BRITISH STANDARD

BS EN
1861:1998

# Refrigerating systems and heat pumps — System flow diagrams and piping and instrument diagrams — Layout and symbols

The European Standard EN 1861:1998 has the status of a British Standard

ICS 01.080.30; 27.080; 27.200

# National foreword

This British Standard is the English language version of EN 1861:1998.

The UK participation in its preparation was entrusted to Technical Committee RHE/18, Refrigeration safety, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

**Cross-references**

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

**Summary of pages**

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 28, an inside back cover and a back cover.

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EUROPEAN STANDARD
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# EN 1861

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Descriptors: cooling systems, heat pumps, charts, diagrams, graphic symbols, piping, instruments, information, classifications, presentation, selection

English version

# Refrigerating systems and heat pumps — System flow diagrams and piping and instrument diagrams — Layout and symbols

Systèmes de réfrigération et pompes à chaleur — Schémas synoptiques pour systèmes, tuyauteries et instrumentation — Configuration et symboles

Kälteanlagen und Wärmepumpen — Systemfließbilder und Rohrleitungs- und Instrumentenfließbilder — Gestaltung und Symbole

This European Standard was approved by CEN on 23 March 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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**CEN**

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

**Central Secretariat: rue de Stassart 36, B-1050 Brussels**



Ref. No. EN 1861:1998 E

## Foreword

This European Standard has been prepared by Technical Committee CEN/TC 182, Refrigerating systems, safety and environmental requirements, the Secretariat of which is held by DIN.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) 1997/23/EC.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 1998, and conflicting national standards shall be withdrawn at the latest by October 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

## Introduction

Recognizing the work already done by other committees, the work has been based on the basic series developed for process plants and other relevant symbol standards. The standard will be revised and harmonized with the relevant standards as soon as these are available.

## Contents

## 1 Scope

This European Standard specifies the symbols and drawing rules for system flow diagrams and piping and instrument diagrams to be applied to refrigerating systems including heat pumps. These diagrams represent the configuration and function of refrigerating systems and form a part of the complete technical documentation necessary for designing, construction, installation, commissioning, operation, maintenance and decommissioning of a refrigerating system.

This standard does not apply to refrigerating systems where the heat is extracted by an electrical circuit, e.g. Peltier-effect.

## 2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units.*

ISO 3098-1, *Technical drawings — Lettering — Part 1: Currently used characters.*

ISO 3511-1, *Process measurement control functions and instrumentation — Symbolic representation — Part 1: Basic requirements*

ISO 3511-2, *Process measurement control functions and instrumentation — Symbolic representation — Part 2: Extension of basic requirements.*

ISO 3511-3, *Process measurement control functions and instrumentation — Symbolic representation — Part 3: Detailed symbols for instrument interconnection diagrams.*

ISO 3511-4, *Industrial process measurement control functions and instrumentation — Symbolic representation — Part 4: Basic symbols for process computer, interface, and shared display/control functions.*

ISO 4196, *Graphical symbols — Use of arrows.*

ISO 5457, *Technical drawings — Sizes and layout of drawing sheets.*

ISO 7200, *Technical drawings — Title blocks.*

ISO 10628, *Flow diagrams for process plants — General rules.*

## 3 Definitions

For the purposes of this standard, the following definition applies:

**flow diagram**

diagram representing the process, configuration and function of a refrigerating system, simplified with the aid of graphical symbols, annotations and alphanumeric codes

## 4 Classification, information content and presentation

### 4.1 General

Depending on the information and presentation, a distinction is made between two types of flow diagrams for refrigerating systems, namely:

— system flow diagram (see **4.2**);

— piping and instrument diagram (P and ID) (see **4.3**).

Flow diagrams shall take into account the functional requirements.

The graphical presentation shall be in accordance with clause **6**. The routes and the direction of flow shall be indicated by lines and arrows.

All pressures indicated on flow diagrams unless otherwise stated are absolute pressures.

### 4.2 System flow diagram

#### 4.2.1 *General*

The system flow diagram shall represent a refrigerating system with the aid of graphical symbols interconnected by flow lines (see example in Figure A.1).

The graphical symbols represent components and the lines represent streams of mass and energy flows or energy carriers, e.g. pipes or wires.

#### 4.2.2 *Basic information*

The system flow diagram shall use the graphical symbols in accordance with clause **6** and shall at least contain the following information:

a) equipment and machinery necessary for the refrigerating system;

b) designation and flow rates of in- and outgoing products which can be cooled or heated;

c) designation of refrigerant, heat transfer medium, absorbant and adsorbant;

d) characteristic operating conditions.

#### 4.2.3 *Additional information*

The system flow diagram shall use the graphical symbols in accordance with clause **6** and can also contain e.g.:

a) designation and flow rates of fluids between the process steps;

b) essential valves in the logical position with respect to their function;

c) functional demands for measurement and control at essential points;

d) supplementary operating conditions;

e) characteristic data of equipment, machinery and other components indicated on the drawing or in separate lists.

### 4.3 Piping and instrument diagram (P and ID)

#### 4.3.1 *General*

The piping and instrument diagram (P and ID), based on the system flow diagram, shall represent the technical realization of a refrigerating system by means of graphical symbols for equipment, machinery and piping together with graphical symbols for measurement and control functions (see example in Figure A.2).

#### 4.3.2 *Basic information*

The P and ID shall use the graphical symbols in accordance with clause **6** and shall at least contain the following information:

a) designation of refrigerant, heat transfer medium, absorbant and adsorbant;

b) characteristic operating conditions;

c) equipment, machinery and other components (e.g. drives, piping, conveyors, valves and fittings) as well as installed standby equipment;

d) characteristic data of equipment, machinery and other components indicated, if necessary, in separate lists;

e) size, pressure rating, material and type of piping, e.g. by piping number, piping class or identification number;

f) thermal insulation;

g) measurement and control functions;

h) safety equipment.

