INTERNATIONAL STANDARD

ISO 1151-11

First edition
2023-12

Flight dynamics — Vocabulary —

Part 11: Control system

Reference number
ISO 1151-11:2023(E)

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Published in Switzerland

Contents

Page

Foreword ..... **iv**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

3.1 Basic concepts 1

3.2 Basic elements 3

3.3 Control system classification 6

Index **10**

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Flight dynamics — Vocabulary —

Part 11: Control system

1 Scope

This document establishes the terms and definitions of the basic concepts applied in science, engineering and manufacturing in the field of flight control systems of aircraft (airplane and helicopter).

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 Basic concepts

3.1.1
system
combination of components, parts, and elements that are interconnected to perform one or more specific functions

3.1.2
control system
set of mechanical or electronic devices that manages, commands, directs or regulates the behaviour of other devices or *systems* (3.1.1) by controlling the output

3.1.3
flight control system
complex of mechanical and electronic devices of aircraft (airplane and helicopter) providing its stability and controllability to allow the pilot to control the movement and attitude of aircraft at all stages and the modes of flight by changing the external forces or moments acting on aircraft

3.1.4
automatic flight control system
AFCS
type of flight control system (3.1.3) which provides aircraft control by measuring controlled variables and comparing them with reference input to reach the goal defined over measured values in terms of quality

Note 1 to entry: The AFCS is composed of several sub-systems that work together to provide automatic flight control. The main components of the AFCS are the *autothrottle system* (3.3.9), *flight director system* (3.3.10), *autopilot system* (3.3.11), *flight management system (FMS)* (3.3.12).

Note 2 to entry: The crew can select whether to put the aircraft under *autopilot* (3.3.9) or manual control mode. Under the autopilot mode, the aircraft *flight control surfaces* (3.1.7) move automatically; under the manual control mode, the pilot follows the displayed *flight director* (3.3.10) commands to achieve the desired status.

3.1.5
effector
control effector
external device that directly changes forces and/or moments acting on aircraft to control aircraft position and attitude

3.1.6
inceptor
control inceptor
cockpit controller
cockpit device for enabling pilot input through direct linkage or a *flight control system* (3.1.3) or computer to *control effectors* (3.1.5)

3.1.7
control surface
flight control surface
aerodynamic control surface
movable airfoil that provides reactive force when in motion relative to the surrounding air for guiding or controlling an aircraft in flight

3.1.8
primary flight control surface
primary control
control surface (3.1.7) used as *effector* (3.1.5) providing force or moment for aircraft stability or manoeuvring control

3.1.9
secondary flight control surface
secondary control
control surface (3.1.7) used to modify an aerodynamic characteristic of aircraft

3.1.10
actuator
device for producing motion of *effector* (3.1.5) and/or force acting on effector

3.1.11
sensor
physical device for detection of *inceptor* (3.1.6) positions, feedback measurements or scheduling information

3.1.12
longitudinal control
control of airplane's pitching about the lateral axis

3.1.13
lateral control
control of airplane's rolling about the longitudinal axis

3.1.14
directional control
control of airplane's yawing about the normal or vertical axis

3.1.15
control effectiveness
measure of the effect of utilizing a *control effector* (3.1.5), either moment, moment coefficient, or angular acceleration produced for a given *control surface* (3.1.7) deflection

3.1.16
control power
aircraft angular acceleration per unit of *control effector* (3.1.5) deflection

3.1.17
authority
permissible maximum amplitude of a signal or physical parameter

3.1.18
control authority
aggregate effect of the effectiveness of all the *control effector* (3.1.5) in whatever combination

3.1.19
control sensitivity
magnitude of aircraft response to forces applied on the *control inceptor* (3.1.6) or *control effector* (3.1.5)

3.1.20
attitude control
control of the orientation of aircraft with respect to inertial frame of reference

3.1.21
trim system
part of a *flight control system* (3.1.3) that adjusts the aerodynamic forces on the *primary flight control surfaces* (3.1.8) to maintain the aircraft at the set altitude without control input

