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Hydraulic fluid power — General rules relating to systems

Transmissions hydrauliques — Règles générales relatives aux systèmes

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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.

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.

International Standard ISO 4413 was prepared by Technical Committee lSO/TC 131, *Fluid power systems*, Subcommittee SC 9, *Installations and systems*.

This second edition cancels and replaces the first edition (ISO 4413:1979), which has been technically revised.

Annexes A to D of this International Standard are for information only.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit.

The application of hydraulic fluid power systems requires a thorough understanding and precise communication between supplier and purchaser. This International Standard was prepared to assist that understanding and communication and to document many of the good practices learned from experience with hydraulic systems.

Use of this International Standard assists:

a) the identification and specification of the requirements for hydraulic systems and components;

b) the identification of respective areas of responsibility;

c) the design of systems and their components to comply with specific requirements;

d) understanding of the safety requirements of a hydraulic system.

General rules given in this International Standard have no legal status except those paragraphs that are included in contractual agreements between purchasers and suppliers. Deviation from those parts of this International Standard included in contractual agreements shall also be agreed to in writing by the purchaser and supplier. Attention shall be drawn by the purchaser and/or supplier to applicable national or local codes or laws.

General rules that contain the verb “shall” are counsels of good engineering practice, universally applicable with rare exception. Use of the word “should” in the document is not an indication of choice but an indication that the desirable engineering practices described may have to be modified due to the peculiarities of certain processes, environmental conditions or equipment size.

Titles or parts of the text which are marked with an asterisk (*) indicate subclauses for which discussion is needed between the supplier and purchaser to define the requirements and/or responsibilities. These are also listed in annex A.

Hydraulic fluid power — General rules relating to systems

1 Scope

This International Standard provides general rules relating to hydraulic systems on machinery used in industrial manufacturing processes. It is intended as a guide for both suppliers and purchasers, with a view to ensuring:

a) safety;

b) uninterrupted system operation;

c) ease and economy of maintenance;

d) long life of the system.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1219-1:1991, *Fluid power systems and components — Graphic symbols and circuit diagrams — Part 1: Graphic symbols.*

ISO 1219-2:1995, *Fluid power systems and components — Graphic symbols and circuit diagrams — Part 2: Circuit diagrams.*

ISO 4400:1994, *Fluid power systems and components — Three-pin electrical plug connectors with earth contact — Characteristics and requirements.*

ISO 4401:1994, *Hydraulic fluid power — Four-port directional control valves — Mounting surfaces.*

ISO 4406:—[1], *Hydraulic fluid power — Fluids — Method for coding level of contamination by solid particles.*

ISO 4021:1992, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system.*

ISO 5598:1985, *Fluid power systems and components — Vocabulary.*

ISO 5781:—[2], *Hydraulic fluid power — Pressure-control valves (excluding pressure-relief valves), sequence valves, unloading valves, throttle valves and check valves — Mounting surfaces.*

ISO 6149-1:1993, *Connections for fluid power and general use — Ports and stud ends with ISO 261 threads and O-ring sealing — Part 1: Ports with O-ring seal in truncated housing.*

ISO 6162:1994, *Hydraulic fluid power — Four-screw split-flange connections for use at pressures of 2,5 MPa to 40 MPa (25 bar to 400 bar) — Type I metric series and type II inch series.*

ISO 6164:1994, *Hydraulic fluid power — Four-screw, one-piece square-flange connections for use at pressures of 25 MPa and 40 MPa (250 and 400 bar).*

ISO 6263:1997, *Hydraulic fluid power — Compensated flow-control valves — Mounting surfaces.*

ISO 6264:1998, *Hydraulic fluid power — Pressure-relief valves — Mounting surfaces.*

ISO 6952:1994, *Fluid power systems and components — Two-pin electrical plug connector with earth contact — Characteristics and requirements.*

ISO 7368:1989, *Hydraulic fluid power — Two-port slip-in cartridge valves — Cavities.*

ISO 7789:1998, *Hydraulic fluid power — Two-, three- and four-port screw-in cartridge valves — Cavities.*

ISO 7790:1997, *Hydraulic fluid power — Four-port modular stack valves and four-port directional control valves, sizes 02, 03 and 05 — Clamping dimensions.*

ISO 8434-1:1994, *Metallic tube connections for fluid power and general use — Part 1: 24° compression fittings.*

ISO 8434-2:1994, *Metallic tube connections for fluid power and general use — Part 2: 37° flared fittings.*

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1) To be published. (Revision of ISO 4406:1987)

2) To be published. (Revision of ISO 5781:1987)

ISO 8434-3:1995, *Metallic tube connections for fluid power and general use — Part 3: O-ring face seal fittings.*

ISO 8434-4:1995, *Metallic tube connections for fluid power and general use — Part 4: 24° cone connectors with O-ring weld-on nipples.*