#### 4.3.3 *Additional information*

The P and ID shall use the graphical symbols in accordance with clause **6** and may also contain e.g.:

a) mass flows and charges of refrigerant and heat transfer medium;

b) route and direction of flow of refrigerant and heat transfer medium;

c) data on the construction of piping, equipment, valves, machinery and thermal insulation indicated, if necessary, in separate lists.

## 5 Layout of diagrams

### 5.1 Drawing rules

#### 5.1.1 *General*

The standardized drawing rules shall be used for the graphical representation of flow diagrams for refrigerating systems.

#### 5.1.2 *Drawing sheet sizes*

Drawing sheet sizes as shown in ISO 5457 shall be used.

NOTE Considering the various copying techniques available, long sizes and sizes larger than A0 should be avoided.

#### 5.1.3 *Title block*

The basic title block for drawings and lists as shown in ISO 7200 shall be used.

### 5.2 Graphical symbols

The graphical symbols shall be in accordance with clause **6** except that graphical symbols for measurement, control functions and safety equipment shall be in accordance with ISO 3511-1 to ISO 3511-4 (also see annex B).

### 5.3 Connecting lines

#### 5.3.1 *Line width*

The line width shall be related to the proposed grid module ($M$) for flow diagrams $M = 2{,}5$ mm.

To obtain a clear representation, different line widths shall be used. Main flow lines or main piping shall be highlighted.

NOTE The following line widths, chosen from ISO 128 (see annex C), should be used:

a) 1,0 mm (0,4 $M$) for:

— main flow lines;

b) 0.5 mm (0,2 $M$) for:

— graphical symbols for equipment and machinery, except valves, fittings and piping accessories;

— rectangular boxes for illustrating unit operations, equipment, etc.;

— subsidiary flow lines;

— energy carrier lines and auxiliary system lines;

c) 0,25 mm (0,1 $M$) for:

— graphical symbols for valves, fittings and piping accessories;

— symbols for measurement, control functions, safety equipment, control and data transmission lines;

— reference lines;

— other auxiliary lines.

Line widths of less than 0,25 mm (0,1 $M$) shall not be used.

#### 5.3.2 *Line spacing*

The minimum spacing between parallel lines shall not be less than twice the width of the thickest line (see ISO 128), but not less than 1 mm.

NOTE A spacing of 10 mm and more is desirable between flow lines.

#### 5.3.3 *Direction of flow*

Inlet and outlet arrows as shown in ISO 4196 shall be used for indicating the inlet and outlet of streams into or out of the diagram.

Arrows shall be incorporated in the line for indicating the direction of the streams within the flow diagram. Arrows shall only be used at the inlets to equipment and machinery (except for pumps) and upstream of pipe branches. They shall not touch the outline of the graphical symbols.

NOTE If a diagram is comprised of several sheets, it is recommended that incoming and outgoing flow lines or piping of a sheet be drawn in such a manner that the lines continue at the same level when the individual sheets are joined together.

#### 5.3.4 *Connections*

Connections between flow lines or piping shall be drawn as shown in Table 1, subject group 1.

#### 5.3.5 *Connections of secondary system lines*

Secondary system lines shall be shown by short lines with indication of the direction of flow and reference to the type of energy carrier and possibly drawing number.

### 5.4 Inscriptions

#### 5.4.1 *Type of lettering*

Lettering of ISO 3098-1 shall be used.

NOTE The use of vertical letters type B is recommended.

#### 5.4.2 *Height of lettering*

The height of letters shall be at least:

a) 3,5 mm for identification numbers of major equipment;

b) 2,5 mm for other inscriptions.

#### 5.4.3 *Arrangement of inscription*

a) *Equipment*

Identification numbers for equipment shall be clearly allotted to the pertaining graphical symbol, but shall not be written into it.

NOTE Further details (e.g. designation, nominal capacity, pressure, material) can either be placed under the identification numbers or indicated in separate tables.

b) *Flow lines or piping*

Designation of flow lines or piping shall be written above horizontal lines, to the left of and parallel to vertical lines.

If the beginning and end of flow lines or piping are not immediately recognizable, identical ones shall be indicated by corresponding letters.

c) *Valves and fittings*

Designation of valves and fittings shall be written next to the graphical symbol and parallel to the direction of flow.

d) *Measurement and control functions*

ISO 3511-1 and ISO 3511-4 shall be used.

e) *Flow rates*, *operating conditions*, *thermophysical properties*

Flow rates, operating conditions and thermophysical properties shall be entered either in horizontal rectangular boxes or in a separate table. The boxes shall be connected to the reference points by means of reference lines. If the data are shown in tabular form, a serial number corresponding to the data list shall be written into the box.

f) *SI units*

SI units shall be used in accordance with ISO 1000.

## 6 Selection of graphical symbols

### 6.1 General

The symbols of the ISO basic series given in Table 1 are based on ISO 10628.

### 6.2 Series selection

The symbols of the ISO basic series shall be used in a system flow diagram. The symbols of the ISO basic and/or refrigeration basic series shall be used in a P and ID diagram.

NOTE It is recommended also to use graphical symbols of the ISO basic series in P and ID diagrams, since very often it is not possible to show in a graphical symbol every special feature of the equipment. The special features are given in the equipment data sheets.

### 6.3 Subject groups

NOTE The graphical symbols are grouped together in subject groups according to functional and/or design features. They are arranged in an ISO basic and refrigeration series and examples of application.

