INTERNATIONAL STANDARD

ISO 8426

First edition
1988-10-01

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

Hydraulic fluid power — Positive displacement pumps and motors — Determination of derived capacity

Transmissions hydrauliques — Pompes et moteurs volumétriques — Détermination de la cylindrée mesurée

Reference number
ISO 8426 : 1988 (E)

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.

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 8426 was prepared by Technical Committee ISO/TC 131, *Fluid power systems.*

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

Hydraulic fluid power — Positive displacement pumps and motors — Determination of derived capacity

0 Introduction

This International Standard is intended to unify testing methods for fluid power positive displacement hydraulic pumps and motors so as to enable the performance of different components to be compared.

Requirements for test installations, procedures and presentation of results are described.

1 Scope and field of application

This International Standard specifies the methods for determining the derived capacity of fluid power positive displacement hydraulic pumps and motors under steady-state conditions and at defined, continuously rotating shaft speeds.

The unit may be tested as a pump, with mechanical energy applied to the shaft and hydraulic energy obtained at the fluid connections, or as a motor, with the hydraulic energy supplied to the fluid connections and mechanical energy obtained at the shaft.

Accuracy of measurement is divided into three classes (A, B and C) which are explained in annex A.

2 References

ISO 1219, *Fluid power systems and components — Graphic symbols*.

ISO 3448, *Industrial liquid lubricants — ISO viscosity classification*.

ISO 4391, *Hydraulic fluid power — Pumps, motors and integral transmissions — Parameter definitions and letter symbols*.

ISO 5598, *Fluid power systems and components — Vocabulary*.

ISO 6743-4, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems)*.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 5598 and the following definitions apply.

NOTE — Some of the following definitions have been taken from ISO 5598 and are included, for convenience, in this International Standard.

3.1 direction of rotation: Direction of rotation as viewed looking at the shaft end.

NOTE — In dubious cases, a sketch should be provided.

3.2 hydrostatic power unit: Device for the transmission of energy by means of a pressurized fluid.

3.3 volume flow rate: The volume of a fluid crossing the transverse plane of a flow path per unit of time.

3.4 derived capacity: The volume of fluid displaced by a pump or motor per shaft revolution, calculated from measurements at different speeds under test conditions.

3.5 fluid temperature: Temperature of the fluid at a stated point.

4 Symbols and units

4.1 The symbols and units used throughout this International Standard are shown in table 1.

4.2 The graphical symbols used in the figures depicting test circuits are in accordance with ISO 1219.

5 Test installation — General requirements

5.1 General

5.1.1 Pre-test condition

Before commencing the tests, the unit shall be run in accordance with the manufacturer's recommendation.

5.1.2 Unit installation

5.1.2.1 The test installation shall be designed to prevent air entrainment and precautions shall be taken to remove all free air from the system before testing.

5.1.2.2 The unit shall be installed and operated in the test circuit (see 5.2) in accordance with the manufacturer's operating instructions.

5.1.2.3 The tests shall be carried out in still air and the ambient temperature shall be recorded.

5.1.2.4 If any additional means of controlling temperature are used, it shall be stated in the test report.

5.1.3 Filtration

5.1.3.1 Filters of sufficient number and appropriate type shall be installed to provide a standard of filtration in the test circuit which is at least equal to that recommended by the unit manufacturer.

5.1.3.2 Details on such filtration used in the test circuit shall be stated in the test report.

5.2 Test circuits

5.2.1 General

Figures 1, 2 and 3 illustrate basic circuits that do not incorporate all the safety devices necessary to protect against damage in the event of any component failure. It is important that those responsible for carrying out the tests give consideration to safeguarding personnel and equipment.

NOTE — The graphical symbols used in figures 1, 2 and 3 are in accordance with ISO 1219.

5.2.2 Pump circuit

5.2.2.1 Either an open test circuit, similar to that shown in figure 1, or a closed test circuit in accordance with figure 2 shall be used.

5.2.2.2 If a pressurized inlet condition is required, a control valve shall be provided in the inlet pipe at a point not less than $10d$ from the pressure tapping point.

