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# Aerospace — Electrohydrostatic actuator (EHA) — Characteristics to be defined in procurement specifications

*Aéronautique et espace — Actionneurs électrohydrostatiques (EHA) — Caractéristiques à définir dans les spécifications d'approvisionnement*



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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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## Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22072 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

# Aerospace — Electrohydrostatic actuator (EHA) — Characteristics to be defined in procurement specifications

## 1 Scope

This International Standard defines the general characteristics, requirements and design data to be included in the procurement technical specification of an electrohydrostatic actuator (EHA) to be used to power aircraft control surfaces or other moving parts of an aerospace vehicle.

This type of actuator is an alternative to the hydraulically powered servocontrol actuators that are currently used. It is intended that this International Standard cover the unique requirements of EHAs.

Test methods are defined in a separate ISO document.

## 2 Normative references



The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7137, *Aircraft — Environmental conditions and test procedures for airborne equipment*



## 3 Terms and definitions

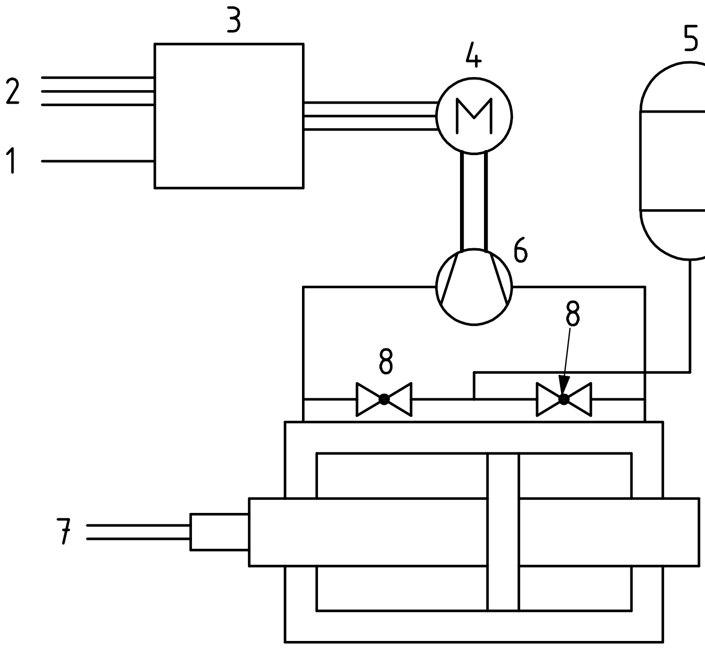
For the purposes of this document, the following terms and definitions apply.

**3.1**
**electrohydrostatic actuator**
**EHA**
electrically powered actuator that includes one or several hydraulic rams whose chambers are connected to a bi-directional, fixed-displacement pump driven by a variable-shaft-speed, electric motor controlled by power electronics

NOTE 1 A typical arrangement includes an integrated hydraulic fluid compensator, a manifold that interconnects the above hydraulic elements and in which components necessary for additional functions can be installed, see Figure 1.

NOTE 2 This assembly is part of the position control loop of the surface, or of any other load, in which the error signal, difference between the commanded and achieved positions, determines the command of the speed and direction of rotation of the motor. Other components of the position servo loop, e.g. position transducer, control electronics generating the error signal and control laws, do not necessarily form part of this assembly.

NOTE 3 This assembly may also perform other functions, for example allowing the operation of other actuators installed in parallel, or ensuring the damping of movement of the load in case of loss of all electric power.




**Key**

1 command signal
2 power supply
3 power electronics
4 electric motor
5 fluid compensator
6 pump
7 position transducer signal
8 check valve (2 places)



**Figure 1 — Typical arrangement of an electrohydrostatic actuator**

## 4 Requirements

### 4.1 General

The requirements defined in 4.2 to 4.13 shall be met under all rated operating conditions and during the service life specified.

### 4.2 Brief description of the system

The EHA is one component of a system. The various configurations or reconfigurations typical of this system involve specific modes of EHA operation which shall be described. Normal and failure modes of operation for the EHA shall be defined.

### 4.3 Description and interfaces

#### 4.3.1 General description

The unit shall be described in terms of functions and the associated terminology defined.