A distinction is made between the following subject groups:

— 1: Piping;
— 2: Shutoff valves;
— 3: Check valves;
— 4: Regulating valves;
— 5: Valves/fittings with safety function;
— 6: Valve actuators;
— 7: Pipe fittings;
— 8: Vessels and tanks;
— 9: Vessels with internals; Columns with internals; Chemical reactors with internals;
— 10: Facilities for heating or cooling;
— 11: Heat exchangers; Steam generators;
— 12: Filters; Liquid filters; Gas filters, filter-driers;
— 13: Separators;
— 14: Agitators;
— 15: Liquid pumps;
— 16: Compressors; Vacuum pumps; Fans;
— 17: Lifting, conveying and transport;
— 18: Scales;
— 19: Distribution facilities;
— 20: Motors, engines, drives.

### 6.4 Graphical symbols for equipment, machinery and piping

The graphical symbols given in Table 1 shall be used.

NOTE 1 Graphical symbols are shown in the recommended sizes for flow diagrams (grid module $M = 2{,}5$ mm).

NOTE 2 Preferred flow line connections to a graphical symbol are indicated by an —Ⓐ in Table 1. The indicated flow line connections are not a part of the graphical symbol. When flow diagrams are produced by means of computer aided design systems (CAD), flow lines can only be connected to a graphical symbol at grid points.

NOTE 3 The grid underneath the graphical symbol gives an idea of the proportions of the graphical symbol and facilitates its positioning and reproduction.

NOTE 4 Graphical symbols may be turned or mirrored, if their meaning does not depend on the orientation. The representation of some graphical symbols (e.g. columns, vessels, etc.) should be adjusted to the actual scale with respect to the refrigerating system.

NOTE 5 Symbols from different subject groups can be combined to form more detailed symbols.

**Table 1 — Graphical symbols for equipment, machinery and piping**

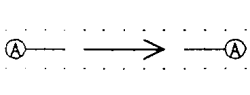
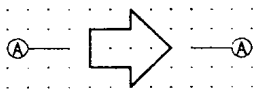
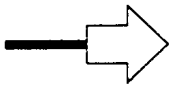
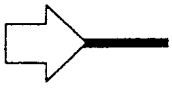
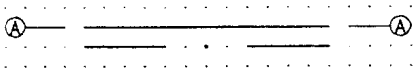
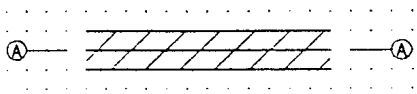
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 1 Piping** | | |
| | Refrigerant, refrigerant solutions; main circuit | |
| | Refrigerant, secondary circuit | |
| | Heat transfer medium | |
| | Cooling water for condenser | |
| | Other substances (e.g. oil) | |
| | Product to be cooled or heated (including water) | |
| |  Flow/motion in direction of arrow<br>  Arrow for inlet or outlet of essential substances |  Outlet<br>  Inlet |
| |  Piping, heated or cooled<br>  Piping, insulated | |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

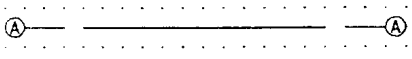
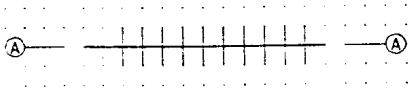
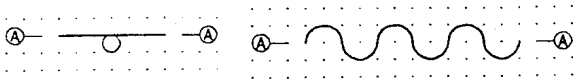
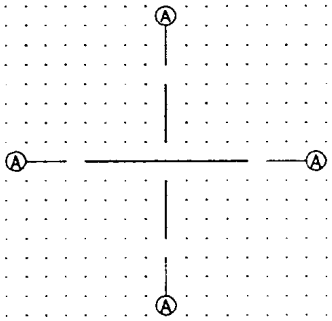
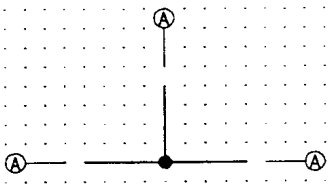
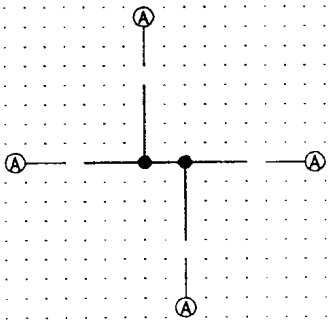
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| |  Signal line  Actuating line | |
| |  Capillary Flexible piping |  |
| |  Intersection of flow lines without connections, e.g. for piping | |
| | Connection of flow lines or piping:  T-type connection  Cross-type connection | |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

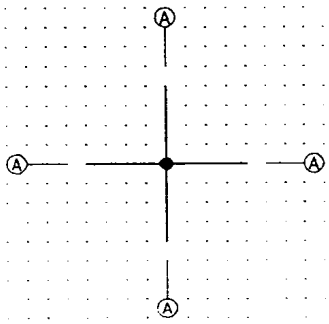
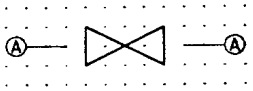
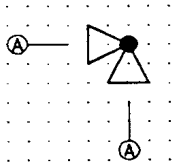
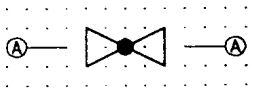
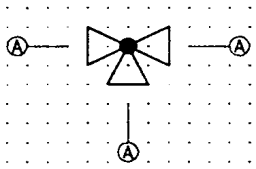
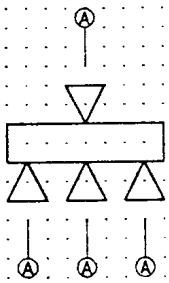
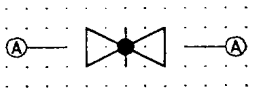
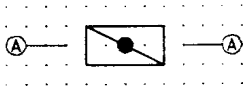
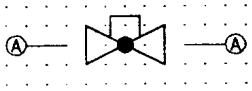
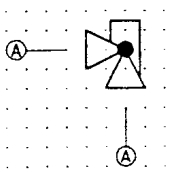
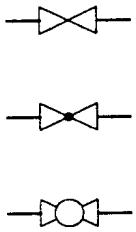
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| |  Cross-type connection (crossing) | |
| **Subject group 2 Shut-off valves** | | |
|  Valve, general |  Open at normal operation |  Closed at normal operation |
|  Angle valve, general |  Globe valve | |
|  Three-way valve, general |  Ball valve |  Four-way valve, general |
| |  Gate valve |  Butterfly valve |
| |  Through shut-off valve, safeguarded against deliberate actuation |  Angle shut-off valve, safeguarded against deliberate actuation |
| | |   Change over valve (black side closed) |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

