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Aerospace — Hydraulic, pressure compensated, variable delivery pumps — General requirements

Aéronautique et espace — Pompes hydrauliques à débit variable régulé en fonction de la pression — Exigences générales

[Revision of first edition (ISO 8278:1986)]

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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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ISO 8278 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

This second edition cancels and replaces the first edition and also ISO 12334: 2000; the entire document has been rewritten and it incorporates requirements from ISO 12334.

Aerospace series — Hydraulic, pressure compensated, variable delivery pumps — General requirements

1 Scope

This International Standard establishes the general requirements for pressure compensated, variable delivery hydraulic pumps, suitable for use in aircraft hydraulic systems at pressures up to 35 000 kPa (5 000 psi).

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

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

ISO 6771, *Aerospace — Fluid systems and components — Pressure and temperature classifications*

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*, 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 and ISO 8625-3 and the following apply.

3.1
variable delivery, hydraulic pump
self-regulating hydraulic pump that supplies hydraulic power to the hydraulic system (or sub-system) at a nominal constant pressure

Note 1 to entry: The pump can be driven by a variety of power sources, including:

— by an engine via an accessory gearbox;

— electric motor;

— pneumatic power drive.

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

Note 1 to entry: Typically, the purchaser is an aircraft manufacturer, an equipment manufacturer that has hydraulic 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
the document compiled by the purchaser 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
manufacturer of the pump who will be responsible for the design, production and qualification of the pump

3.5
ports of the hydraulic pump

3.5.1
pump inlet port
port that receives flow from the hydraulic reservoir to supply the pump

3.5.2
pump discharge port
port that supplies pressurised flow to the system

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

3.5.4
shaft seal port
port that routes any shaft seal leakage from the pump 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 supply port of the pump

Note 1 to entry: The rated temperature is expressed in degrees centigrade.

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

Note 1 to entry: The minimum continuous temperature is expressed in degrees centigrade.

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:

- pressure ripple;
- reactions to system functioning;
- demands that may affect fatigue.

3.7.2
inlet pressure

3.7.2.1
rated inlet pressure
minimum pressure measured at the inlet port of the pump at which the pump is required to provide performance without any degradation, with all other parameters at their rated values, except for the fluid temperature, which is the minimum continuous temperature

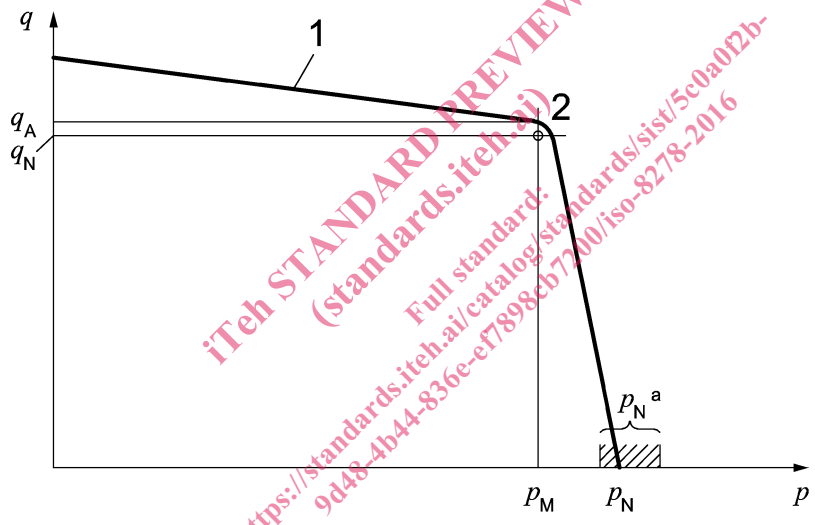
3.7.2.2
maximum inlet pressure
maximum steady state inlet pressure at which the pump may be required to operate

3.7.2.3
minimum inlet pressure
lowest pump inlet port pressure, specified by the purchaser, for which the supplier ensures that the pump might be required to operate without cavitation during a system failure or during a system high-flow transient condition

Note 1 to entry: For the purposes of this International Standard, cavitation is assumed to occur when there is a 2 % reduction in discharge flow with reducing inlet pressure.

3.7.3
discharge pressure
maximum pressure against which the pump is required to operate continuously at rated temperature, at rated speed and at zero flow (see Figure 1)

Note 1 to entry: This diagram is given as an indication. It may be presented in a different way, for example, the axes may be reversed.



