INTERNATIONAL STANDARD

ISO 4414

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Pneumatic fluid power — General rules relating to systems

Transmissions pneumatiques — 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 4414 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 9, *Installations and systems.*

This second edition cancels and replaces the first edition (ISO 4414:1982), which has been technically revised.

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

Introduction

In pneumatic fluid power systems, power is transmitted and controlled through air or a neutral gas under pressure within a circuit.

The application of pneumatic fluid power systems requires a thorough understanding and precise communication between the 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 pneumatic systems.

Use of this International Standard assists:

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

b) the identification of the 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 pneumatic 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 the supplier to applicable national and local codes or laws.

General rules which contain the verb "shall" are counsels of good engineering practice, universally applicable with rare exceptions. 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 that discussion is needed between the supplier and purchaser to define the requirements and/or responsibilities. These are also listed in annex A.

Pneumatic fluid power — General rules relating to systems

1 Scope

This International Standard provides general rules relating to pneumatic systems 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.

This International Standard does not apply to air compressors and the systems associated with air distribution as typically installed in a factory.

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 65:1981, *Carbon steel tubes suitable for screwing in accordance with ISO 7-1.*

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

ISO 5782-1:1997, *Pneumatic fluid power — Compressed air filters — Part 1: Main characteristics to be included in suppliers' literature and product marking requirements.*

ISO 6301-1:1997, *Pneumatic fluid power — Compressed air lubricators — Part 1: Main characteristics to be included in suppliers' literature and product marking requirements.*

ISO 6953-1:1990, *Pneumatic fluid power — Air line pressure regulators — Part 1: Main characteristics to be included in commercial literature and specific requirements.*

ISO 8778:1990, *Pneumatic fluid power — Standard reference atmosphere.*

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 (e.g. motor or cylinder) that transforms fluid energy into mechanical energy.

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

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

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, up/down) or the status of a function performed by the system (e.g. clamp, lift, advance).

3.7 neutral gas: Gas that has properties similar to air and does not react to the effects of pressure and/or temperature in a manner different to air.

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

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

3.10 pneumatics: Science and technology which deals with the use of air or neutral gases as the fluid power medium.

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

3.12 supplier: Party that contracts to provide the product(s) to satisfy the purchasers requirements.

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

4 Requirements

4.1 General

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

4.1.1 Instructions

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

4.1.2 Language*

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

4.2 Hazards*

When agreed between purchaser and supplier, an assessment of the hazards listed in annex B shall be performed. This assessment may include the influence of the pneumatic fluid power system with 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 pneumatic systems, all intended operations and use of the systems shall be considered.

Pneumatic systems shall be designed and components selected, applied, mounted and adjusted to provide uninterrupted operation, extended life and safe operation.

In the event of a failure, safety of personnel shall be the prime consideration, and damage to equipment and the environment minimized. Possible modes of failure and intended operations and use 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 failure mode 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.

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

Attention should also be paid to the consequences of blockages, pressure drops or leaks which could affect safe operation of components.

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

Silencers shall be used where the sound pressure level caused by exhausting air is above that permitted by applicable codes and standards. The use of exhaust port silencers, in themselves, shall not create a hazard. Silencers should not create detrimental back pressure.

4.3.6 Leakage

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

4.3.7 Airborne hazardous substances

Systems shall be so designed, constructed and/or equipped that hazards due to airborne hazardous substances included in the exhausting air can be minimized.

4.4 System requirements*

The supplier and purchaser 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 supplier and purchaser shall define site conditions and the design of the system shall take account of these conditions.

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), etc.;

e) protection for electrical circuits;

f) altitudes of installations over 1 000 m above sea level;

g) pressure, flow capability, moisture content and cleanliness of compressed air, if supplied from a source not included in the pneumatic system (see ISO 8573-1);

h) sources of vibration;

i) emergency resources, e.g. possibility of fire, explosion or other hazards and availability of related emergency resources;

j) unusual environmental conditions;

k) requirements for guarding;

l) legal factors, including environmental regulations;

m) other safety and special requirements.

4.5.2 Drawings *

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

a) floor plan, including location and installation dimensions;

b) foundation requirements, including floor loading;

c) water supply reqirements;

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 the circuit diagram or with supplementary literature:

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

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 air motor;

e) the pressure settings of pressure control valves;

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

g) when specified, the time sequence charts, 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;

h) 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;

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

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

k) 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) additional information required on various components as shown in table 1;

e) 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 literature such as instruction/maintenance sheets, catalogue sheets or accessory tags.

Optional information that can be given either on the component or in supplementary literature is described in table 1.

Table 1 — Additional information to be given on components and/or in supplementary literature

Component	Required information	Optional information	Remarks
Air motors	Direction of rotation	Free air consumption	
Rotary actuators	Angle of rotation Displacement		
Cylinders	Cylinder bore Length of stroke		
Solenoids	Voltage a.c. frequency or d.c. power or V·A	Protection classification (IP rating)	In accordance with IEC 529
Directional control valves	Working pressure range Port size		Can substitute for rated pressure
Pressure switches	Working pressure range Pressure differential range Voltage and current-carrying capacity of switch	Protection classification (IP rating)	Can substitute for rated pressure In accordance with IEC 529
Filters	Direction of flow µm rating Port size		See ISO 5782-1
Pressure regulators	Direction of flow Port size	Range of pressure adjustment	See ISO 6953-1
Lubricators	Direction of flow Port size	Minimum flow required to operate, oil valve adjustment direction	See ISO 6301-1
Flexible hose	Date of manufacture (year/quarter)	Nominal diameter (inside diameter)	
NOTE — Temperature ratings for all components is optional.			

5.2.2 Components within a system

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

For stacked assemblies (see figure 1), the order should be clearly indicated adjacent to, but not on, the stack.

5.2.3 Ports

All ports 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).

5.2.4 Valve control mechanisms

5.2.4.1 Non-electrical

Non-electrical valve control mechanisms and their functions shall be clearly and permanently identified with the same identification used on the circuit diagram.

5.2.4.2 Electrical

Electrical control mechanisms (solenoids and their attaching plugs or cables) shall be identified on the electrical and pneumatic circuit diagrams with the same identification.

5.2.5 Internal devices

Valves and other functional devices (orifice plugs and passages, shuttle valves, check valves, etc.) located within a manifold, mounting plate, pad, or fitting shall be identified adjacent to their access openings. Where access openings are located under a component or components, identification shall be provided adjacent to the component and marked "CONCEALED".

5.2.6 Function plates

A function plate should be provided for each control station and located where it can be easily read. The function plate information shall be relevant and easily understood, providing positive identification of each system function controlled.