

INFO TECH n. 11/2019

Dipartimento Tecnico – 13 Marzo 2019

(english text at the bottom)

LOSS OF CONTROL IN-FLIGHT (LOC-I) AND AIRCRAFT TRIM SYSTEM

Cari Colleghi,

In questa Info Tech vogliamo condividere la posizione dell'IFALPA sugli incidenti di perdita di controllo In volo (LOC-I) ed i sistemi di trimmaggio aeromobile.

I LOC-I sono incidenti in cui si perde il controllo dell'aeromobile in volo.

Nell'ultimo decennio tale tipo di incidenti hanno superato gli incidenti di tipo "Controlled Flight into Terrain" (CFIT) come primo contributore agli incidenti mortali nell'aviazione commerciale.

Questa "Position Paper" si concentra su LOC-I e sui modi per mitigare questi rischi.

Ci preme rimarcare in questa premessa le raccomandazioni elaborate dall'IFALPA al fine di mitigare tali rischi legati al trim:

- Fornire agli equipaggi di volo strumenti che consentano loro di rilevare e riconoscere immediatamente condizioni pericolose di trimmaggio errato e degradato o di avaria del sistema.
- Migliorare e mantenere tramite addestramento la competenza e le capacità del pilota per affrontare condizioni di trimmaggio errato.
- Migliorare la conoscenza e la consapevolezza di questo tipo di incidenti includendo e analizzando sistematicamente i dati di trim come parte del processo di occurrence reporting.

Buona lettura

[ANPAC - Dipartimento Tecnico](#)

Per ogni osservazione o feedback è gradita un'email a: dt@anpac.it

[English Version](#)

LOSS OF CONTROL IN-FLIGHT (LOC-I) AND AIRCRAFT TRIM SYSTEM

Dear Members,

In this Info Tech we want to share the position of IFALPA on incidents and accidents of loss of control In Flight (LOC-I) and aircraft trim systems.

The LOC-I are incidents and accidents in which control of the aircraft in flight is lost. In the last decade, this type of accident has overtaken "Controlled Flight into Terrain" (CFIT) accidents as the first contributor to fatal accidents in commercial aviation. This "Position Paper" focuses on LOC-I and on ways to mitigate these risks.

We would like to underline in this premise the recommendations prepared by the IFALPA in order to mitigate these risks related to the trim:

- Provide tools for flight crews to immediately detect and detect dangerous conditions of incorrect and degraded trimming or system failure.
- Improve and maintain the pilot's skills and abilities to tackle erroneous trimming conditions through training.
- Improve the knowledge and awareness of this type of incident by systematically including and analyzing trim data as part of the occurrence reporting process.

Enjoy the reading

[ANPAC - Dipartimento Tecnico](#)

Any comments or feedback is welcome by emailing us at: dt@anpac.it

LOC-I and Aircraft Trim Systems

BACKGROUND

Loss of Control In-flight (LOC-I) are accidents or incidents in which the control of the aircraft in flight is lost, resulting in major deviations from the intended flight path. In the last decade 2004-2014, LOC-I airplane accidents have overtaken CFIT, Controlled Flight into Terrain-related ones as the first contributor to fatalities in commercial aviation.¹

PRELIMINARY ANALYSIS

Trim system

Historically, an aircraft trim system was needed to reduce control loads on the three axes: pitch, roll, and yaw. With the development of flight control systems as well as Fly-By-Wire (FBW) designs, pilots are now fully assisted in trimming the aircraft throughout the entire flight envelope. Therefore, depending on aircraft type, trim can be partially or completely transparent to flight crews.

Loss of Control related to trim system

Recent occurrences involving trim issues have happened in all phases of flight. The out-of-trim conditions resulted principally from:

- Unsafe automatic trimming due to previous system failures (trim runaway, auto trim beyond normal limits up to mechanical or electrical stops, trim failure or trim degraded modes).
- Normal automatic trimming for a specific phase of flight immediately followed by large aerodynamics and thrust modification. Under-speed high-nose-up trimmed approach followed by a go around maneuver is a typical example and there is currently rulemaking activity happening on this specific subject.^{2 3}
- Improper manual trim (switch confusion, spatial disorientation).

In most cases, and regardless of the initial scenario, the maximum out-of-trim condition happened quickly (less than one minute) and was reached before, or at the very beginning of, the overall event. It was often not recognized as such by crews. Typical subsequent warnings included auto-pilot disconnection alarms (manual or consequently to failures), stick shaker and/or bank angle warnings with or without flight law reconfiguration and protections activation.

Most of the time, crews have only indirect cues and are not fully aware of the trim setting. In other words, they don't know the position of some of the main flight control surfaces in terms of authority (i.e. rudder or trimmable horizontal stabilizer). There have been numerous accidents and incidents in recent years where flight crews did not even try to operate trim switches at all. If they did so, it was only after 1 or 2 minutes.

1 IATA, 2016, "2010-2014 LOC-I Accident Analysis Report", 1st edition

2 EASA, 2017, "Rulemaking Program, RMP EPAS, 2017-2021

3 EASA, 2015, "RMT.0647 Loss of control or loss of flight path during go-around"

Moreover, some occurrence reports have considered an out-of-trim condition as the initial failure rather than a contributing factor. There is often a lack of full data on trim position (on the three axes), and stress is preferentially put on the controls and thrust inputs and not on trim dynamics.

POSITION

Prevention objectives

In order to mitigate such trim-related risks, IFALPA recommends the following actions:

- To provide flight crews with tools allowing them to detect and recognize immediately dangerous out-of-trim conditions as well as trim degraded mode operation or failures.
- To enhance and maintain pilot proficiency and skills to deal with full or partial out-of-trim conditions.
- To enhance knowledge and awareness of this type of accident by systematically including and analysing trim data as part of the occurrence reporting process.

Display of trim information, alerts, warnings

While the display of trim information and/or associated alerts can be designed in various ways, any detected or predicted abnormal trim conditions should trigger, in a timely manner, clear visual/aural alerts or warnings with as much information as relevant to understand the situation.

Since the trim system can be faulty by itself (i.e. trim overrun) or in degraded mode (i.e. icing), the monitoring should be as simple as possible and could rely, for example, on direct surface sensing. Priority of alerts and warning should be considered, since most trim upsets lead to multiple alarms conditions. Particular attention should be paid to the avoidance of false positive alarms.

Additionally, IFALPA would welcome the introduction of any display designed to help pilots recognize an impending excursion outside the flight envelope as an additional tool to avoid out-of-trim conditions.

Out-of-Trim detection and recovery training⁴

Even if trimming is now simplified in modern FBW aircraft, trim-related training is important during initial and operational and recurrent training. The following elements should be included in the training:

- Manual flying skills, in non-normal flight laws when manual trimming is required. This should include all three axes.
- Stalls or Upset recovery from partial or full out-of-trim conditions on different axis. (i.e. "trimmed stalls") in order to mitigate the startle effect. Training should include increased awareness of the possibility of out-of-trim condition upon autopilot disconnection.
- Review of normal, abnormal, and emergency manoeuvres or conditions where trim may be required as per SOP.
- Flight controls characteristics, specificity of the trim system design, elevators or ailerons authority limitations (if they exist) and thrust pitch moment management.

⁴ ICAO, 2014, "Doc 10011 - Manual on Aeroplane Upset Prevention and Recovery Training"