International Standard 8278

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

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

First edition — 1986-11-01

UDC 621.65 : 629.7 **Ref. No. ISO 8278-1986 (E)**

Descriptors: aircraft, aircraft equipment, hydraulic systems, hydraulic equipment, pumps, specifications, quality assurance, acceptance testing, testing conditions.

Price based on 22 pages

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8278 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

Contents

This page intentionally left blank

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

1 Scope and field of application

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

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

NOTE — A schematic summary is provided in the annex for easy reference to the contents of this International Standard.

2 References

ISO 2093, *Metallic coatings — Electroplated coatings of tin.*

ISO 2653, *Environmental tests for aircraft equipment — Ice formation.*

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

ISO 2671, *Environmental tests for aircraft equipment — Acoustic vibration.*

ISO/TR 2685, *Aircraft — Environmental conditions and test procedures for airborne equipment — Resistance to fire in designated fire zones.*

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

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

ISO 7137, *Aircraft — Environmental conditions and test procedures for airborne equipment.* [2)]

ISO 7320, *Aerospace — Fluid systems port connection, seal and fitting end — Dimensions.*

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

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, *Aerospace — Accessory drives and mounting flanges — Metric series —*

Part 1: Design criteria. [3)]

Part 2: Dimensioning of couplings with spigot. [3)]

3 Functional requirements

3.1 Hydraulic fluid

The hydraulic fluid that the particular pump model is designed to handle shall be specified 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 125 % of rated speed;
- at rated inlet pressure.

1) At present at the stage of draft. (Revision of ISO 3601/1-1978.)

2) Endorsement, in part, of the publication EUROCAE ED-14A/RTCA DO-160A (a document published jointly by the European Organisation for Civil Aviation Electronics and the Radio Technical Commission for Aeronautics).

3) At present at the stage of draft.

The value and tolerance range of the rated discharge pressure shall be stated in the detail specification and shall be one of the following values of rated discharge pressure (see ISO 6771):

— 4 000 kPa (40 bar)

— 10 000 kPa (100 bar)

— 16 000 kPa (160 bar)

— 20 000 kPa (200 bar)

— 28 000 kPa (280 bar)

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

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 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).

3.4 Inlet pressures

3.4.1 Rated inlet pressure

The rated inlet pressure of the pump shall be defined as the indicated pressure at the inlet port of the pump when it is operating 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 stated 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 pressures

3.5.1 Rated case drain pressure

Rated case drain pressure shall be defined as that 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 designed 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 given maximum 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 fluid temperature at the inlet port of the pump. It shall be expressed in degrees Celsius.

The rated temperatue is related to the maximum temperature (see 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.

