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Aerospace — Hydraulic, pressure-compensated, variable delivery pumps — General requirements for 35 000 kPa systems

Aéronautique et espace — Pompes hydrauliques à débit variable régulé en fonction de la pression — Exigences générales pour circuits 35 000 kPa

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12334 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

Aerospace — Hydraulic, pressure-compensated, variable delivery pumps — General requirements for 35 000 kPa systems

1 Scope

This International Standard specifies the general requirements for pressure-compensated, variable delivery hydraulic pumps, suitable for use in aircraft hydraulic systems at 35 000 kPa.

This International Standard shall be used in conjunction with detail specifications concerning each pump model.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2093:1986, *Electroplated coatings of tin — Specification and test methods*.

ISO 2669:1995, *Environmental tests for aircraft equipment — Steady-state acceleration*.

ISO 2671:1982, *Environmental tests for aircraft equipment — Part 3.4: Acoustic vibration*.

ISO 2685:1998, *Aircraft — Environmental test procedure for airborne equipment — Resistance to fire in designated fire zones*.

ISO 3601-1:1988, *Fluid systems — Sealing devices — O-rings — Part 1: Inside diameters, cross-sections, tolerances and size identification code*.

ISO 6771:1987, *Aerospace — Fluid systems and components — Pressure and temperature classifications*.

ISO 7137:1995, *Aircraft — Environmental conditions and test procedures for airborne equipment*.

ISO 7320:1992, *Aerospace — Couplings, threaded and sealed, for fluid systems — Dimensions*.

ISO 8077:1984, *Aerospace process — Anodic treatment of aluminium alloys — Chromic acid process 20 V DC, undyed coating*.

ISO 8078:1984, *Aerospace process — Anodic treatment of aluminium alloys — Sulfuric acid process, undyed coating*.

ISO 8079:1984, *Aerospace process — Anodic treatment of aluminium alloys — Sulfuric acid process, dyed coating*.

ISO 8081:1985, *Aerospace process — Chemical conversion coating for aluminium alloys — General purpose*.

ISO 8399-1:1998, *Aerospace — Accessory drives and mounting flanges (Metric series) — Part 1: Design criteria*.

ISO 8399-2:1998, *Aerospace — Accessory drives and mounting flanges (Metric series) — Part 2: Dimensions*.

3 Functional requirements

3.1 Hydraulic fluid

The hydraulic fluid on which the pump is intended to be operated shall be defined in the detail specification.

3.2 Rated discharge pressure

The rated discharge pressure of the pump shall be defined as the maximum pressure against which the pump is required to operate continuously at rated temperature, at rated speed and at zero flow (see Figure 1).