3.2 Basic elements

3.2.1
aileron
primary flight control surface (3.1.8), movable airfoil at the trailing edge of an airplane wing used as *effector* (3.1.5) to change rolling moments for *lateral control* (3.1.13) about the longitudinal axis of the aircraft

3.2.2
elevator
primary flight control surface (3.1.8), movable (auxiliary) airfoil hinged to the rear of the left and right *horizontal stabilizer* (3.2.17) of the aircraft tail used as *effector* (3.1.5) to change pitching moments for *longitudinal control* (3.1.12) about the transversal axis of the aircraft

3.2.3
rudder
primary flight control surface (3.1.8), movable (auxiliary) airfoil hinged to the rear of the vertical stabilizer (fin) of the aircraft tail used as *effector* (3.1.5) to change yawing moments for *directional control* (3.1.14) about the normal axis of the aircraft

3.2.4
elevon
control surface (3.1.7) on an airplane that combines the functions of *elevator* (3.2.2) and *aileron* (3.2.1) to control both roll and pitch attitudes

3.2.5
ruddervator
control surface (3.1.7), usually a on 'V' or 'butterfly' tail airplane, that combines the functions of *elevator* (3.2.2) and *rudder* (3.2.3) to control both yaw and pitch attitudes

3.2.6
canard
horizontal *control surface* (3.1.7) mounted ahead of the wing to provide longitudinal stability and control and to control pitch attitude

3.2.7
flap
secondary control (3.1.9), movable airfoil usually attached to the trailing edge of a wing on an airplane that changes its camber to increase both its lift and its drag

3.2.8
leading-edge flap
secondary control (3.1.9), movable element of an airplane wing attached near its leading edge that changes its camber to increase both its lift and its drag

3.2.9
slat
secondary control (3.1.9), movable element of an airplane wing attached near its leading edge that produces a slot aft of the leading edge in order to allow air from below the wing to pass through and maintain laminar flow at high angle-of-attack

3.2.10
spoiler
uncambered *control surface* (3.1.7) deflected symmetrically upward above the aft surface of the wing for reducing the wing lift during landing and for increasing drag to act as *speed brakes* (3.2.11) or deflected on one side only to act as *aileron* (3.2.1) for roll control

3.2.11
speed brake
uncambered *control surface* (3.1.7) deflected symmetrically upward above the aft surface of the wing for increasing drag to reduce aircraft speed during final approach to touchdown

3.2.12
stabilator
stabilizer elevator
airplane *control surface* (3.1.7) that combines the functions of an *elevator* (3.2.2) and a *horizontal stabilizer* (3.2.17)

3.2.13
balance tab
auxiliary hinged airfoil on the trailing edge of the aircraft *control surface* (3.1.7) used to balance, either fully or partially, the aerodynamic loads on the control surface, thus reducing stick loads

3.2.14
servo tab
Flettner tab
auxiliary hinged airfoil (movable surface) on the trailing edge of the aircraft *control surface* (3.1.7) to assist the movement of the control surface

Note 1 to entry: A servo tab is integrated into the flight control's operating components in such a way as to drive, or help to drive, the control surface during normal control inputs.

Note 2 to entry: The pilot controls the tab not the control surface. The movement of the tab makes the control surface move.

3.2.15
anti-servo tab
anti-balance tab
movable surface on the trailing edge of the *stabilator* (3.2.12) providing force acting against the movement of the stabilator to reduce the sensitivity to pilot input

3.2.16
drag-rudder
split drag rudder
control device for *directional control* (3.1.14) on tailless or flying wing type airplane designed as assembly of two *flaps* (3.2.7) mounted together on each wing

Note 1 to entry: Deflection of drag-rudder means that both flaps are symmetrically deflected at a certain angle in opposite directions.