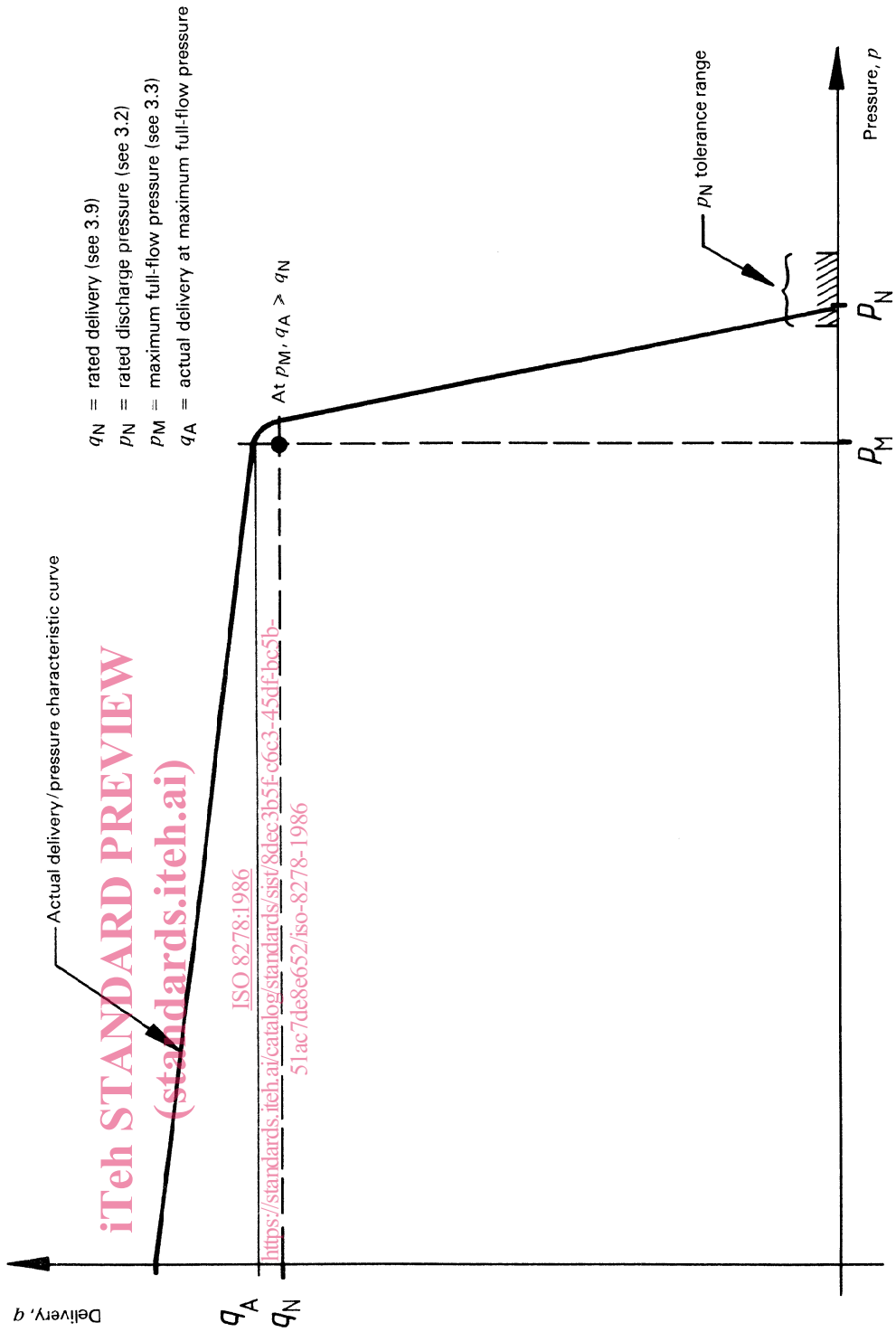
The minimum continuous fluid temperature at the pump inlet port may be specified in the detail specification.

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.



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 characteristic curve of pumps

The maximum displacement of any pump model shall be determined by calculation from the geometry and 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 of temperature shall not be taken into account in the calculation, because the maximum displacement is intended to be an index of the size of the pump rather than of its performance.

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.

It 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 nomograph in figure 2.

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 the specifications laid down in 5.12.

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	1 050
	Type II	1 050
	Type III	500
Category B (for example, used for civil applications)	Type I	2 000
	Type II	2 000
	Type III	1 000

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 determining output power by calculation 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 as 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 laid down in 5.8.4. These pulsations shall not exceed ± 10 % of the rated discharge pressure 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

All pump models shall incorporate means to control the delivery which shall act to increase the delivery of the pump from zero to its maximum full-flow value for any given operating speed, as the discharge pressure is reduced from rated discharge pressure to maximum full-flow pressure and *vice versa.*

3.15.1 Response time

The response time of the pump shall be defined as the time interval between the moment when an increase (or decrease) in discharge pressure begins and the subsequent moment when the discharge pressure reaches its first maximum (or minimum) value. In figures 3 and 4, the time intervals t_1 and t_2 are the response times of the pump as a function of the system impedance.