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

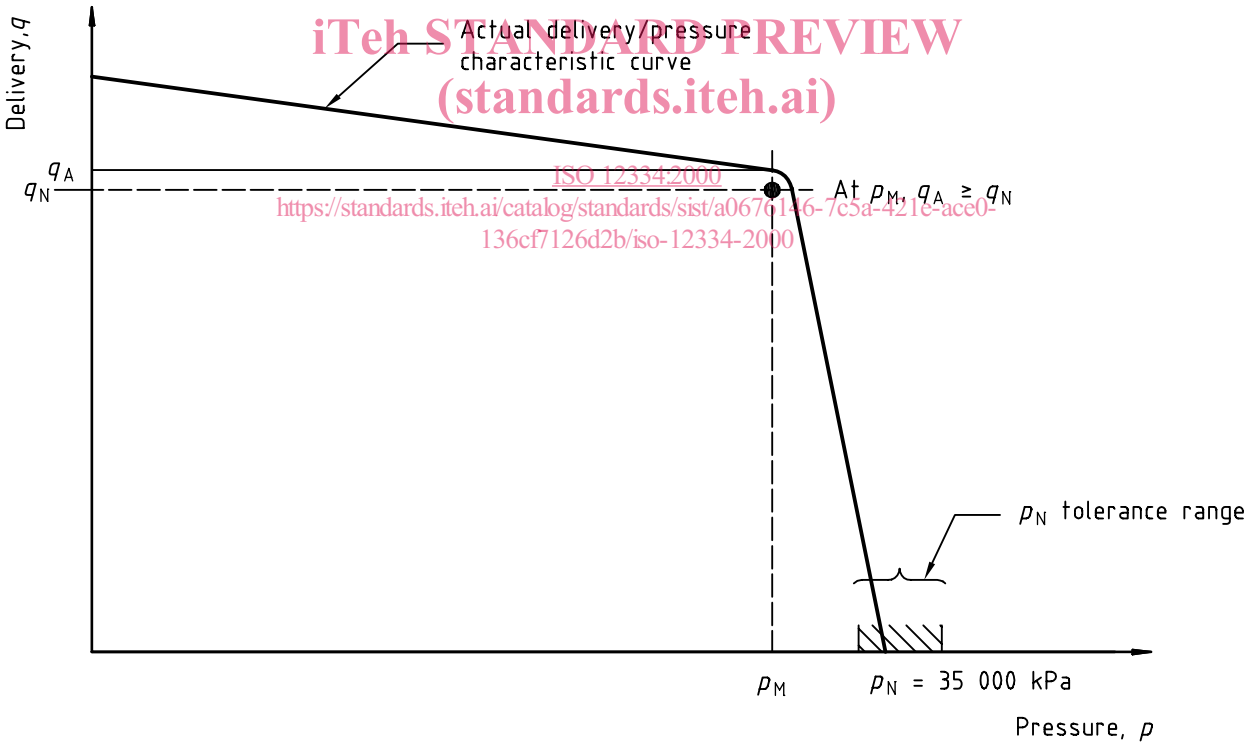
— from 30 °C to rated temperature;

— from 50 % to 115 % of rated speed;

— at rated inlet pressure.

The value of the rated discharge pressure shall be 35 000 kPa. The maximum and minimum tolerance shall be specified in the detail specification:

This permissible tolerance on rated discharge pressure shall be doubled in each direction for fluid temperatures below 30 °C or pump speeds between 25 % and 50 % of rated speed.



Key

q_N = rated delivery (see 3.9)

p_N = rated discharge pressure (see 3.2)

p_M = maximum full-flow pressure (see 3.3)

q_A = actual delivery at maximum full-flow pressure

NOTE — This diagram is given as an indication. It may be presented in a different way, for example, the axes may be reversed.

Figure 1 — Delivery/pressure characteristics of pumps

3.3 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 does not react 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).

3.4 Inlet pressure

3.4.1 Rated inlet pressure

The rated inlet pressure of the pump shall be defined as the pressure measured at the inlet port of the pump when it operates at rated speed, maximum full-flow pressure and rated temperature. Rated inlet pressure shall be expressed as an absolute value.

The value of rated inlet pressure shall be specified in the detail specification.

3.4.2 Cavitation pressure

The cavitation pressure of the pump shall be defined as the inlet pressure obtained when, after adjustment of the pump at rated speed, rated temperature and 90 % of maximum full-flow pressure, by reducing inlet pressure, the discharge flow is reduced by 10 %.

3.4.3 Minimum inlet pressure

The minimum inlet pressure of the pump shall be defined as the minimum inlet pressure, stipulated by the supplier, for which the pump meets the rated conditions of operation.

NOTE It is recommended to size the inlet lines so as to prevent any cavitation at the inlet port of the pump, in steady delivery conditions and in sudden demand conditions.

3.5 Case drain pressure

3.5.1 Rated case-drain pressure

Rated case-drain pressure shall be defined as the maximum pressure at which the pump is required to operate continuously in the system.

Rated case-drain pressure shall be stated in the detail specification.

3.5.2 Case proof-pressure

Unless a different value is specified in the detail specification, all pumps shall be designated to withstand a pressure of at least 3 500 kPa (35 bar) at the case-drain port or 150 % of the rated case-drain pressure, whichever is the greater, without permanent damage being done or performance being impaired.

3.6 Case drain flow

The pump shall be capable of producing a minimum case drain flow at a maximum given differential pressure between case pressure and inlet pressure, as specified in the detail specification.

Minimum and maximum case drain flow shall be stated in the detail specification under conditions as specified in the detail specification.

