INTERNATIONAL STANDARD

ISO 1151-7

Second edition
2023-11

Flight dynamics — Vocabulary —

Part 7: Flight points and flight envelopes

Dynamique de vol – Vocabulaire —

Partie 7: Points de vol et domaines de vol

Reference number
ISO 1151-7:2023(E)

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Published in Switzerland

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Foreword

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This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 8, *Aerospace terminology*.

This second edition cancels and replaces the first edition (ISO 1151-7:1985), which has been technically revised.

The main changes are as follows:

— new terms for subclause "Types of aircraft motion" have been supplemented.

A list of all parts in the ISO 1151 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Flight dynamics — Vocabulary —

Part 7: Flight points and flight envelopes

1 Scope

This document defines the concepts and terms used in flight dynamics studies to specify aircraft flight conditions and envelopes.

This document applies to the analysis of operational, experimental or simulated flights for the purposes of safety analyses and qualification, taking into account potential failures and likely environmental conditions.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Accomplishment of a mission

3.1.1
mission
purpose of a flight achieved while respecting constraints, among others, of time and of space

Note 1 to entry: The objective and the constraints can be specified in a flight plan.

3.1.2
flight program
preschedule of intermediate objectives required to fulfil the *mission* (3.1.1) within an *authorized flight envelope* (3.7.1)

Note 1 to entry: Provision can be made in the flight programme for some conditional changes of intermediate objectives according to circumstances arising during the flight (failure, meteorology, traffic, etc.).

3.1.3
phase
flight phase
portion of the flight characterized by an intermediate objective

Note 1 to entry: The intermediate objective is defined with some tolerance as to the accuracy with which the objective is considered to have been achieved, such that the following phase can be initiated under conditions that allow it to be executed.

Note 2 to entry: Examples of flight phases are: take-off, climb, cruise, descent, approach, landing.

3.1.4
sub-phase
flight sub-phase
portion of a *phase* (3.1.3) characterized by an elementary objective

EXAMPLE "Ground run" in the "take-off" phase, "flare" and "ground run" in the "landing" phase.

Note 1 to entry: The elementary objective is defined with some tolerance as to the accuracy with which the objective is considered to have been achieved, such that the following sub-phase can be initiated under conditions that allow it to be executed.

Note 2 to entry: Following the breakdown of a phase into sub-phases, certain parameters can often be considered as constants during the sub-phase [e.g. mass characteristics of the aircraft, *state of the atmosphere* (3.4.1)].

3.2 Controls, geometric configuration and condition of systems

3.2.1
control
element located in the cockpit and operated by the crew to fly the aircraft

EXAMPLE Stick; throttles; undercarriage and flap selection levers; switches to engage autopilot or dampers; pressurization and air conditioning controls.

Note 1 to entry: The same control can be a *piloting control* (3.2.1.1) during one *sub-phase* (3.1.4) and a *selector* (3.2.1.2) during another sub-phase; for example, the throttle is a selector during the "take-off" phase and a piloting control during the "approach" phase.

3.2.1.1
piloting control
control (3.2.1) operated by the pilot, in a continuous or intermittent manner, during a *sub-phase* (3.1.4) in order to comply with the *piloting rules* (3.5.1) and to achieve the objective of that sub-phase

3.2.1.2
selector
control (3.2.1) put into a position by the crew, as laid down in the flight manual, at the beginning of a *sub-phase* (3.1.4) and which remains in that position throughout that sub-phase

3.2.2
configuration
geometric configuration
set of quantities characterizing the relative positions of the various components of the aircraft, that can be controlled by *selectors* (3.2.1.2)

Note 1 to entry: See ISO 1151-6:1982, 6.0.2.

Note 2 to entry: The list of quantities is restricted to those involved in the problem under consideration.

Note 3 to entry: The geometric configuration shall not be confused with the geometric state (see ISO 1151-1-6:1982, 6.1.17) of which it forms only a part.

3.2.3
situation of the systems
set of parameters defining the operating behaviour of the aircraft systems concerned with flight dynamics

Note 1 to entry: The list of parameters is restricted to those involved in the problem under consideration.

3.3 State of the aircraft

3.3.1
situation of loads carriage
list of the different internal or external loads (passengers, freight, containers and pallets, fixed or jettisonable fuel tanks, internally or externally carried stores, etc.) for a given *mission* (3.1.1), with their positions, that modify the mass, the mass distribution, and, in certain cases, the geometric form of the aircraft

Note 1 to entry: Internal fuel is not included in these loads. For flight refuelling tankers, fuel is considered to be a load.

Note 2 to entry: For certain missions, the situation of loads carriage can be modified during a transition *sub-phase* (3.1.4) (e.g. by jettisoning stores or dropping parachutists). See note 1 to entry in 3.3.2.2.

3.3.2
selected situation
list of the set of positions of the different *selectors* (3.2.1.2) during a *sub-phase* (3.1.4)

Note 1 to entry: For each sub-phase, there is a single selected situation, defined either in the flight manual for operational flights or in the study programme for experimental flights.