The oscillographic trace of discharge pressure against time shall be used as the criterion of movement of the delivery control mechanism. All pump models when operating at rated inlet

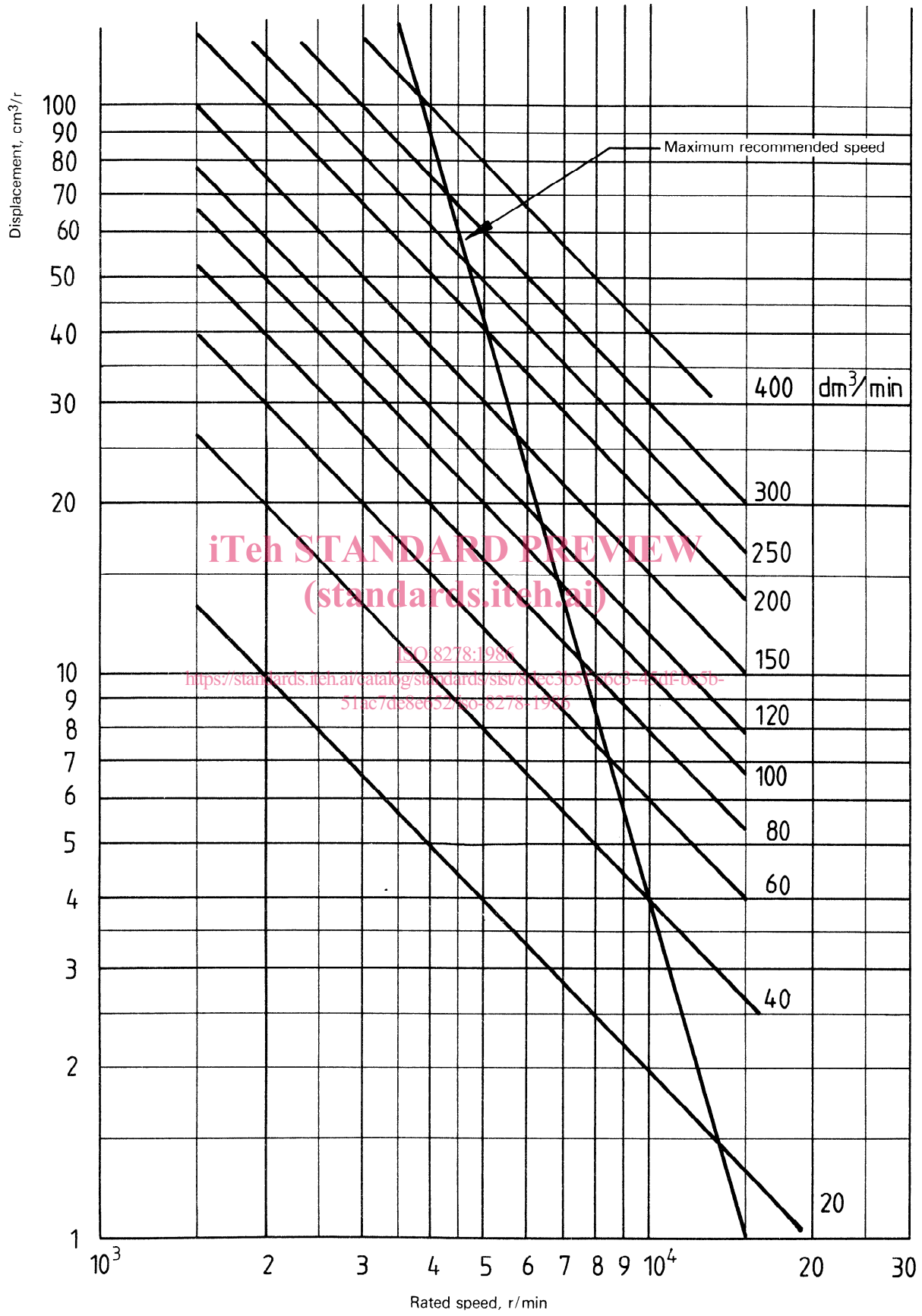


Figure 2 — Nomograph of maximum recommended values for rated speeds against pump displacement

temperature, at rated speed and in a circuit, the system impedance of which is that defined in 5.8.1.1 for response tests, shall have a response time of 0,05 s max., unless otherwise specified in the detail specification.