5.2.2.3 The inlet pipe shall be straight and of uniform bore consistent with the pump inlet dimensions.

5.2.2.4 A boost pump and a pressure-relief valve shall be provided if it is required to boost the inlet pressures.

5.2.2.5 The boost pump supply shall be greater than the maximum requirements of the pump under test.

NOTE — If a closed test circuit (see figure 2) is used, the boost pump need only supply a flow slightly in excess of the total circuit losses, unless a greater flow is required for cooling purposes.

5.2.2.6 If means other than a boost pump are used, e.g. air-loaded tank, precautions shall be taken to minimize the effects of entrained air or dissolved air.

Table 1 — Symbols and units

Symbol	Description	Unit	Dimension[1]
d	Internal diameter of pipe	m	L
n	Rotational speed[2]	r/min	T^{-1}
p	Pressure[2]	bar[3]	$ML^{-1}T^{-2}$
q_V	Volume flow rate[2]	l/min	L^3T^{-1}
q_{V_e}	Actual flow rate[2]	l/min	L^3T^{-1}
V	Volume[2]	m^3	L^3
V_i	Derived capacity[4]	ml/rev	L^3
θ	Temperature[2]	°C	Θ
ν	Kinematic viscosity	m^2/s	L^2T^{-1}
ϱ	Mass density	kg/m^3	ML^{-3}

1) M = mass; L = length; T = time; Θ = temperature

2) Letter symbols in accordance with ISO 4391.

3) 1 bar = 10^5 Pa = 0,1 MPa; 1 Pa = 1 N/m^2

4) In ISO 4391, the symbol V_i is used for "swept volume".

5.2.3 Motor circuit

5.2.3.1 A test circuit incorporating a controlled fluid supply similar to that shown in figure 3 shall be used.

5.2.3.2 The inlet pipe shall be straight and of uniform bore consistent with the motor inlet dimensions.

6 General test conditions

6.1 Test fluid

6.1.1 Since the performance of a unit may vary considerably with the viscosity of the fluid, a fluid approved by the manufacturer of the unit shall be used when testing; the type of fluid used shall be stated in the test report.

6.1.2 The fluid temperature shall be maintained within the specified limits.

6.1.3 The kinematic viscosity, ν, and the mass density, ϱ, of the fluid shall be recorded for the controlled temperature used during the test.

6.2 Test temperatures

6.2.1 The tests shall be carried out at a stated fluid temperature, measured at the inlet to the pump or motor, within the range recommended by the unit manufacturer.

6.2.2 The fluid shall be maintained within the limits given in table 2 during the period in which all readings are being taken for a specific set of test conditions.

6.2.3 The following temperature measurements shall be recorded in the test report:

a) fluid temperature at inlet of unit;

b) fluid temperature at outlet of unit;

c) fluid temperature at point of measurement of flow;

d) ambient temperature.

6.3 Casing pressure

If the fluid pressure within the casing of a unit affects its performance, the pressure during testing shall be maintained at a value recommended by the manufacturer; in such cases, the casing fluid pressure shall be recorded in the test report.

6.4 Steady-state conditions

6.4.1 Each set of measurements shall be taken only when the values of controlled parameters are within the limits given in table 2.

Table 2 — Limits of permissible variation in the values of controlled parameters

Controlled parameter	Limit of permissible variation in the values of controlled parameters for class of measurement accuracy[1]		
	A	B	C
Rotational speed, %	± 0,5	± 1	± 2
Flow rate, %	± 0,5	± 1,5	± 2,5
Pressure, where p < 1,5 bar gauge, bar	± 0,01	± 0,03	± 0,05
Pressure, where $p \geqslant$ 1,5 bar gauge, %	± 0,5	± 1,5	± 2,5
Fluid temperature, °C	± 0,5	± 1	± 2

1) See annex A.

6.4.2 The number of readings taken and their disposition over their range shall be selected so as to give a representative indication of the performance of the unit over the full range of the function being varied.

6.5 Volume flow rate

The volume flow rate of the test unit shall be measured adjacent to the motor inlet ($q^{M}_{V_{1,e}}$) or pump outlet ($q^{P}_{V_{2,e}}$), as appropriate, and the corresponding temperature and pressure shall also be recorded. Where flow measurements are made remote from the units, the corresponding temperature and pressure shall be recorded.