3.2.17
horizontal stabilizer
tailplane
horizontal surface, fixed or adjustable, of an aircraft empennage, to provide angular stability for rotations about the lateral axis

3.2.18
trimmable horizontal stabilizer
adjustable horizontal stabilizer
fully moving horizontal tail surface, not in response to *inceptor* (3.1.6) movement but in response to the *trim system* (3.1.21) settings depending on flight mode

3.2.19
taileron
left and right *tailplanes* (3.2.17) used as *primary flight control surfaces* (3.1.8) in both pitch and roll

3.2.20
main rotor collective control
<rotary wing aircraft> changing the pitch of all the main rotor blades by the same amount (or collectively) with respect to the main rotor shaft to control the magnitude of the main rotor thrust vector

3.2.21
main rotor cyclic control
<rotary wing aircraft> changing the pitch of the rotor blades individually with respect to azimuth as they move around the rotor disk to control the direction of the main rotor thrust vector for *longitudinal control* (3.1.12) or *lateral control* (3.1.13)

3.2.22
tail rotor collective control
<rotary wing aircraft> changing the pitch of all the tail rotor blades by the same amount (or collectively) with respect to the tail rotor shaft to adjust the magnitude of the tail rotor thrust for *directional control* (3.1.14)

3.2.23
thrust vectoring
rotation of a vehicle's thrust axis to control its trajectory or support its weight

3.2.24
yoke
type of *control inceptor* (3.1.6), movable column on which an airplane control wheel is mounted

Note 1 to entry: A yoke movement in or out is used to control the *elevators* (3.2.2) or other *effectors* (3.1.5) related to *longitudinal control* (3.1.12) and control wheel rotation is used to control the *ailerons* (3.2.1) or other effectors related to *lateral control* (3.1.13).

3.2.25
control stick
type of *control inceptor* (3.1.6), vertical stick in the flight deck to control the *ailerons* (3.2.1) or other *effectors* (3.1.5) related to *lateral control* (3.1.13) by side-to-side movement and to control the *elevators* (3.2.2) or other effectors related to *longitudinal control* (3.1.12) by fore-and-aft movement

3.2.26
sidestick
side arm controller
type of *control inceptor* (3.1.6), control column in the form of a short handgrip beside the pilot, with the same function as *control stick* (3.2.25)

3.2.27
pedal
rudder pedal
type of *control inceptor* (3.1.6) operated by pushing with feet, primary for *directional control* (3.1.14) via *rudder* (3.2.3) in fixed wing aircraft

3.2.28
antitorque pedal
tail rotor control
type of single rotor helicopter *control inceptor* (3.1.6) operated by pushing with feet, for *directional control* (3.1.14) via thrust to *tail rotor collective control* (3.2.22)

3.2.29
collective lever
collective
type of helicopter *control inceptor* (3.1.6) usually operated with pilot left hand for main rotor thrust control through simultaneous engine power control and *main rotor collective control* (3.1.20)

3.2.30
hydraulic actuator
actuator (3.1.10) made as hydraulic cylinder or fluid motor that uses hydraulic power from external supplier to facilitate mechanical operation

3.2.31
electro-hydrostatic actuator
EHA
self-contained *hydraulic actuator* (3.2.30) that integrates a cylinder, feedback unit, variable speed pump, servo motor, electric drive and control electronics, into a compact unit requiring only an electrical connection

3.2.32
electromechanical actuator
EMA
mechanical *actuator* (3.1.10) where the control knob or handle has been replaced by an electric motor that converts electrical energy into mechanical motion

3.3 Control system classification

3.3.1
manual flight control system
mechanical flight control system
flight control system (3.1.3), in which *inceptors* (3.1.6) in pilot desk are mechanically connected directly to the corresponding *effectors* (3.1.5) [*control surfaces* (3.1.7)] of the aircraft by a system of rods, levers, cables and pulleys, so all the inputs are done manually by the pilot, giving the pilot all the control of the aircraft

3.3.2
hydro-mechanical flight control system
flight control system (3.1.3), in which *inceptors* (3.1.6) in pilot desk are mechanically connected directly to the valve of *hydraulic actuators* (3.2.30), output of which in its turn mechanically connected with corresponding *effectors* (3.1.5)

3.3.3
electro-hydraulic flight control system
flight control system (3.1.3), in which electric signal (analogue or digital) from *sensors* (3.1.11) of *inceptors'* (3.1.6) movement in pilot desk and signal from *automatic flight control system* (3.1.4) pass through electrical cables to the electric valve of *hydraulic actuators* (3.2.30), output of which in its turn mechanically connected with corresponding *effectors* (3.1.5)

