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Aerospace fluid systems and components — Variable displacement hydraulic motors — General specifications

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

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.

Introduction

It is noted that, while ISO standards refer to SI units, large segments of the aerospace industry refer to other measurement systems as a matter of common working practice. All dimensions used in this document are in SI units with the non-SI units given in addition for the convenience of those users more familiar with these.

It is further noted that the standard ISO decimal symbol "," (comma) is not used as common working practice for inch dimensions. A decimal point is used in the inch dimensions in this document as in many other aerospace standards.

NOTE The use of non-SI units and the decimal point in this document does not constitute general acceptance of measurement systems other than SI within International Standards.

Aerospace fluid systems and components — Variable displacement hydraulic motors — General specifications

1 Scope

This document establishes the general requirements for variable displacement uni-directional and bi-directional hydraulic motors, suitable for use in aircraft hydraulic systems at pressures up to 35 000 kPa (5 000 psi).

These requirements include:

— design requirements;

— test requirements.

Primary and secondary function motors (see Clause 4) are covered in this document; however, actuators with internal rotation angle limits and low-speed motors are not covered.

This document is intended to be used in conjunction with the detail specification that is particular to each application.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 2093, *Electroplated coatings of tin — Specification and test methods*

ISO 2669, *Environmental tests for aircraft equipment — Steady-state acceleration*

ISO 2671, *Environmental tests for aircraft equipment — Part 3.4 : Acoustic vibration*

ISO 2685, *Aircraft — Environmental test procedure for airborne equipment — Resistance to fire in designated fire zones*

ISO 3323, *Aircraft — Hydraulic components — Marking to indicate fluid for which component is approved*

ISO 3601-1, *Fluid power systems — O-rings — Part 1: Inside diameters, cross-sections, tolerances and designation codes*

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

ISO 7320, *Aerospace — Couplings, threaded and sealed, for fluid systems — Dimensions*

ISO 8078, *Aerospace process — Anodic treatment of aluminium alloys — Sulfuric acid process, undyed coating*

ISO 8079, *Aerospace process — Anodic treatment of aluminium alloys — Sulfuric acid process, dyed coating*

ISO 8399-1, *Aerospace — Accessory drives and mounting flanges (Metric series) — Part 1: Design criteria*

ISO 8399-2, *Aerospace — Accessory drives and mounting flanges (Metric series) — Part 2: Dimensions*

ISO 8625-1, *Aerospace — Fluid systems — Vocabulary — Part 1: General terms and definitions related to pressure*

ISO 8625-2, *Aerospace — Fluid systems — Vocabulary — Part 2: General terms and definitions relating to flow*

ISO 8625-3, *Aerospace — Fluid systems — Vocabulary — Part 3: General terms and definitions relating to temperature*

ISO 11218, *Aerospace — Cleanliness classification for hydraulic fluids*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8625-1, ISO 8625-2, ISO 8625-3, and the following apply.

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

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

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

3.1
variable displacement hydraulic motor
mechanical actuator that converts hydraulic pressure and flow into torque and angular velocity (rotation) and whose speed is controlled by varying the displacement of the hydraulic motor

Note 1 to entry: The use of a variable displacement hydraulic motor permits the optimization of hydraulic flow demand.

Note 2 to entry: The motor's output torque, direction of rotation (if bi-directional) and associated operating speed and resultant flow consumption is controlled by a servo valve which varies the motor's displacement which is typically operated in closed loop control.

Note 3 to entry: The specifications, design, manufacture and qualification of the servo valve is outside the scope of this document.

3.1.1
uni-directional hydraulic motor
variable displacement hydraulic motor (3.1) that generates output torque via the drive shaft in only one direction

3.1.2
bi-directional hydraulic motor
variable displacement hydraulic motor (3.1) that generates output torque via the drive shaft to both clockwise and anti-clockwise directions

Note 1 to entry: Except for *bi-directional over-centre hydraulic motors* (3.1.3), bi-directional operation is typically achieved by reversing the differential pressure across the inlet/outlet ports, thus reversing the output torque.

Note 2 to entry: Except for *bi-directional over-centre hydraulic motors* (3.1.3), the position of the swashplate is controlled in each direction by a dedicated controller.

3.1.3
bi-directional over-centre hydraulic motor
bi-directional hydraulic motor (3.1.2) whose direction of rotation of the output drive shaft is controlled by the angle of the motor swashplate which can go over centre

Note 1 to entry: This may be accomplished by controlling the position of the swashplate in each direction by a single controller.

3.2
purchaser
organization that has the engineering responsibility for the system that includes the motor

Note 1 to entry: Typically, the purchaser is a system *supplier* (3.4), an aircraft manufacturer or a contractor.