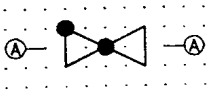
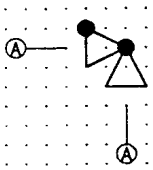
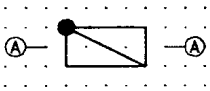
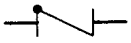
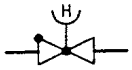
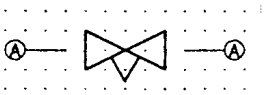
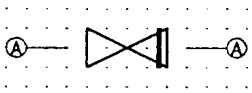
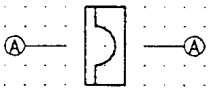
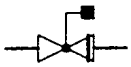
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 3 Check valves** | | |
|  Check valve, general |  Lift check valve  Angle check valve  Swing check valve |  The dot is always on the inlet side of the valve  Through check valve, shutting off |
| **Subject group 4 Regulating valves** | | |
|  Valve with constant control behaviour |  Straight globe valve with constant control behaviour  Gate valve with constant control behaviour  Butterfly valve with constant control behaviour | |
| **Subject group 5 Valves/fittings with safety function** | | |
|  Safety valve The thick line indicates the outlet side |  Bursting disk The curvature is on the outlet side |  Safety through valve with dead weight loading (to atmosphere or low pressure side)  Safety angle valve with spring loading (to atmosphere or low pressure side) |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

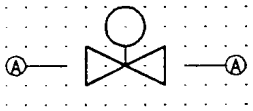
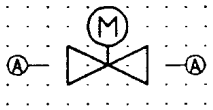
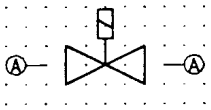
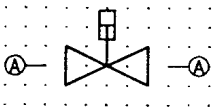
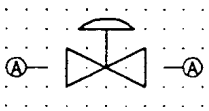
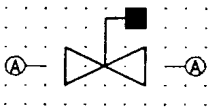
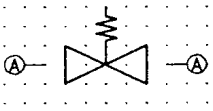
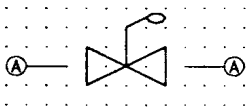
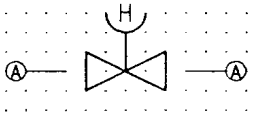
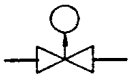
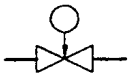
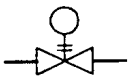
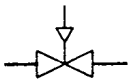
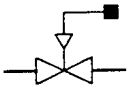
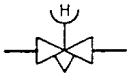
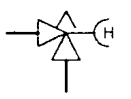
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 6 Valve actuators** | | |
|  Drive, general with actuating energy or automatic |  Electric motor drive<br>  Solenoid drive<br>  Piston drive<br>  Diaphragm drive<br>  Driven by working pressure against fixed dead weight<br>  Driven by working pressure against fixed spring<br>  Float valve drive<br>  Drive, manual | In case of failure of actuating energy<br>  Opening<br>  Closing<br>  Blocked<br>When actuated<br>  Quick closing<br>  Dead weight loaded Quick closing (e.g. oil quick closing valve)<br>Hand control valves<br>  Through pattern<br>  Angle pattern |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

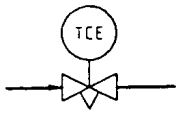
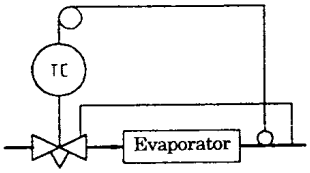
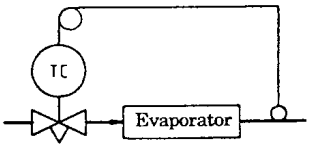
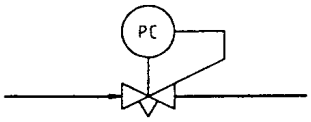
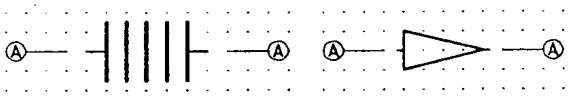
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| | |  <br>Electronic expansion valve<br><br>Automatic valves without auxiliary energy<br>  <br>Thermostatic expansion valve with external pressure equalizing<br>  <br>Thermostatic expansion valve with internal pressure equalizing<br>  <br>Constant pressure valve |
| **Subject group 7 Pipe fittings** | | |
| |  <br>Piping compensator Reducer, general<br>  <br>Disconnectable joint |  <br>Disconnectable valve |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

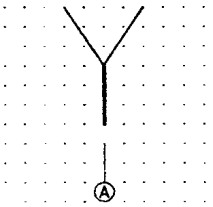
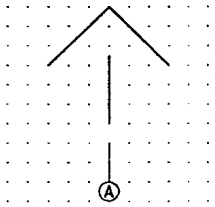
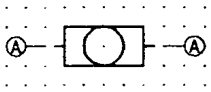
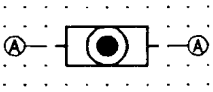
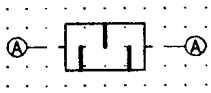
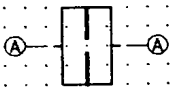
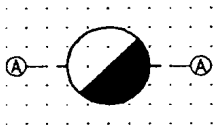
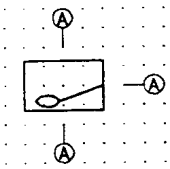
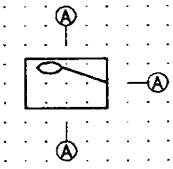
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| |  Funnel |  Outlet to the atmosphere |
| |  Sight glass |  Sight glass with humidity indicator |
| |  Silencer |  Orifice plate |
| |  Steam trap | |
| |  Low pressure float valve (opens at falling level) |  High pressure float valve (opens at rising level) |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