Note 2 to entry: The selected situation can be divided into two sub-sets: a *selected geometric configuration* (3.3.2.1) and a *selected situation of the systems* (3.3.2.2).

Note 3 to entry: An order to change the position of a selector may not be associated with a geometric displacement of the selector itself, but may be achieved by appropriate signalling.

3.3.2.1
selected geometric configuration
list of the set of positions of only those *selectors* (3.2.1.2) concerned with the *geometric configuration* (3.2.2) of the aircraft during a *sub-phase* (3.1.4)

3.3.2.2
selected situation of the systems
list of the set of positions of only those *selectors* (3.2.1.2) concerning the systems (3.2.3) during a *sub-phase* (3.1.4)

Note 1 to entry: Certain sub-phases, called transition sub-phases, are characterized by the change either in the position of components or in the state of the systems controlled by the change in the position of one or of several selectors. The duration of the transition sub-phase is then determined by the time taken to change the position of the components or the state of the system, for example, sub-phase "undercarriage out".

Note 2 to entry: In certain studies, and in particular during a flight test, it can be useful to study the behaviour of the aircraft in positions of the components or for system functions that do not usually occur during operational flights. For example, the flight can be studied at low incidence with leading edge slats extended or at high incidence with slats retracted, even though in operational flight the position of the slats can be automatically fixed by the incidence and the speed. To describe those particular *selected situations* (3.3.2), it is necessary to indicate that the automatic system has been made inoperative by a selector activated specifically for that purpose.

3.3.3
failure situation
list of the set of abnormal positions of components and of the set of abnormal functions of the systems during a *sub-phase* (3.1.4)

Note 1 to entry: See ISO 1151-6:1982, 6.0.2.

Note 2 to entry: The failure of a system, the operation of which is not involved in a sub-phase, shall be taken into consideration in defining the failure situation, because it can modify the probability of failures in that sub-phase or in other sub-phases.

Note 3 to entry: In line with this definition, the non-operation of one of the lines of a redundant system shall be considered as a failure, even if the other lines maintain the function of the system. In those conditions, the failure situation is said to be a "partial failure situation".

Note 4 to entry: In the case of a flight or simulator test, or of a training flight, a failure may be provoked or simulated.

3.3.4
real situation
result of the *selected situation* (3.3.2) and of the *failure situation* (3.3.3) during a *sub-phase* (3.1.4)

Note 1 to entry: The real situation may be broken down into two sub-sets: *real geometric configuration* (3.3.4.1) and *real situation of the systems* (3.3.4.2).

3.3.4.1
real geometric configuration
result of the *selected geometric configuration* (3.3.2.1) and of the *failure situation* (3.3.3) during a *sub-phase* (3.1.4)

3.3.4.2
real situation of the systems
result of the *selected situation of the systems* (3.3.2.2) and of the *failure situation* (3.3.3) during a *sub-phase* (3.1.4)

3.3.5
state of the aircraft
result of a *situation of loads carriage* (3.3.1), a *real situation* (3.3.4), a mass and a mass distribution of the aircraft during a *sub-phase* (3.1.4)

Note 1 to entry: In some cases, for calculations, for flight tests or simulated flight tests, it can be useful to define the state of the aircraft independently of the sub-phase.

3.4 Environment

3.4.1
state of the atmosphere
set of physical parameters characterizing, at a point, the atmosphere considered as undisturbed by the aircraft and having an influence on the motion of the aircraft and on the behaviour of the crew

Note 1 to entry: The point considered is either the actual point at which the aircraft is or one of the points at which it is likely to be, during its flight.

Note 2 to entry: The following parameters and certain gradients, when necessary, are taken into consideration: pressure (ISO 1151-5:1987, 5.1.1), temperature (ISO 1151-5:1987, 5.1.2), density (ISO 1151-5:1987, 5.1.3), humidity, wind speed (ISO 1151-2:1985, 2.2.3), intensity and distribution of turbulence, visibility, icing conditions.

Note 3 to entry: During a *sub-phase* (3.1.4), the state of the atmosphere can often be considered as not varying.

Note 4 to entry: The state of the atmosphere can be affected by the presence of other aircraft.

3.4.2
model state of the atmosphere
state of the atmosphere (3.4.1) for which the values of the parameters are defined as a function of the altitude, the geographic coordinates and the time

3.4.3
standard state of the atmosphere
model state of the atmosphere (3.4.2) for which the values of the parameters are identical to those of the standard atmosphere, as a function of the geometric altitude or the geopotential altitude of the point considered

Note 1 to entry: The standard atmosphere is defined in ISO 2533, which assumes that the air is clean, dry and motionless with respect to the Earth.