3.15.2 Stability

The stability of the pump shall be defined as the freedom from persistent or quasi-persistent oscillation or "hunting" of the delivery control mechanism at any frequency that can be traced to the pump delivery control means. The oscillographic trace of discharge pressure against time shall be used as the criterion of stability.

All pump models, under any operating condition within the limits stated in the detail specification and at any speed greater than 50 % of the rated speed, after a change in flow demand, shall recover steady-state operation (other than permissible pressure pulsations as specified in 3.14) within not more than 1 s after the initial response to that change in flow demand.

When required by the purchaser, the pump manufacturer shall provide adequate pump parameters to permit the system designer to integrate pump dynamic performance into his complete pump/system analysis.

3.16 Maximum transient pressure

The maximum transient pressure shall be defined as the peak value of the oscillographic trace of discharge pressure, made during operation of a pump, as specified in 5.8.2 and measured as shown in figure 3.

The value of the maximum transient pressure, as determined in the transient pressure test specified in 5.8.2, shall not exceed 135 % of the rated discharge pressure or the maximum pressure specified in the detail specification.

3.17 Depressurization

If it is required by the detail specification that the pump be depressurized either automatically or remotely, for example by means of an electrical signal, the depressurization control shall not, when de-energized, interfere with the normal operation of the variable delivery control. The detail specification shall specify the qualification and inspection tests for the depressurization control.

3.18 Balance

The moving parts of the hydraulic pump shall be inherently balanced and the pump shall not vibrate in such a manner as to cause failure of any part in the pump or drive mechanism at speeds up to and including 125 % of the rated speed.

3.19 Adjustment

Means shall be provided to adjust the delivery control mechanism to cause zero flow to occur at rated discharge pressure. This adjustment shall, preferably, be continuous or it is acceptable for it to be in steps of less than 1 % of the rated discharge pressure over a minimum range from 95 % to 130 % of the rated discharge pressure. The adjustment device shall be capable of being securely locked and it shall be possible to carry out adjustment and locking using only standard hand tools. Where practicable, the adjustment device shall be fitted in such a way that adjustments can be made while operating under full system pressure with negligible loss of fluid.

3.20 Safety wire sealing

Lead type safety wire sealing shall not be used.

3.21 Directionally critical components

Wherever practical, internal parts which are subject to malfunction or failure owing to the fact that they have been installed the wrong way round or out of true position shall have mechanical provisions to ensure that they cannot be installed or assembled incorrectly.

3.22 Environmental requirements

The detail specifications shall define environmental conditions to which the pumps will be exposed and in which the pumps shall operate. These detail specifications shall also define how these requirements can be checked by reference to the applicable test methods laid down in the relevant International Standards.

The following environmental conditions shall be considered:

a) temperatures and altitude (see ISO 7137);

b) humidity (see ISO 7137);

c) fluids susceptibility (see ISO 7137);

d) vibrations (see ISO 7137);

e) acoustic vibrations (see ISO 2671);

f) steady state acceleration (see ISO 2669);

g) fungus resistance (see ISO 7137);

h) salt spray (see ISO 7137);

i) water proofness (see ISO 7137);

j) sand and dust (see ISO 7137);

k) shock (see ISO 7137);

l) fire resistance (see ISO/TR 2685);

m) ice formation (see ISO 2653).

3.23 Installation requirements

3.23.1 Dimensions

Dimensions pertinent to the installation of pumps in aircraft shall be specified on the manufacturer's installation drawing.