3.3
detail specification
document compiled by the *purchaser* (3.2) that specifies the following:

a) technical requirements;

b) acceptance and qualification test requirements;

c) reliability, testability and maintainability requirements;

d) quality requirements;

e) packaging requirements;

f) other requirements

Note 1 to entry: Technical requirements include performance requirements and design requirements.

3.4
supplier
organization that provides the motor

Note 1 to entry: Typically, the supplier is the manufacturer of the motor who will be responsible for the design, production, and qualification of the motor.

3.5.1
motor inlet port
port that receives flow from the hydraulic system to supply the motor

3.5.2
motor return port
port that returns flow back to the system reservoir

3.5.3
motor case drain port
port that drains internal leakage flow to the system reservoir

Note 1 to entry: Not all motors have a case drain port; instead the case drain fluid is supplied to the motor outlet port.

3.5.4
shaft seal leakage port
port that routes any shaft seal leakage from the motor to an overboard drain, collector tank, ecology bottle, etc.

3.6.1
rated temperature
maximum continuous temperature of the fluid to be supplied at the inlet port of the motor

3.6.2
normal operating temperature
temperature of the fluid to be supplied at the inlet port of the motor at which full performance of the motor is required

3.6.3
minimum continuous temperature
minimum temperature of the fluid at the supply port of the motor at which the motor is able to function

Note 1 to entry: This temperature is generally higher than the minimum *survival temperature* (3.6.5).

3.6.4
extreme operating temperature
temperature of the fluid to be supplied at the inlet port of the motor at which the motor runs with an agreed degraded performance

3.6.5
survival temperature
ambient temperature at which the motor is not required to run, but runs without degradation at the *normal operating temperature* (3.6.2)

3.7.1
design operating pressure
normal maximum steady pressure

Note 1 to entry: Excluded are reasonable tolerances, transient pressure effects such as may arise from the following:

— pressure ripple;

— reactions to system functioning;

— demands that may affect fatigue.

3.7.2
rated supply pressure
system rated pressure, which is normally the hydraulic power generation system *design operating pressure* (3.7.1)

3.7.3
rated differential pressure
differential pressure measured between the motor inlet and outlet ports required to produce the *rated torque* (3.11.1)

3.7.4
no-load break-out pressure
differential pressure required for starting the output shaft, without interruption, with the case drain port at the *rated case drain pressure* (3.7.6.1) and the return port at the *nominal motor return pressure* (3.7.5.1)

Note 1 to entry: This corresponds to *break-out torque* (3.11.2).

3.7.5.1
nominal motor return pressure
pressure generated at the return port as the motor returns flow back to the system

3.7.5.2
rated motor return pressure
maximum pressure at the return port

Note 1 to entry: This is applicable to uni-directional motors only.

Note 2 to entry: This is a stressing term only as the *nominal motor return pressure* (3.7.5.1) is generally considerably less than the rated motor return pressure.

3.7.6.1
rated case drain pressure
nominal pressure at which the motor case is required to operate continuously in the system

3.7.6.2
maximum case pressure
maximum of either

— the maximum pressure peak that may be imposed by the hydraulic system on the *motor case drain port* (3.5.3), or

— the pressure resulting from the internal bypassing of the rated flow towards the return and drain ports in order to take into account the accidental transitory separation of the components

3.8
rated consumption
maximum flow rate measured at the *motor inlet port* (3.5.1) under the following conditions:

— rated fluid temperature;

— *rated differential pressure* (3.7.3);

— *rated speed* (3.10);

— using the hydraulic fluid specified in the *detail specification* (3.3)

3.9
maximum displacement
theoretical volume of fluid consumed by one revolution of the motor drive shaft at full stroke

Note 1 to entry: It is expressed in cubic centimetres per revolution (cubic inches per revolution).

Note 2 to entry: The maximum displacement is calculated from the geometrical configuration of the motor, without allowing for the following effects:

— permissible manufacturing tolerances;

— distortions of the motor structure;

— the compressibility of the hydraulic fluid;

— internal leakage;

— temperature.

Note 3 to entry: The maximum displacement is used to indicate the size of the motor rather than its performance.

3.10
rated speed
maximum speed at which the motor is required to operate continuously at *rated temperature* (3.6.1) and at *rated differential pressure* (3.7.3)

Note 1 to entry: The rated speed is expressed as the number of revolutions of the motor output shaft per minute.

3.11.1
rated torque
minimum torque value at rated operating conditions

3.11.2
break-out torque
minimum torque against which the motor will start at operating conditions specified in the *detail specification* (3.3)

Note 1 to entry: This corresponds to *no-load break-out pressure* (3.7.4)