ISO 10372:1992, *Hydraulic fluid power — Four- and five-port servovalves — Mounting surfaces.*

ISO 10763:1994, *Hydraulic fluid power — Plain-end, seamless and welded precision steel tubes — Dimensions and nominal working pressures.*

ISO/TR 11688-1:1995, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning.*

ISO 12151-1:—[3], *Connections for hydraulic fluid power and general use — Hose fittings — Part 1: Hose fittings with ISO 8434-3 O-ring face seal end.*

ISO 12151-2:—[3], *Connections for hydraulic fluid power and general use — Hose fittings — Part 2: Hose fittings with ISO 8434-1 and ISO 8434-4 24° cone connector ends with O-rings.*

ISO 12151-3:—[3], *Connections for hydraulic fluid power and general use — Hose fittings — Part 3: Hose fittings with ISO 6162 flange ends.*

ISO 12151-4:—[3], *Connections for hydraulic fluid power and general use — Hose fittings — Part 4: Hose fittings with ISO 6149-2 and ISO 6149-3 stud ends.*

ISO 12151-5:—[3], *Connections for hydraulic fluid power and general use — Hose fittings — Part 5: Hose fittings with ISO 8434-2 37° flared ends.*

IEC 204-1:1997, *Electrical equipment of industrial machines — Part 1: General requirements.*

IEC 529:1989, *Degrees of protection provided by enclosures (IP code).*

3 Definitions

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

3.1 actuator: Component that transforms fluid energy into mechanical energy (e.g. motor, cylinder).

3.2 commissioning: Procedure by which a system is formally accepted by the purchaser.

3.3 component: Individual unit (e.g. cylinder, motor, valve, filter; but excluding piping) comprising one or more parts, designed to be a functional part of a fluid power system.

3) To be published.

3.4 control mechanism: Device that provides an input signal to a component (e.g. lever, solenoid).

3.5 emergency control: Control function that brings a system to a safe condition.

3.6 function plate: Surface that contains information describing either the performance of a manually operated device (e.g. on/off, forward/reverse, left/right, up/down) or the status of a function performed by the system (e.g. clamp, lift, advance).

3.7 operating device: Device that provides an input signal to a control mechanism (e.g. cam, electrical switch).

3.8 piping: Any combination of fittings, couplings or connectors with pipes, hoses or tubes which allows fluid flow between components.

3.9 purchaser: Party that stipulates the requirements of a machine, equipment, system or component and judges whether the product satisfies those requirements.

3.10 supplier: Party that contracts to provide the product(s) to satisfy the purchaser's requirements.

3.11 system: Arrangement of interconnected components which transmits and controls fluid power energy.

4 Requirements

4.1 General

The requirements given in 4.1.1 to 4.5 apply to all systems within the scope of this International Standard.

4.1.1 Instructions

Hydraulic systems shall be installed and used in accordance with the instructions and recommendations of the system supplier.

4.1.2 Language*

The purchaser and supplier shall agree on the language to be used for machine marking and applicable documentation. The supplier shall be responsible for ensuring that the translation has the same meaning as the original text.

4.2 Hazards*

When agreed between the purchaser and supplier, an assessment of the hazards listed in annex B shall be performed. This assessment may include the influence of the fluid power

system on the other parts of the machine, system or environment. Standards listed in annex B may be used in this assessment.

So far as is practicable, the hazards identified shall be eliminated by design and, where this is not practicable, the design shall incorporate safeguards against such hazards.

4.3 Safety requirements

4.3.1 Design considerations

When designing hydraulic systems, all aspects of possible methods of failure (including control supply failure) shall be considered.

In each case, components shall be selected, applied, fitted and adjusted so that in the event of a failure, safety of personnel shall be the prime consideration.

The prevention of damage to the system and the environment shall be considered.

4.3.2 Component selection

All components in the system shall be selected or specified to provide for safety in use, and they shall operate within their rated limits when the system is put to its intended use. Components shall be selected or specified to operate reliably under all intended uses of the system. Particular attention shall be paid to the reliability of components that could cause a hazard in the event of their failure or malfunction.

4.3.3 Unintended pressures

All parts of the system shall be designed or otherwise protected against pressures exceeding the maximum working pressure of a system or any part of the system or the rated pressure of any specific component.

The preferred means of protection against excessive pressure are one or more pressure relief valves located to limit the pressure in all parts of the system. Alternative means, such as pressure compensator pump controls, may be used, provided those means satisfy the application requirements.

Systems shall be designed, constructed and adjusted to minimise surge pressures and intensified pressures. Surge pressures and intensified pressures shall not cause hazards.

Loss of pressure or critical drop in pressure shall not expose persons to a hazard.

4.3.4 Mechanical movements

Mechanical movements, whether intended or unintended (including effects from, for example, acceleration, deceleration or lifting/holding of masses), shall not result in a situation which is hazardous to persons.