Note 2 to entry: Particular states of the atmosphere, derived from the standard state, are usually defined by increments of temperature ΔT with respect to the temperature in the standard atmosphere of ISO 2533, ΔT being independent of the pressure altitude (ISO 1151-5:1987, 5.3.1).

3.4.4
reference state of the atmosphere
model state of the atmosphere (3.4.2) for which the values of the parameters are the functions of the geometric altitude or of the geopotential altitude of the point considered

Note 1 to entry: The reference atmosphere used shall be specified.

Note 2 to entry: ISO 2533 gives, for the reference atmospheres that it defines, the mean values of the characteristics of the atmosphere as a function of altitude for different latitudes and times of the year.

3.4.5
state of the runway
set of physical parameters of the runway affecting the motion of the aircraft and the behaviour of the crew, during the *sub-phases* (3.1.4) of the take-off and landing *phases* (3.1.3)

Note 1 to entry: The following parameters are taken into consideration: length, width, mean slope, profile in elevation, material, roughness, water, snow, ice.

Note 2 to entry: For mobile runways (e.g. runway on a ship), a similar definition may be given.

Note 3 to entry: For aircraft that take off and alight on water, a similar definition can be given for the state of the water surface.

3.5 Flight points

3.5.1
step
piloting rules
set of positions in which the crew puts the *selectors* (3.2.1.2) and set of values for the various flight parameters or of the relationships between those parameters which are maintained, manually or automatically, in order that the objective of the *sub-phase* (3.1.4) is achieved

Note 1 to entry: The parameters considered are the position with respect to a reference trajectory, calibrated airspeed, the Mach number, the attitude angles of the aircraft, etc.

Note 2 to entry: See ISO 1151-5:1987, 5.6.1

Note 3 to entry: See ISO 1151-1:1988, 1.3.3.

Note 4 to entry: Piloting rules shall be given with tolerances; these tolerances shall be compatible with the tolerances of the sub-phase objective.

Note 5 to entry: Piloting rules are specified in the flight manual for the operational flights and in the programme of tests for real or simulated experimental flights.

3.5.2
piloting work
work the crew is required to do, during a *sub-phase* (3.1.4), in order to comply with the *piloting rules* (3.5.1)

3.5.3
supplementary rules
set of instructions relating to the action the crew takes during a *sub-phase* (3.1.4), but excluding those instructions laid down in the *piloting rules* (3.5.1)

Note 1 to entry: The supplementary rules concern, for example, the use of the radio, the reading and verification of check lists.

Note 2 to entry: Supplementary rules are specified in the flight manual for operational flights and in the programme of tests for real or simulated experimental flights, or are imposed by air traffic regulations.

3.5.4
supplementary work
work the crew is required to do, during a *sub-phase* (3.1.4), in order to comply with the *supplementary rules* (3.5.3)

3.5.5
flight point
flight case
chosen set of flight conditions, during a *sub-phase* (3.1.4), consisting of:

— the *state of the aircraft* (3.3.5);

— the *state of the atmosphere* (3.4.1);

— the *state of the runway* (3.4.5), if appropriate;

— the *piloting rules* (3.5.1);

–— the *supplementary rules* (3.5.3).

Note 1 to entry: In some cases, this set may be reduced, e.g. pressure altitude (ISO 1151-5:1987, 5.3.1), Mach number (ISO 1151-1:1988, 1.3.3), load factor (ISO 1151-1:1988, 1.5.9).

3.6 Effective flight points

3.6.1
excursion
involuntary variations by the crew of the flight parameters, during a *sub-phase* (3.1.4), with respect to values imposed by the *piloting rules* (3.5.1) concerned with that sub-phase

Note 1 to entry: Those variations are due, for example, to involuntary movements of the crew, to malfunctioning and imperfections of the systems, to the development of failures or to atmospheric disturbances.

3.6.2
effective flight point
effective flight case
set of flight conditions that exist in a *sub-phase* (3.1.4), consisting of:

— the *state of the aircraft* (3.3.5);

— the *state of the atmosphere* (3.4.1);

— the *state of the runway* (3.4.5), if appropriate;

— the *piloting rules* (3.5.1) and an *excursion* (3.6.1);

— the *supplementary rules* (3.5.3).

3.7 Flight envelopes

3.7.1
authorized flight envelope
set of *flight points* (3.5.5) for which the flight is authorized concerning the safety point of view

Note 1 to entry: The authorized flight envelope is sometimes defined by flight points, taking into account only the *state of the aircraft* (3.3.5), the *state of the atmosphere* (3.4.1) and the *state of the runway* (3.4.5), if appropriate.

3.7.2
peripheral flight envelope
set of *effective flight points* (3.6.2), situated outside the *authorized flight envelope* (3.7.1), which may be brought about by *excursions* (3.6.1) from the authorized flight envelope, whose amplitude does not exceed some suitably chosen limited value

3.7.3
recommended flight envelope
set of *flight points* (3.5.5) situated within the *authorized flight envelope* (3.7.1) and recommended by the flight manual for operational reasons