6.6 Positioning of pressure- and temperature-tapping points

6.6.1 If pressure measurements are made within a pipe, the pressure-tapping point shall be located not less than $2d$ and not more than $4d$ from the unit port face.

NOTE — Greater distances may be used provided consideration is given to the effect of pipe losses.

6.6.2 If temperature measurements are made within a pipe, the temperature-tapping point shall be located not less than $2d$ and not more than $4d$ from the pressure-tapping point and further removed from the unit.

7 Test procedures

NOTE — For the purposes of this International Standard, it is considered that units to be used as hydraulic motors are tested as motors and units to be used as hydraulic pumps are tested as pumps. For a given unit, different test results may be obtained from two types of test.

7.1 Pumps

7.1.1 During each test, the inlet and outlet pressures shall be kept nominally constant.

7.1.2 Determine, by measurement, the outlet flow rate, $q_{V_{2,e}}$, for different shaft speeds and calculate the derived capacity, V_i, as described in annex B.

7.1.3 Carry out the tests to determine the value of derived capacity, V_i, at a stated outlet pressure p_2 which is approximately 5 % of the maximum continuous rated pressure of the unit, and at the speed increments shown in table 3.

7.1.4 If the unit is of the variable capacity type, carry out the tests at the maximum capacity setting and at such other settings as may be required, e.g. 75, 50 and 25 %.

7.1.5 For units in which the direction of the flow can be reversed, carry out the tests for both directions of flow, if required.

7.2 Motors

7.2.1 During each test, the output shaft shall be kept at nominally constant speed; record the inlet and outlet pressures.

7.2.2 Determine, by measurement, the inlet flow rate, $q_{V_{1,e}}$, for different output shaft speeds and calculate the derived capacity, V_i, as described in annex B.

7.2.3 Carry out the tests to determine the value of derived capacity, V_i, with no load on the output shaft and at the speeds shown in table 3.

7.2.4 If the unit is of the variable capacity type, carry out the tests at the maximum capacity setting and at such other settings as may be required, e.g. 75, 50 and 25 %.

7.2.5 For units in which the direction of rotation can be reversed, carry out tests for both directions of rotation, if required.

7.2.6 If the unit is of the type with an external drain which is returned to the oil reservoir, measure the drainage at or near atmospheric pressure and also its temperature as near as possible to the motor casing for all test conditions.

Table 3 — Pump and motor test speeds

Classes of measurement accuracy	Number of speeds	Speed movements over full continuous rated speed range
A	10 or more	In equal increments
B	5 or more	In equal increments
C	3 or more	At 20, 50 and 100 %

8 Test report

8.1 General

A test report shall be drawn up and shall include the following information:

a) a description of pump or motor;

b) the class of measurement accuracy (see annex A);

c) whether additional cooling means were used (see 5.1.2.4);

d) details of filtration (see 5.1.3);

e) details of test fluid, i.e. its classification in accordance with ISO 6743-4, its viscosity in accordance with ISO 3448 and its density (see 6.1);

f) the test temperatures (see 6.2.3);

g) the casing fluid pressure, if appropriate (see 6.3);

h) a description of the test circuit (see 5.2).

8.2 Presentation of test results

8.2.1 The derived capacity of a pump or motor forms the basis for the determination of the volumetric and overall efficiency of the specific unit tested and is therefore a most important value and should be determined by using the most accurate means which it is economically possible to apply. Because of its importance the test data should be presented in numeric form and the final value determined by calculation. Graphical presentation can only be considered acceptable when the scale for the displacement per revolution is large enough to meet the standards of accuracy required.

8.2.2 The following parameters shall be recorded:

a) (actual) inlet pressure;

b) (actual) outlet pressure;

c) (actual) shaft speed;

d) either

1) pump outlet flow rate per unit of time, or

2) motor inlet flow rate per unit of time;

e) time interval for flow measurements;

f) fluid temperature;

g) fluid viscosity.