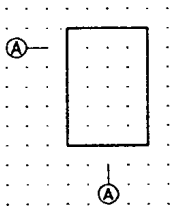
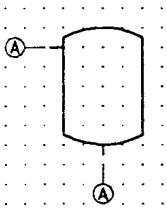
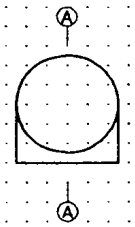
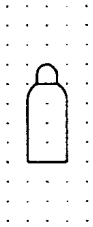
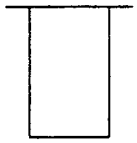
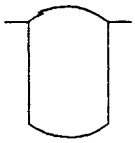
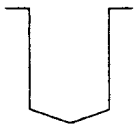
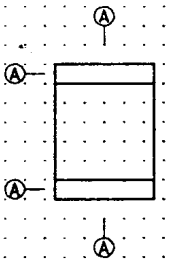
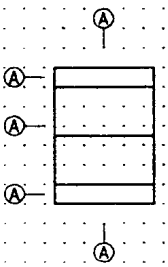
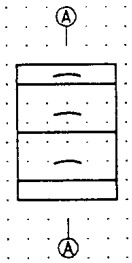
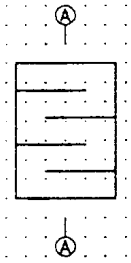
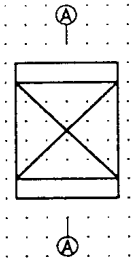
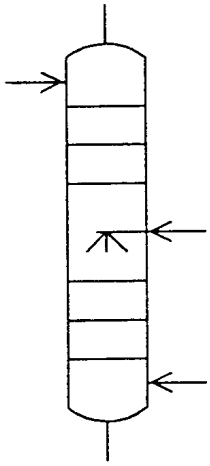
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 8 Vessels and tanks** | | |
|  Vessel, general |  Vessel with dished heads<br>  Spherical vessels<br>  Gas cylinder |  Vessel with flat cover<br>  Vessel with convex cover<br>  Open vessel with conical bottom |
| **Subject group 9 Vessel with internals/Columns with internals/Chemical reactors with internals** | | |
|  Column, general; Vessel with internals, general<br>  Vessel with trays, general; Column with trays, general |  Vessel with bubble trays; Column with bubble trays<br>  Vessel with inbuilt cascade plates<br>  Vessel with fixed bed; Column with fixed bed |  $NH_3$ rectificator with reinforcing and stripping trays |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

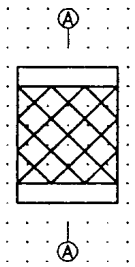
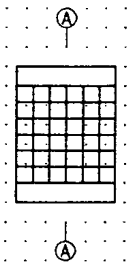
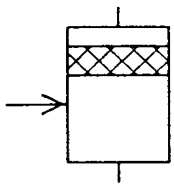
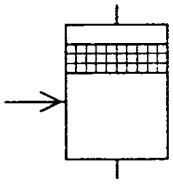
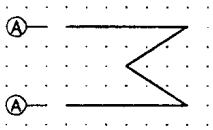
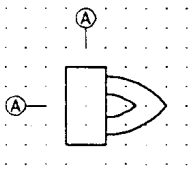
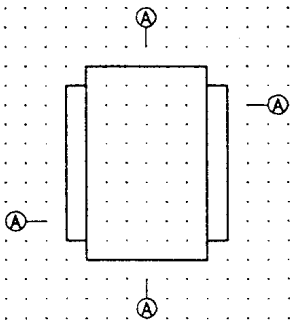
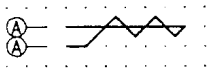
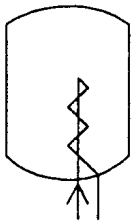
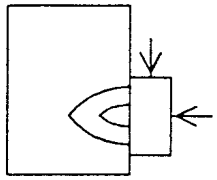
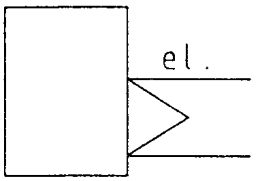
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| |  Vessel with random packing  Vessel with splash plates or baffles | Vessel with built in demister package  Irregular arrangement, e.g. demister package  Regular arrangement, e.g. baffle |
| **Subject group 10 Facilities for heating or cooling** | | |
|  Facility for heating or cooling, general  Firing system, burner |  Jacketed vessel  Inserted coil |  Vessel with inserted coil  Vessel with firing system, burner   Vessel with external electric heater |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