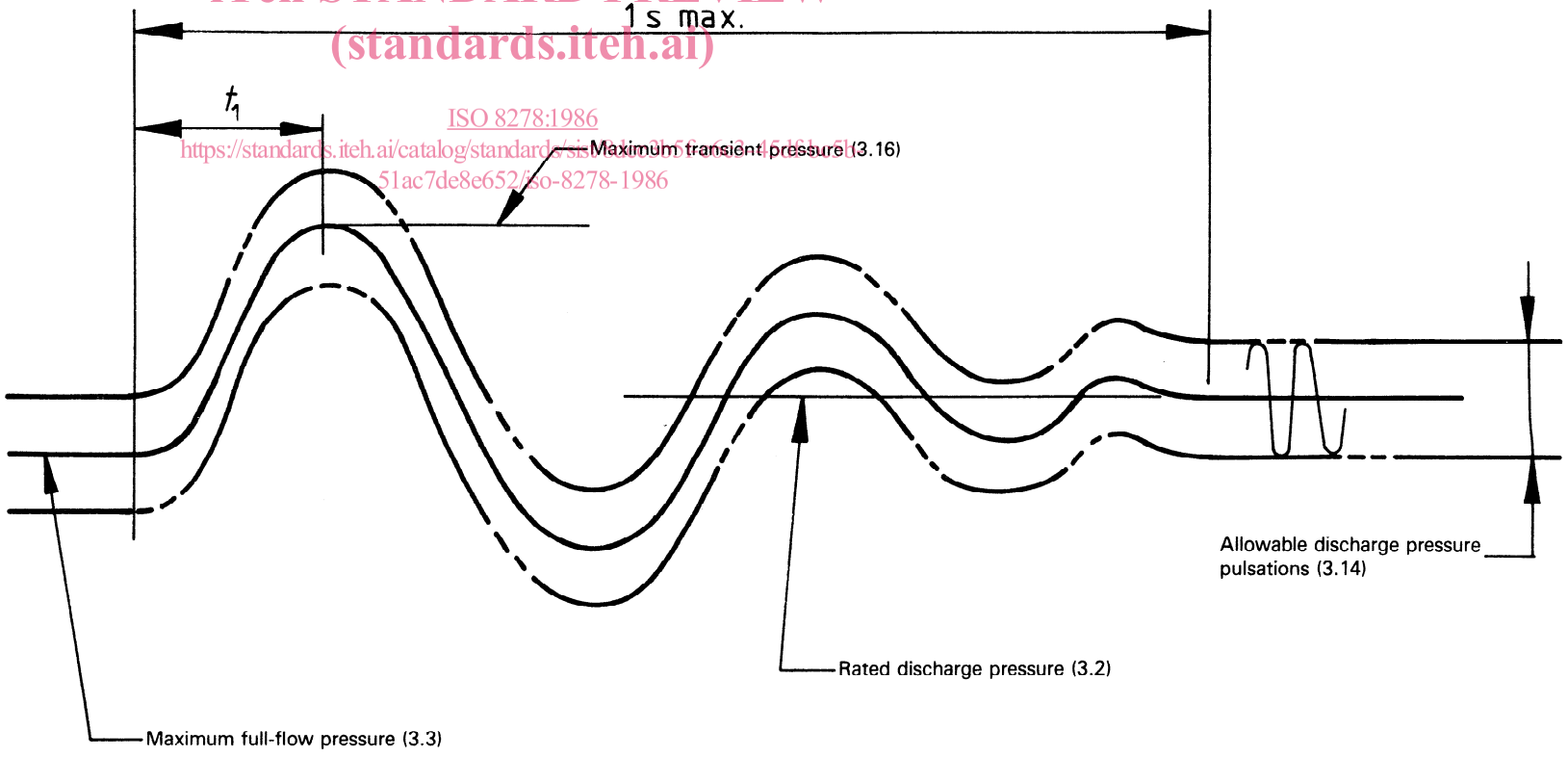


Figure 3 — Typical variation of pressure against time — Transient from maximum full-flow pressure to rated discharge pressure (zero flow)