8.2.3 From the data obtained by test, the following parameters shall be determined and recorded:

a) pressure differential across the test unit, in bars;

b) flow rate, in litres per minute;

c) actual shaft speed, in revolutions per minute or number of revolutions per unit of time;

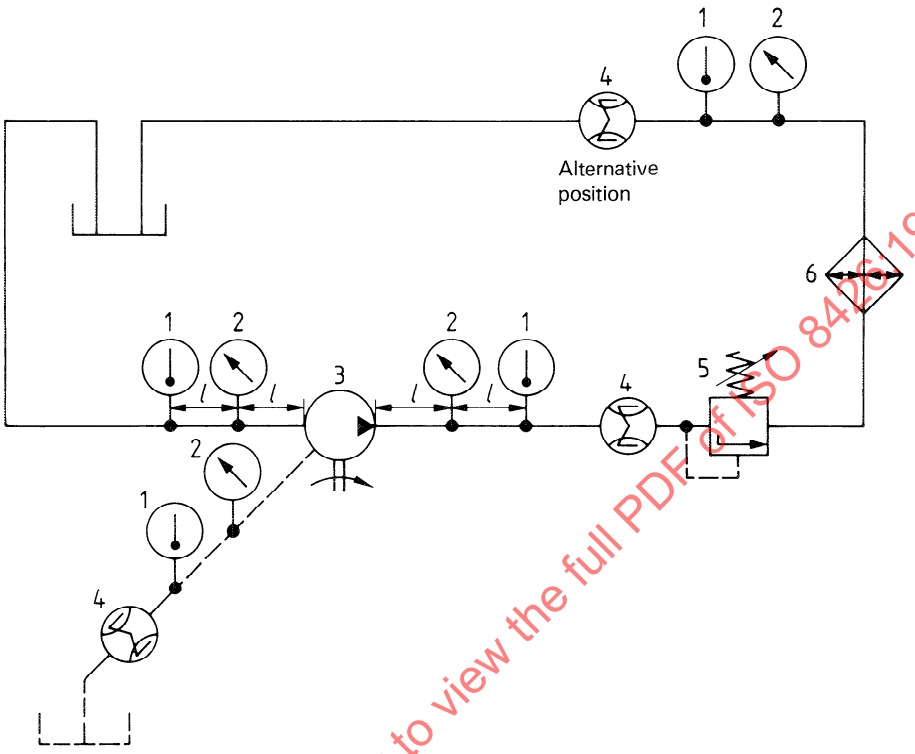
d) fluid viscosity;

e) the calculated fluid displacement per revolution, in millilitres per revolution.

9 Identification statement (Reference to this International Standard)

Use the following statement in test reports, catalogues and sales literature when electing to comply with this International Standard:

"Test for the determination of derived flow characteristics conforms to ISO 8426, *Hydraulic fluid power — Positive displacement pumps and motors — Determination of derived capacity.*"