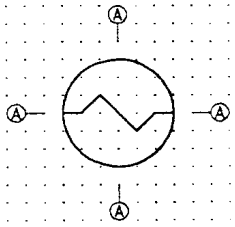
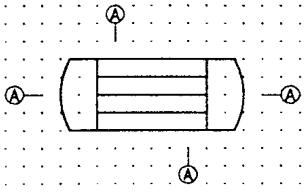
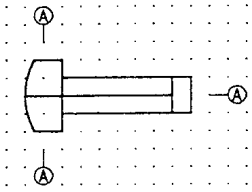
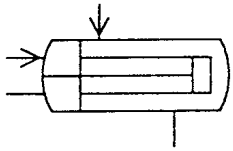
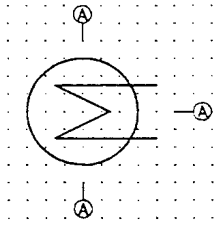
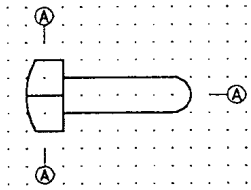
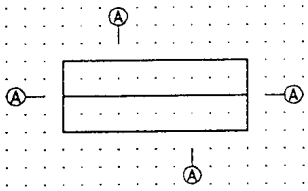
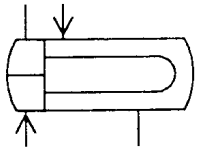
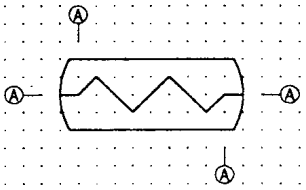
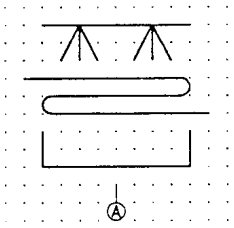
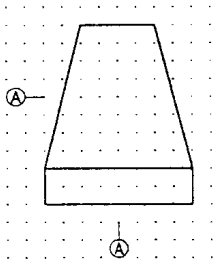
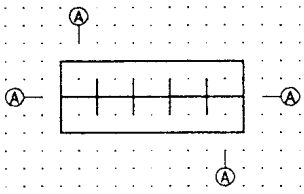
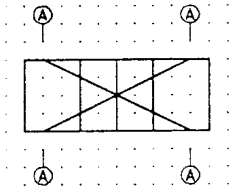
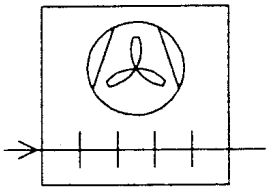
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 11 Heat exchangers/Steam generators** | | |
|  Heat exchanger with intersecting flow lines |  Tube-bundle heat exchanger shell and tube type heat exchanger with fixed tube sheets  Tube-bundle with floating head |  Floating-head tube-bundle heat exchanger |
|  Heat exchanger without intersecting flow lines |  Tube-bundle with U-tubes  Double-pipe heat exchanger |  Tube-bundle heat exchanger with U-tube |
| |  Heat exchanger with tube coil  Spray cooler | |
|  Cooling tower, general |  Finned-tube heat exchanger  Plate-type heat exchanger |  Finned-tube heat exchanger with fan |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

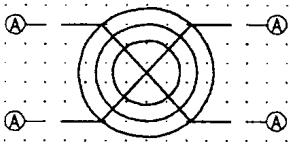
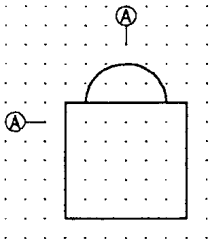
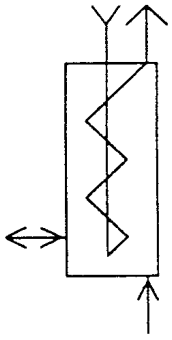
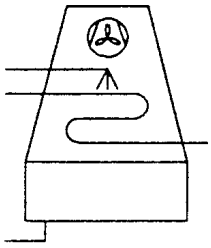
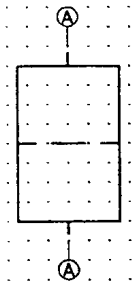
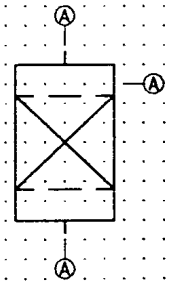
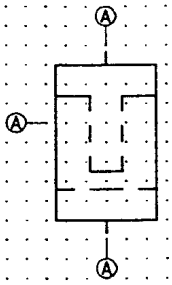
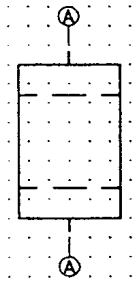
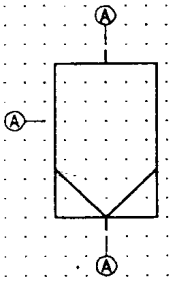
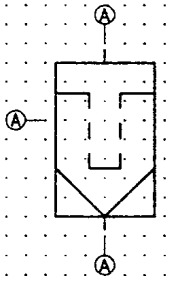
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| |  Spiral-type heat exchanger |  Steam boiler |
| | |  Purger |
| | |  Evaporative condenser with suction fan |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 12 Filters/Liquid filters/Gas filters, filter-driers** | | |
|  Filter, general; Filter equipment, general |  Fixed-bed filter, e.g. filter-drier |  Cartridge filter |
|  Liquid filter, general | | |
|  Gas filter, general; Air filter, general |  Bag filter, cartridge filter for gases | |

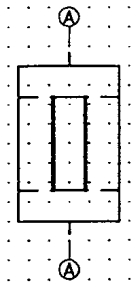

Activated carbon filter

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

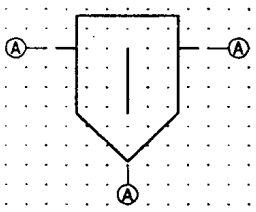
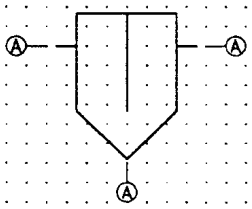
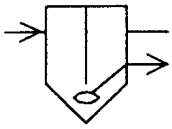
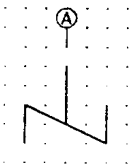
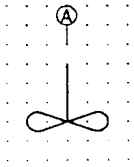
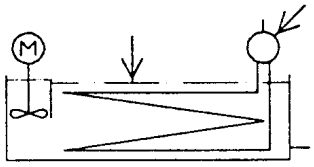
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 13 Separators** | | |
|  Separator, general |  Impact separator |  Oil separator with float drainage |
| **Subject group 14 Agitators** | | |
|  Agitator, general |  Propeller agitator |  Motor driven agitator in an ice bank system |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

