training for IAF and Indian Navy begins during Stage II Alpha at Hakimpet on Iskra and Kiran Mk II aircraft. The basic principles and experiences relating to +Gz stress are gained during Stage II Alpha. The main advantage accruing from the centrifuge training introduced at this stage, is the learning of correct technique in performing anti-G straining manoeuvre (AGSM) at the very start of their career in fighter flying. Learning of AGSM during this phase of flying is important as G-LOC has been reported to occur in Iskra and Kiran aircraft [3]. G-LOC has also been observed in USAF undergraduate pilot training programme [6] at mean +Gz of 3.8 G. G-LOC at low +Gz is due to several factors including no anti-G suit in the

basic trainers, improper or non-performance of the AGSM, un-initiated status of the pupil pilot and one of the two crew in the trainer may not be prepared for the abrupt onset of the +Gz manoeuvre. Thus centrifuge training is likely to reduce the incidence of G-LOC in these pilots. It has been recommended that the pilots should be centrifuge trained before they experience in-flight accelerations of 4 G and greater (without an anti-G suit) and 5 G and above with an anti-G suit [4].

The importance of physical conditioning especially weight training is emphasized during the course. Pilots are required to do weight training during the training and correct way of performing the exercises is demonstrated. A physical conditioning programme increases tolerance to high +Gz aerial combat manoeuvres, where an AGSM is used, by reducing fatigue [4]. The energetics of the AGSM is anaerobic that directly relates to the basis of Aerial Combat Manoeuvres (ACM). Therefore, a physical conditioning programme that increases anaerobic capacity and power is considered desirable to increase ACM tolerance [4].

The pilots are also given centrifuge runs with the anti-G suit so as to make them realize the importance of the suit and quantitative enhancement of their +Gz-tolerance with it. The learning of AGSM will be reinforced by a longer course of two weeks [Advanced Fighter Acromedical Indoctrination Course (AFAIC)] as and when they are selected for Air Superiority fighters. AFAIC is an exhaustive course during which pilots are taken to high +Gz (upto 9 G) as well as alternating 4 G - 8 G peaks (SACM), which is commensurate with the +Gz profile of air superiority fighters [5].

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### Positive Pressure Breathing Under +Gz (PBG)

PBG as a method of reducing the fatigue associated with the AGSM, is the latest +Gz protection method [7]. Centrifuge studies and early flight-test data suggest that the fatigue that develops during high +Gz manoeuvre with the AGSM is reduced by about 50%, i.e., a 5 to 9 +Gz SACM tolerance time is doubled with PBG. A beginning has been made at the Institute to indoctrinate the pilots undergoing training during AFAIC to experience the PBG during high +Gz centrifuge runs. PBG facility exists in Su-30 aircraft and will be provided in LCA or any future fighter aircraft. Centrifuge PBG training is considered essential to derive maximum benefits from it in the aircraft [4].

### Conclusion

Centrifuge training for ab-initio fighter pilots and Positive pressure breathing under +Gz in the centrifuge are the two measures introduced since 1998 at IAM, IAF to enhance +Gz tolerance of pilots. A physical conditioning programme, that increases anaerobic capacity and power to increase +Gz - duration tolerance, is also taught

to the pilots. These measures are likely to minimise the incidence of G-LOC in our pilots.

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