3.3.4
electrical flight control system
flight control system (3.1.3), in which electric signal (analogue or digital) from *sensors* (3.1.11) of *inceptors'* (3.1.6) movement in pilot desk and signal from *automatic flight control system* (3.1.4) pass through electrical cables to the *electro-mechanical actuators* (3.2.32), output of which in its turn mechanically connected with corresponding *effectors* (3.1.5)

3.3.5
fly-by-wire
FBW
flight control system (3.1.3) with electric signal connection between *inceptors* (3.1.6) and *actuators* (3.1.10)

EXAMPLE *Electro-hydraulic flight control system* (3.3.3) or *electrical flight control system* (3.3.4).

3.3.6
fly-by-light
flight control system (3.1.3) with fibre-optic connection between *inceptors* (3.1.6) and *actuators* (3.1.10)

EXAMPLE *Electro-hydraulic flight control system* (3.3.3) or *electrical flight control system* (3.3.4).

3.3.7
stability augmentation system
SAS
type of *automatic flight control system* (3.1.4) which provides or enhances stability for specific aerodynamic characteristics of an airplane providing short-term rate damping

3.3.8
autostabilizer
simple *stability-augmentation system* (3.3.7), usually to provide increased damping and often with limited *authority* (3.1.17)

3.3.9
autopilot
automatic pilot
AP
airborne *automatic flight control system* (3.1.4) that automatically maintains aircraft on a path in space pre-determined by *flight director* (3.3.10) without any action being required by the pilot

3.3.10
flight director
automatic flight director system
instrument *system* (3.1.1) consisting of electronic components that computes and indicates the aircraft attitude required to attain and maintain a preselected flight condition without direct connection to *actuators* (3.1.10)

3.3.11
autothrottle
autothrust
system (3.1.1) setting engines thrust automatically depending on the selected mode to meet speed targets from pilot or from *flight management system* (3.3.12)

3.3.12
flight management system
FMS
on-board computerized *system* (3.1.1) used for multi-purpose navigation, performance computations, and aircraft operations enabling the flight crew to program a route from takeoff to landing, consisting of *automatic flight control system* (3.1.4), flight management computer, aircraft navigation system and electronic flight instrument system

Note 1 to entry: The crew can select whether to put the aircraft under *autopilot* (3.3.9) or manual control mode. Under the autopilot mode, the aircraft *flight control surfaces* (3.1.7) move automatically; under the manual control mode, the pilot follows the displayed *flight director* (3.3.10) commands to achieve the desired status.

3.3.13
full authority automatic flight control system
automatic flight control system (3.1.4) having access to the maximum useable range of *effectors* (3.1.5)

3.3.14
limited authority automatic flight control system
partial authority automatic flight control system
automatic flight control system (3.1.4) having access to only part of the full available range of *effectors* (3.1.5)

3.3.15
robust flight control system
flight control system (3.1.3), which maintains acceptable performance in the presence of significant model uncertainty, disturbances and noise

3.3.16
fault
unpermitted deviation of at least one characteristic property (feature) of the *system* (3.1.1) from the standard condition which may cause a reduction in, or loss of, the capability of the *system* (3.1.1) to perform a required function

3.3.17
failure
permanent interruption of a *system's* (3.1.1) ability to perform a required function under specified operating conditions

3.3.18
fault-tolerant flight control system
flight control system (3.1.3) capable of controlling the aircraft with satisfactory performance even if one or several *faults* (3.3.16), or more critically, one or several *failures* (3.3.17) occur in this system

3.3.19
redundancy
presence of more than one independent means for accomplishing a given function or flight operation

3.3.20
redundant flight control system
overactuated flight control system
flight control system (3.1.3) equipped with more *effectors* (3.1.5) than axes to control

3.3.21
quadruplex flight control system
flight control system (3.1.3) having four hardware lanes for detection and isolation of up to two identical *failure* (3.3.17)

3.3.22
adaptive flight control system
flight control system (3.1.3) capable to modify its own operation to achieve the best possible mode of operation through real-time parameter identification and controller update