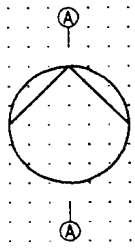
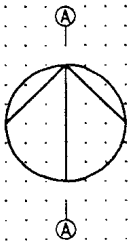
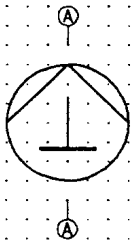
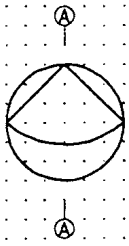
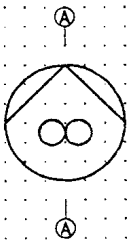
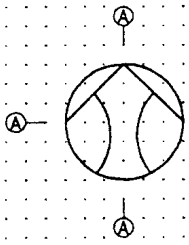
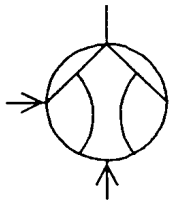
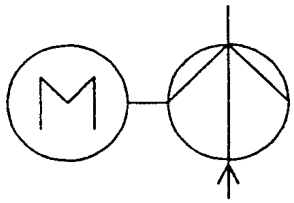
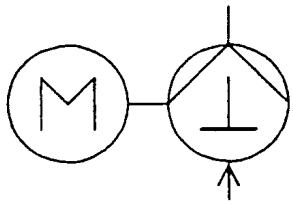
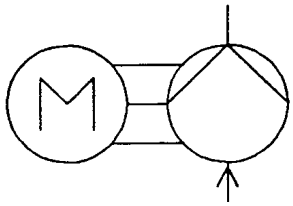
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 15 Liquid pumps** | | |
|  Pump, general<br><br>The arrow indicates the direction of flow |  Centrifugal pump<br>  Reciprocating pump<br>  Diaphragm pump<br>  Gear pump<br>  Screw pump<br>  Liquid jet pump |  Liquid jet pump with operating fluid supply<br>  Centrifugal pump with electric motor<br>  Reciprocating pump with electric motor (with external shaft seal)<br>  Centrifugal pump with hermetic motor, e.g. canned motor |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

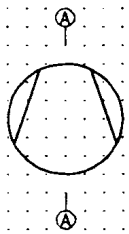
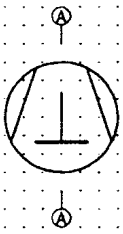
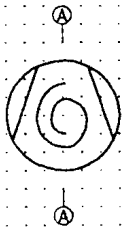
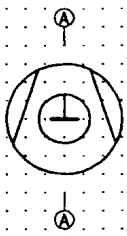
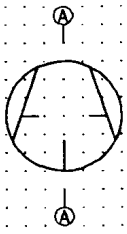
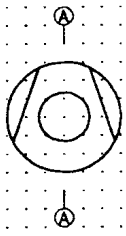
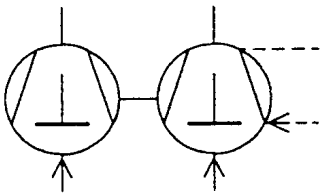
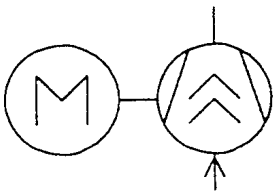
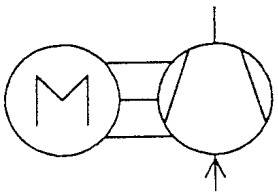
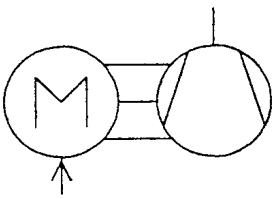
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 16 Compressors/Vacuum pumps/Fans** | | |
|  <br>Compressor, general;<br>Vacuum pump, general<br><br>The narrowing end indicates the direction of flow |  <br>Reciprocating compressor, reciprocating vacuum pump<br><br>  <br>Scroll compressor |  <br>Rotary piston compressor, rotary piston vacuum pump<br><br>  <br>Roller vane compressor, rotary compressor, roller vane vacuum pump |  <br>Turbo compressor, turbo-vacuum pump |  <br>Two-stage reciprocating compressor with cooling<br><br>  <br>Screw compressor with electric motor<br><br>  <br>Hermetic or semihermetic compressor<br><br>  <br>Hermetic or semihermetic motor compressor, suction gas cooled |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