3.7 Rated temperature

The rated temperature of the pump shall be defined as the maximum continuous temperature of the fluid at the inlet port of the pump. It shall be expressed in degrees Celsius.

The rated temperature is related to the maximum temperature (in accordance with ISO 6771) of the hydraulic system in which the pump is to be used and shall be one of the values listed in Table 1. The rated temperature shall be specified in the detail specification.

The minimum continuous temperature of the fluid at the pump inlet port may be specified in the detail specification.

Table 1 — Temperature relationship

Hydraulic system	Maximum system temperature °C	Rated temperature of pump °C
Type I	70	45
Type II	135	110
Type III	200	170

3.8 Maximum displacement

The maximum displacement of the pump shall be defined as the maximum theoretical volume of hydraulic fluid delivered in one revolution of its drive shaft. It shall be expressed in cubic centimetres per revolution.

The maximum displacement of the pump shall be calculated from the geometrical configuration and the dimensions of the pump. The effects of allowable manufacturing tolerances, of deflections of the pump structure, of compressibility of the hydraulic fluid, of internal leakage and temperature shall not be taken into account in the calculation, since the maximum displacement is intended to be an index of the sizes of the pump rather than of its performances.

3.9 Rated delivery

The rated delivery of the pump shall be defined as the measured output of the pump under conditions of rated temperature, rated inlet pressure, rated speed and maximum full-flow pressure.

The rated delivery shall be expressed in cubic decimetres per second and its value shall be specified in the detail specification (with, in parentheses, the corresponding value in cubic decimetres per minute) (see Figure 1).

3.10 Rated speed

The rated speed of the pump shall be defined as the maximum speed at which the detail specification requires the pump to operate continuously at rated temperature and at rated discharge pressure. The rated speed shall be expressed as a number of revolutions of the pump driving shaft per minute.

The rated speed of the pump shall be stated in the detail specification. As an indication, the maximum recommended values are given in the diagram in Figure 2.