Key

1 Actual discharge/pressure characteristic curve
2 At p_M, $q_A > q_N$
p pressure
p_M maximum full-flow pressure (see 3.7.3.1)
p_N rated discharge pressure
p_N[a] tolerance range
q discharge flow
q_A actual discharge at maximum full-flow pressure
q_N rated discharge flow (see 3.8)

Figure 1 — Delivery/pressure characteristic curve of pumps

3.7.3.1
maximum full-flow pressure
maximum discharge pressure at which the pump control will not be acting to reduce pump discharge, at rated temperature, rated speed, rated inlet and case drain pressure

3.7.3.2
maximum pump discharge transient pressure
peak value of the discharge pressure recorded during a discrete transient event (normally found whilst cycling from full flow pressure to rated pressure (zero flow))

3.7.3.3
pressure pulsations
oscillations of the pump discharge pressure, occurring during nominally steady operating conditions, at a frequency equal to the number of pistons times the drive shaft speed, or a multiple thereof

Note 1 to entry: The amplitude of the oscillations is the difference between the average minimum and the average maximum oscillations recorded during a one-second trace.

3.7.4
case drain pressure

3.7.4.1
maximum case drain pressure
maximum continuous pressure developed by the pump to enable case drain fluid to return to the reservoir

3.7.4.2
rated case drain pressure
nominal pressure at which the pump case is required to operate continuously in the system

3.7.4.3
maximum transient case pressure
maximum pressure peak that may be imposed by the hydraulic system on the pump case drain port

3.8
rated discharge flow
flow rate measured at the pump delivery port under conditions of:

— rated fluid temperature;

— rated inlet pressure;

— rated case drain pressure;

— maximum full-flow pressure;

— using the hydraulic fluid specified in the detail specification

Note 1 to entry: The flow shall be measured in the compressed state.

3.9
rated displacement
maximum theoretical volume of fluid generated by one revolution of the pump drive shaft at full stroke

Note 1 to entry: The rated displacement shall be calculated from the geometrical configuration of the pump, without allowing for the effects of:

— permissible manufacturing tolerances;

— distortions of the motor structure;

— the compressibility of the hydraulic fluid;

— internal leakage;

— temperature.

The rated displacement is used to indicate the size of the pump rather than its performance.

3.10
rated speed
maximum speed at which the pump will operate

Note 1 to entry: The rated speed is expressed as a number of revolutions of the pump drive shaft per minute

3.11
response time
time interval between the moment when an increase (or decrease) of the pump delivery pressure begins and the subsequent time when the delivery pressure reaches its first maximum (or minimum) value, when connected to a specified circuit

3.12
stability
freedom from persistent or quasi-persistent oscillation or "hunting" of the pump (cyclic variations in speed) at any frequency that can be traced to the delivery control mechanism, within stated limits in the detail specification

3.13
pump overall efficiency
pump overall efficiency (including volumetric efficiency) is obtained from the equation:

pump overall efficiency (%) = (output fluid power/input shaft power) x 100

where:

— input shaft power = shaft torque x RPM;

— output fluid power = (full-flow pressure – inlet pressure) x rated flow.

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

3.14
rated endurance
total number of hours and cycles of operation to be included in the endurance phase of its qualification testing

3.15
first article inspection
FAI
process that conducts the following:

— verifies that the parts of a component complies 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 General requirements

4.1 Order of precedence

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

4.2 Hydraulic system characteristics

The hydraulic pump shall be designed to supply the hydraulic system as defined in the detail specification.

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

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

— rated temperature;

— minimum continuous temperature.

4.3 Airworthiness requirements

The hydraulic pump shall comply with the applicable airworthiness requirements.

4.4 Qualification

Hydraulic pumps furnished under this standard shall be products that have passed the qualification tests specified in the detail specification.

5 Functional requirements

5.1 Hydraulic fluid

The detail specification shall state the applicable hydraulic fluid.

5.2 Pump pressure

5.2.1 Rated discharge pressure

The design of the pump shall be such as to maintain rated discharge pressure at the following combination and range of conditions:

— from 30 °C to rated temperature;

— from 50 % to 125 % of rated speed;

— at rated inlet pressure.

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

Table 1 — Rated Discharge 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

The maximum and minimum tolerance of the rated discharge pressure shall be specified in the detail specification: The permissible tolerance range shall be doubled in each direction for fluid temperatures below 30 °C or pump speeds from 25 % to 50 % of rated speed.

5.2.2 Maximum full-flow pressure

The maximum full-flow pressure of the pump shall be defined as the maximum discharge pressure at which the pump control will not be acting to reduce pump delivery at rated temperature, speed and inlet pressure.

The detail specification shall specify the minimum value of the maximum full-flow pressure (see Figure 1).

5.2.3 Pressure pulsations

The detail specification shall state the maximum permitted amplitude of the discharge pressure pulsations.

The amplitude of pressure pulsations shall be determined by the test procedure of 14.2.9.

5.2.4 Inlet pressure

5.2.4.1 General

The inlet pressure shall be measured at the inlet port of the pump in a manner that indicates the static head.

5.2.4.2 Rated inlet pressure

The detail specification shall state the value of rated inlet pressure, which shall be in kPa (or psi) absolute.