The following are examples:

— control/electrical/mechanical/structural redundancy,

— local or remote fluid level indication,

- filling,
- draining,
- bleeding,
- internal fluid filtering,
- no-back,
- local dissipation of generated energy,
- force or speed limitation,
- stops,
- temperature monitoring,
- heating of stand-by unit.

### 4.3.2 Mechanical interface

The specification drawing shall define the following:

- allocated space envelope;
- dimensions and tolerances of the mechanical connections or the dimensional standards if connections are achieved through standardized components;
- line replaceable units (LRUs);
- access once installed on aircraft;
- specific items such as hoisting or jack catcher interfaces, as required.



### 4.3.3 Electrical interface

The electrical interface definition shall include

- wiring schematics defining the electrical connections with power supply, control and monitoring systems, standards, sizes and pin allocation of interface connectors;
- any particular requirements or limitation on use of connectors for the LRUs;
- segregation rules to comply with;
- descriptions of signals exchanged, definition of input and output impedances;
- power interruption capability and definition of the strategy for longer interruptions (see 5.3).

### 4.3.4 Hydraulic interface

The hydraulic interface requirements shall include definition and location of possible filling, bleeding, filtering and draining features.

#### 4.3.5 Software

Software may be used to achieve various functions, such as

- electric motor control,
- loop closure,
- monitoring and redundancy management,
- status information,
- built-in test.

The level of criticality and of the associated development, verification, and validation methods shall be specified. Memory capacity extension and processing power shall be specified. If required, dissimilarity in processing/software/compilers/electronic hardware shall be specified.

### 4.4 Performance

#### 4.4.1 Mechanical performance

The definition of the requirements for output force or mechanical power shall take into account the thermal behaviour. These mechanical requirements shall therefore be associated with their duration and environmental conditions. Thus the following shall be specified.



- Maximum operating output force: the maximum driving force to be generated by the unit at very low speed (to be defined), for a short time duration (to be defined), under specified supply and environmental conditions, and the associated tolerances.
- Maximum continuous output force: the maximum holding force, with no movement, or the maximum driving force, at very low speed (to be defined), to be generated under given supply and environmental conditions with no time limitation, with and without its possible no-back device engaged, and the associated tolerances.
- 'Worst case' scenarios: operational sequences, or series of sequences, described as functions of time in terms of position, force, environmental conditions, identified as sizing cases in terms of the instantaneous power absorbed or rejected, or in terms of heat generated. Force fighting shall be considered, depending on system configuration.
- Maximum rate and associated loading conditions, or expressed as the time necessary to reach a given position under a specified load. The rate versus load characteristic shall be identified.
- Run-up time: time from activation of stand-by actuator to being able to achieve maximum rate with a maximum rate demand.
- Dynamic performance as specified below may also be a sizing consideration.
- Working stroke, stop to stop stroke.
- Possible acceptable temporary degradation of performance at start up, following cold soak in particular.

#### 4.4.2 Servo loop static performance

The following characteristics, with and without the possible no-back device, shall be specified:

- overall accuracy,
- hysteresis,
- resolution,
- stiffness,
- freeplay.

#### 4.4.3 Servo loop dynamic performance and stability

Bandwidth of the position servo loop shall be expressed in terms of amplitude ratio and phase lag in the frequency range, for defined amplitudes and loads.

The following shall be specified:

- maximum acceptable overshoot;
- minimum acceptable stability margins of the position servo loop and any minor control loops (e.g. motor speed);
- acceptable speed oscillation, characterized by frequency and amplitude (motor and pump may generate torque ripple);
- response time of the possible no-back device;
- acceptable limit cycle (a no-back device may generate a limit cycle);
- dynamic performance and stability of the servo loop, the input being the force applied to the actuator, the output being the piston position, at constant command.



### 4.5 Electrical power consumption

Steady state power consumption with no movement, as a function of the applied load, and peak consumption in the course of typical manœuvres, under specified supply conditions, shall be specified.

### 4.6 Hydraulic consumption

Allowable fluid loss, allowable refill interval, and life of fluid shall be specified.

### 4.7 Strength and life

#### 4.7.1 Static strength

Static strength is defined by the following.

- *Limit load* (without permanent deformation or leakage): maximum specified driving or resisting force, with or without movement, generated by the unit with account taken of any force limitation function possibly incorporated. In the case where a no-back device is included, the maximum holding force may define this limit load.
- *Ultimate load* (without rupture): 1,5 × limit load.