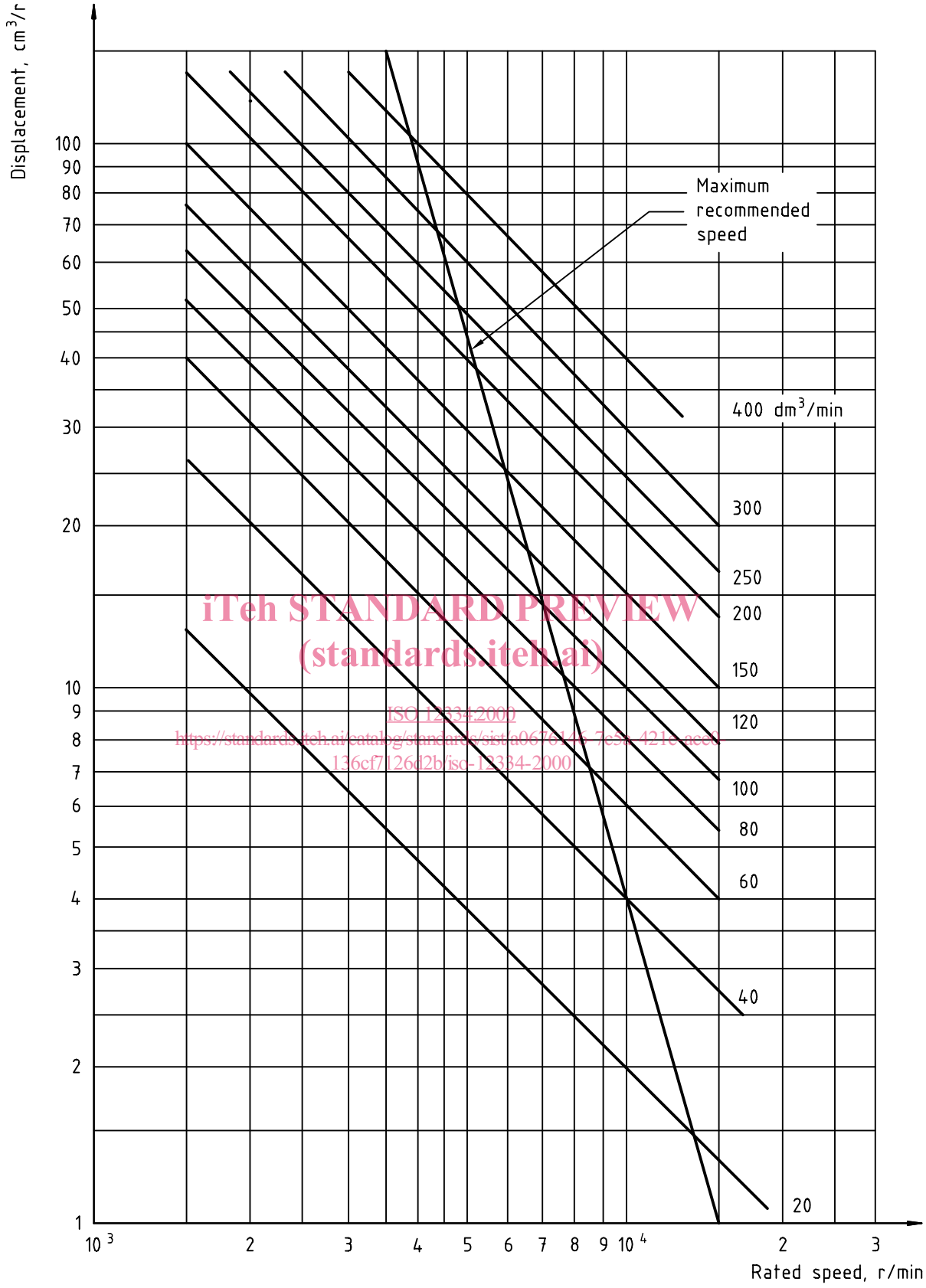


Figure 2 — Nomograph of maximum recommended values for rated speeds against pump displacement

3.11 Endurance

If the duration and the conditions of the endurance test are not specified in the detail specification, they shall be in accordance with Table 2 and 5.13 of this International Standard.

Table 2 — Duration of endurance test

Pump	Hydraulic system (see Table 1)	Duration of endurance test h
Category A (for example, used for military applications)	Type I	2 000
	Type II	2 000
	Type III	1 000
Category B (for example, used for commercial applications)	Type I	4 000
	Type II	4 000
	Type III	2 000

3.12 Torque

The detail specification shall specify:

— the maximum value of driving torque for rated operating conditions for the pump;

— the torque value when the pump is operated at zero flow, at rated pressure, temperature and rotation speed.

3.13 Efficiency

Efficiency shall be defined as the ratio of output power to input power when the pump is operated under rated conditions and at maximum full-flow pressure. In general, it shall be stated as a percentage.

NOTE The above ratio is commonly referred to as "overall efficiency" and includes volumetric efficiency.

When calculating output power from flow rate and pressure change, only the net pressure difference between inlet and outlet ports of the pump shall be used. The flow rate may be as measured in the low pressure side of the discharge line, provided that adequate compensation is made for compressibility when calculating efficiency.

The following efficiency values shall be stated in the detail specification:

— overall delivery of the pump when new;

— overall delivery of the pump after endurance test, this value being considered an objective.

3.14 Discharge pressure pulsations

Pressure pulsations shall be defined as the oscillations of the discharge pressure, occurring during nominally steady operating conditions, at a frequency equal to or higher than the pump drive shaft speed.

The amplitude of pressure pulsations shall be determined by the test procedure described in 5.9.5. These pulsations shall not exceed ± 2 100 kPa or a pressure band specified in the detail specification, when the pump is tested in the circuit which simulates the actual system in which the pump is to be installed, as defined in the detail specification. The system volume may be simulated using tubing of the discharge line diameter, while being careful to avoid a line length the natural frequency of which is resonant with pulsation frequency.

3.15 Variable delivery control

3.15.1 General

All pump models shall incorporate means to control the delivery with the effect of making the delivery of the pump pass from zero to its maximum full-flow value for any given operating speed, when the discharge pressure is reduced from rated discharge pressure to maximum full-flow pressure and vice versa.