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Aerospace series — Constant displacement hydraulic motors — General specifications

Série aérospatiale — Moteurs hydrauliques à cylindrée fixe — Spécifications générales

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

This second edition cancels and replaces the first edition (ISO 9206:1990) and ISO 12333:2000. The entire document has been rewritten and it incorporates requirements from ISO 12333:2000.

Aerospace series — Constant displacement hydraulic motors — General specifications

1 Scope

This International Standard establishes the general requirements for constant displacement hydraulic motors, suitable for use in aircraft hydraulic systems at pressures up to 35 000 kPa (5 000 psi).

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

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 3601-1:2012, *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 8081, *Aerospace process — Chemical conversion coating for aluminium alloys — General purpose*

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:—[1], *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.

3.1
fixed displacement hydraulic motor
mechanical actuator that converts hydraulic pressure and flow into torque and angular displacement (rotation)

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

Note 1 to entry: Typically, the purchaser is an aircraft manufacturer, an equipment manufacturer that has the actuation system responsibility or a modification centre.

Note 2 to entry: The purchaser is responsible for the compilation of the detail specification.

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 requirements;

d) quality requirements;

e) packaging requirements;

f) other 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
ports of the hydraulic 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

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

1) To be published. (Revision of ISO 11218:1993)

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

3.6
temperature terms

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

Note 1 to entry: It is expressed in degrees centigrade.

3.6.2
minimum continuous temperature
minimum temperature of the fluid to be continuously supplied at the supply port of the motor

Note 1 to entry: It is expressed in degrees centigrade.

Note 2 to entry: This temperature is generally higher than the survival temperature.

3.7
pressure terms

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 *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 return pressure

3.7.5
motor return pressure

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 pressure is generally considerably less than the rated motor return pressure.

3.7.6
case drain 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 integral bypassing of the rated flow towards the outlet and drain ports in order to take into account the accidental transitory separation of the components

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

— rated fluid temperature;

— *rated differential pressure* (3.7.3);

— *rated speed* (3.10.1);

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

3.9
rated displacement
maximum theoretical volume of fluid generated by one revolution of its output shaft

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

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

— permissible manufacturing tolerances;

— distortions of the motor structure;

— the compressibility of the hydraulic fluid;

— internal leakage;

— temperature.

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

3.10
speed terms

3.10.1
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 shall be expressed as the number of revolutions of the motor output shaft per minute.

3.10.2
maximum no-load speed
speed reached at rated conditions with no opposing torque

3.11
torque terms

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: The specification shall be met at any angular position of the output shaft.

3.11.3
stalling torque
minimum opposing torque which stops the rotation of the outlet shaft at the *rated supply pressure* (3.7.2) and for the outlet port and case drain port pressures specified in the *detail specification* (3.3)

3.12
motor overall efficiency
obtained from the formula:

motor overall efficiency (%) = (output shaft power/input fluid power) × 100

where

output shaft power= shaft torque × RPM;

input fluid power= (inlet pressure – return pressure) × rated flow

Note 1 to entry: This formula ignores compressibility effects. If this formula is to be used, the flow rate measurement should be made on the compressed flow stream.

3.13
rated endurance
total number of hours and cycles of operation to be included in the endurance phase of its qualification testing

3.14
first article inspection
process that conducts the following:

— verifies that the parts of a component comply with the drawings;

— verifies that the manufacturing processes have been compiled and are adhered to;

— verifies that the assembly processes have been compiled and are adhered to;

— verifies that the acceptance test of the component is in accordance with the test procedure, and that the results of the test are in agreement with the test requirements

4 Classification

The hydraulic motors covered by this International Standard are classified in two categories.

— Category A: Primary function motors, for example, flight controls, slats, flaps, adjustable planes, transfer units, constant speed drives, etc.

— Category B: Secondary function motors, for example, hoists, guns, radars, doors, etc.

The motor category shall be specified in the detail specification.

5 General requirements

5.1 Order of precedence

The detail specification shall take precedence in the case of a conflict between the requirements of this International Standard and the detail specification.

5.2 Hydraulic system characteristics

The hydraulic motor shall be designed to be operated by the hydraulic system as defined in the detail specification.

The detail specification shall include the characteristics of the hydraulic system in which the motor is to be used. This shall include the flow versus pressure curves for the supply, return, and case drain lines for the following hydraulic fluid temperatures:

— normal operating temperature (for example, +20 °C);

— rated temperature;

— minimum continuous temperature.

5.3 Airworthiness regulations

The hydraulic motor shall comply with the applicable airworthiness regulations.

5.4 Qualification

Hydraulic motors furnished under this International Standard shall be products that have passed the qualification tests that are specified in the detail specification.

6 Functional requirements

6.1 Hydraulic fluid

The detail specification shall state the applicable hydraulic fluid.

6.2 Pressures

6.2.1 Rated supply pressure

The value of the rated supply pressure shall be stated in the detail specification and shall be one of the following values of rated supply pressures listed in Table 1 (derived from ISO 6771).

Table 1 — Rated supply pressure

Pressure Class	Metric system kPa basic	Imperial system psi basic
A	4 000	600
B	10 500	1 500
C	16 000	2 500
D	21 000	3 000
E	28 000	4 000
J	35 000	5 000

6.2.2 Rated differential pressure

The rated differential pressure shall be specified in the detail specification.

6.2.3 No-load break-out pressure

The no-load break-out pressure shall be specified in the detail specification.

6.2.4 Motor return port pressure

6.2.4.1 Nominal return pressure

The nominal return pressure shall be specified in the detail specification.

6.2.4.2 Rated motor return pressure

The rated motor return pressure (where applicable) shall also be specified in the detail specification. Unless otherwise specified in the detail specification, the rated motor return pressure shall be 7 000 kPa (1 000 psi).

6.2.5 Case port pressure

6.2.5.1 Rated case port pressure

The rated case port pressure shall be specified in the detail specification.

Caution should be taken defining the rated case pressure. Too high a pressure may cause abnormal shaft seal and shaft bearing loading, affecting their operation and reducing the motor life.