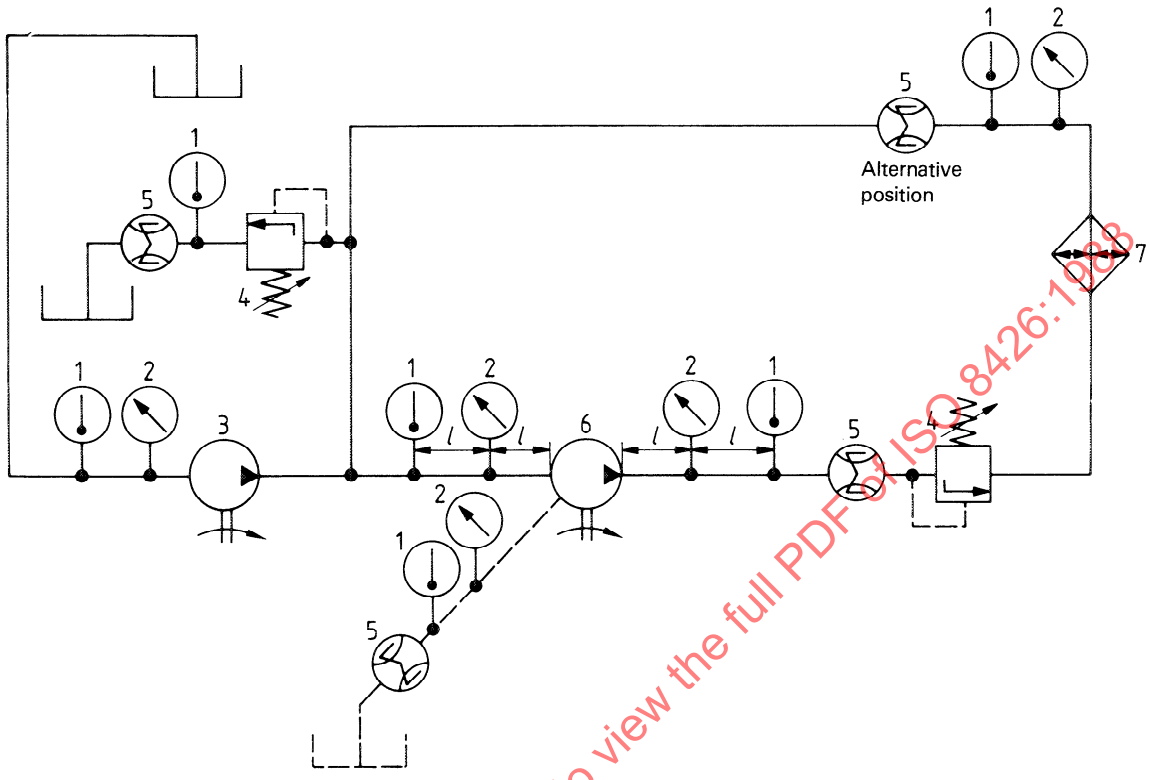


NOTE — Positioning of pressure- and temperature-tapping points (see 6.6): $2d \leqslant l \leqslant 4d$

Key

1 Temperature indicators
2 Pressure indicators
3 Pump under test
4 Integrating flowmeters
5 Pressure-control valve
6 Temperature controller

Figure 1 — Open test circuit for pump unit

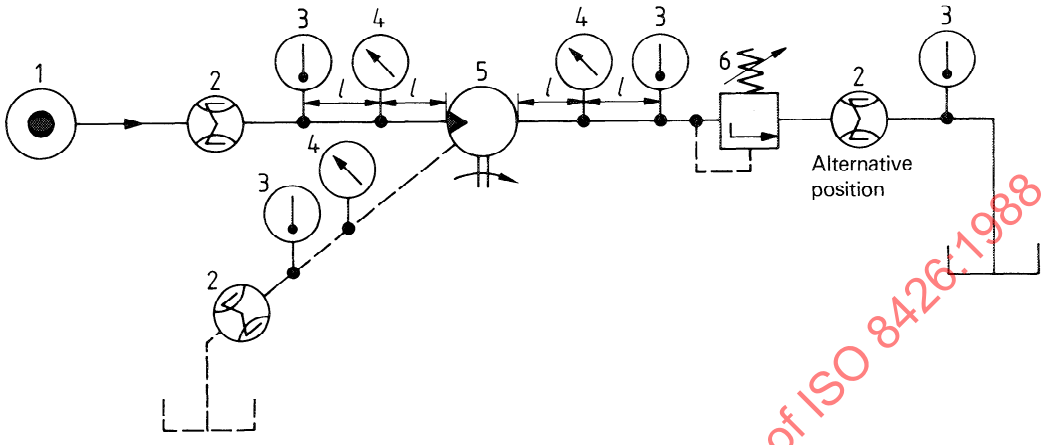


NOTE — Positioning of pressure- and temperature-tapping points (see 6.6): $2d \leqslant l \leqslant 4d$

Key

1 Temperature indicators
2 Pressure indicators
3 Boost pump
4 Pressure-control valves
5 Integrating flowmeters
6 Pump under test
7 Temperature controller

Figure 2 — Closed test circuit for pump unit



NOTE — Positioning of pressure- and temperature-tapping points (see 6.6): $2d \leqslant l \leqslant 4d$

Key

1 Controlled flow source
2 Integrating flowmeters
3 Temperature indicators
4 Pressure indicators
5 Motor under test
6 Pressure-control valve

Figure 3 — Test circuit for motor unit