4.3.5 Noise

For the design of low noise machinery and systems, see ISO 11688-1.

4.3.6 Leakage

Leakage (internal or external) shall not cause a hazard.

4.3.7 Temperature

4.3.7.1 Operating temperature

The full range of operating temperatures for the system or any component shall not exceed those specified limits at which they can safely be used.

4.3.7.2 Surface temperature

Hydraulic systems shall be designed to protect persons from surface temperatures that exceed touchable limits by either location or guarding.

4.4 System requirements*

The purchaser and supplier shall establish specifications for the operation and function of the system, including

a) working pressure range;

b) operating temperature range;

c) type of fluid to be used;

d) cycle rates;

e) duty cycle;

f) service life of components;

g) sequence of events;

h) lubrication;

i) lifting requirements;

j) emergency and safety requirements;

k) details of painting or protective coating.

4.5 Site conditions*

4.5.1 Specifications*

The purchaser shall specify on the inquiry all the information required for proper selection and application of systems.

Examples of information required are

a) ambient temperature range of the installation;

b) humidity range of the installation;

c) available utilities, e.g. electricity, water, waste;

d) electric network details, e.g. voltage and its tolerance; frequency, available power (if limited);

e) protection for electrical devices;

f) atmospheric pressure;

g) contamination;

h) sources of vibration;

i) possible severity of a fire or explosion hazard;

j) standard of maintenance available;

k) reserves, e.g. flow, pressure and volume;

l) space for access, maintenance and use, as well as the location and mounting of components and systems to ensure their stability and security in use;

m) available cooling and heating media and capacities;

n) requirements for guarding;

o) legal and environmental limiting factors;

p) other safety requirements.

4.5.2 Drawings*

Where specified and agreed between the purchaser and supplier, the supplier shall provide drawings that indicate

a) floor plan, including location and installation dimensions;

b) foundation requirements, including floor loading;

c) water supply requirements;

d) electrical supply requirements;

e) piping layout (photographs may be used by agreement).

5 System design

5.1 Circuit diagrams

The supplier shall provide a circuit diagram in accordance with ISO 1219-2 which reflects the system design, identifies the components and satisfies the requirements of clause 4.

The following information shall be included on or with the circuit diagram:

a) identification of all equipment by name, catalogue number, serial or design number, and the manufacturer's or supplier's name;

b) the size, wall thickness and specification of pipe and tube and the size and specification of hose assemblies;

c) the bore diameter of each cylinder, the diameter of each cylinder piston rod, the length of stroke, the estimated maximum force and the speed required for the intended service;

d) the displacement per revolution, the maximum torque output, speeds and direction of rotation required for the intended service of each hydraulic motor;

e) the flow rate and the direction of rotation of each pump, as viewed from the driven shaft end;

f) the power, rotational speed, and the type of each pump prime mover;

g) the pressure settings;

h) the types of strainers, filters and replacement elements;

i) the volume of fluid required to fill the system to maximum level;

j) the recommended fluid type and viscosity grade;

k) when specified, the time sequence chart, e.g. the time range of the cycle and data or text, or both, showing the operations performed, including the function(s) of the related electrical and mechanical controls and actuators;

l) clear indication of any circuitry contained within circuit manifolds; where boundary lines or boundary envelopes are used for this purpose, the boundary indicated shall include only symbols of components mounted on or within the manifold;

m) clear indication of the function of each actuator in each direction;

n) the pre-charge pressures and nominal volumes of accumulators;

o) the size, type and location of pressure test, sampling and bleed points in the circuit;

p) identification of all component or manifold ports (as marked on the component or manifold);

q) the expected flow rate and maximum and minimum pressure of the cooling medium, and the maximum temperature of the cooling medium supply;

r) identification of all electrical signal converters, as marked on the electrical circuit diagram.

5.2 Identification

5.2.1 Components

The following particulars shall be provided by the supplier and shown, if practicable, in a permanent and readily visible form on all components:

a) the manufacturer's or supplier's name and brief address;

b) the manufacturer's or supplier's product identification;

c) the rated pressure;

d) symbols according to ISO 1219-1, with all ports correctly identified.

Where lack of available space would result in lettering too small to be legible, information may be provided on supplementary materials such as instruction/maintenance sheets, catalogue sheets or accessory tags.

5.2.2 Components within a system

Each component shall be given a unique item number and/or letter. This unique item number shall be used to identify the component on all diagrams, lists and layouts. It should be clearly and permanently marked on the installation adjacent to, but not on, the component.

The order of stacking modules shall be clearly indicated adjacent to, but not on, the stack.

5.2.3 Ports

All ports, power take-off, test and bleed points and drain outlets (e.g. reservoir drains) shall be clearly and distinctly identified. The identification shall correspond to the data on the circuit diagram.

When components have standard port identifications applied by the component supplier, these shall be supplemented by identifications corresponding to the circuit diagram (see 5.2.1 and 5.2.2).