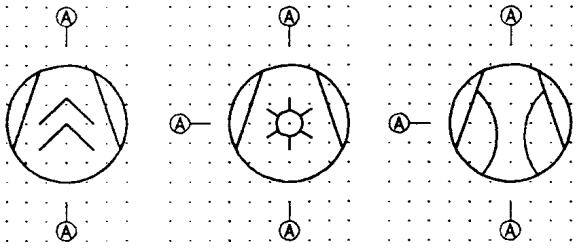
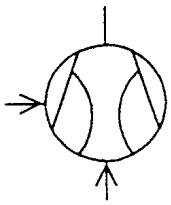
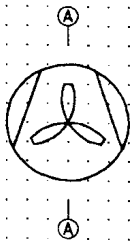
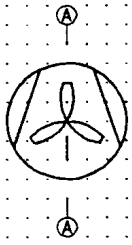
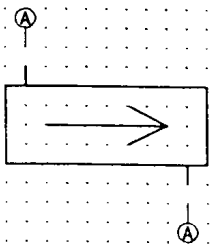
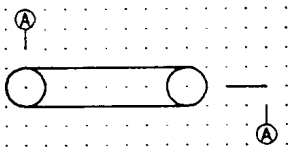
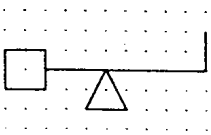
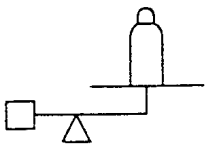
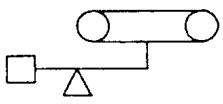
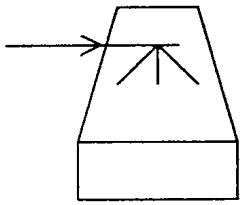
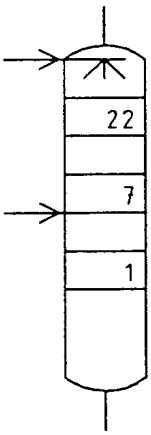
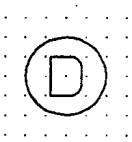
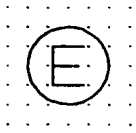
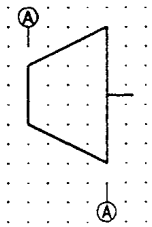
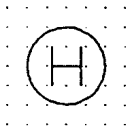
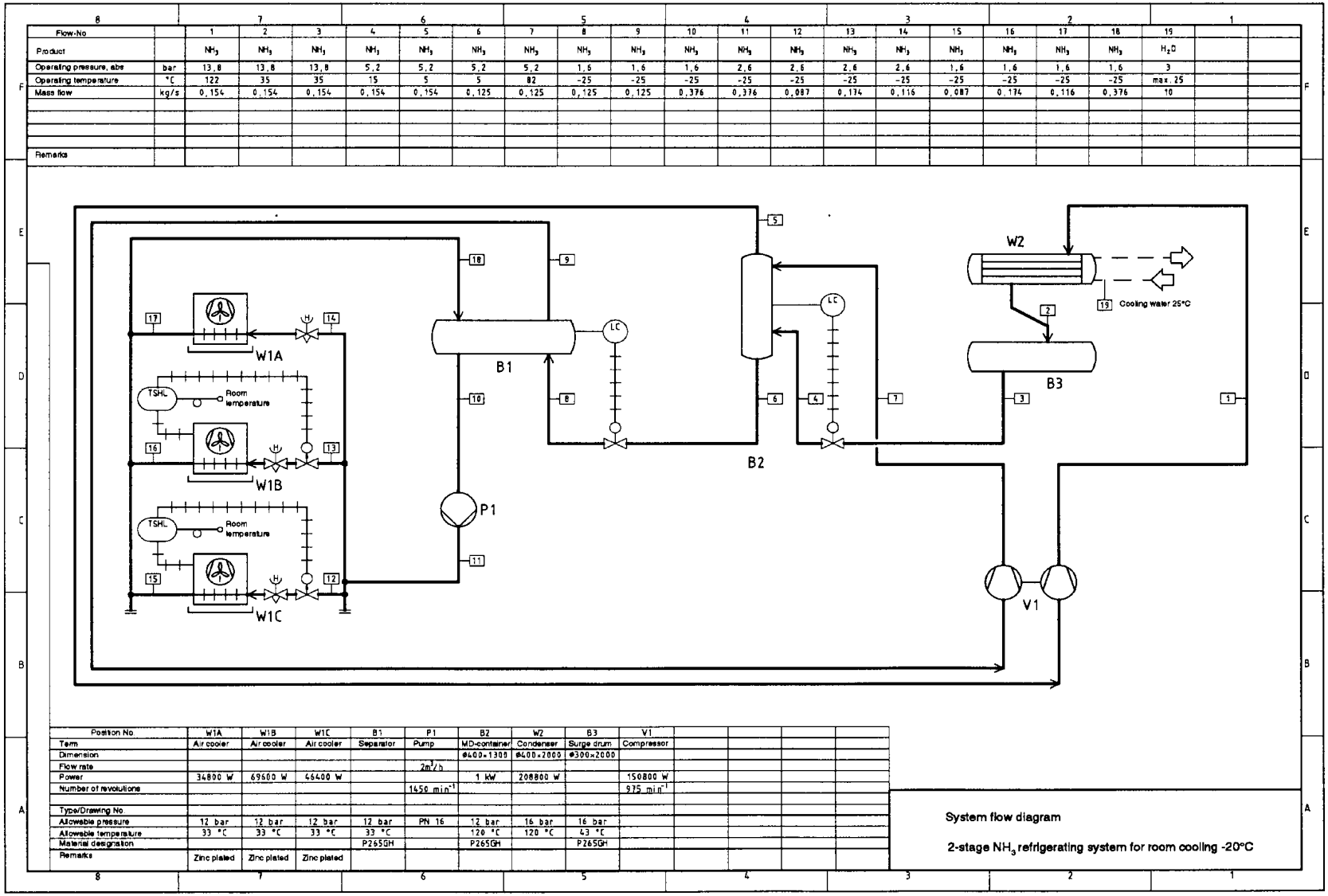
| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| |  Screw compressor; Liquid ring compressor, liquid ring vacuum pump; Ejector compressor, jet vacuum pump |  Ejector compressor with operating fluid supply |
|  Fan, general |  Centrifugal fan;  Axial or propellor fan | |
| **Subject group 17 Lifting, conveying and transport** | | |
|  Continuous conveyor, general |  Belt conveyor, general |  |
| **Subject group 18 Scales** | | |
|  Scales, general | |  Platform scales with gas cylinder;  Belt weigher |

**Table 1 — Graphical symbols for equipment, machinery and piping** *(continued)*

| Graphical symbols | | |
|---|---|---|
| **ISO basic series** | **Refrigeration series** | **Examples of application** |
| **Subject group 19 Distribution facilities** | | |
|  <br>Distribution device for fluids; spray nozzle | |  <br>Cooling tower with water spray nozzle<br>  <br>Tray column with spray nozzle and indicated number of trays |
| **Subject group 20 Motors, engines, drives** | | |
|  <br>Drive, general |  <br>Electric motor, general<br>  <br>Combustion engine<br>  <br>Drive with expansion of operating fluid, turbine<br>  <br>Hydraulic drive<br>  <br>Pneumatic drive |  <br>Direct current motor<br>  <br>Alternating, three phase current motor |

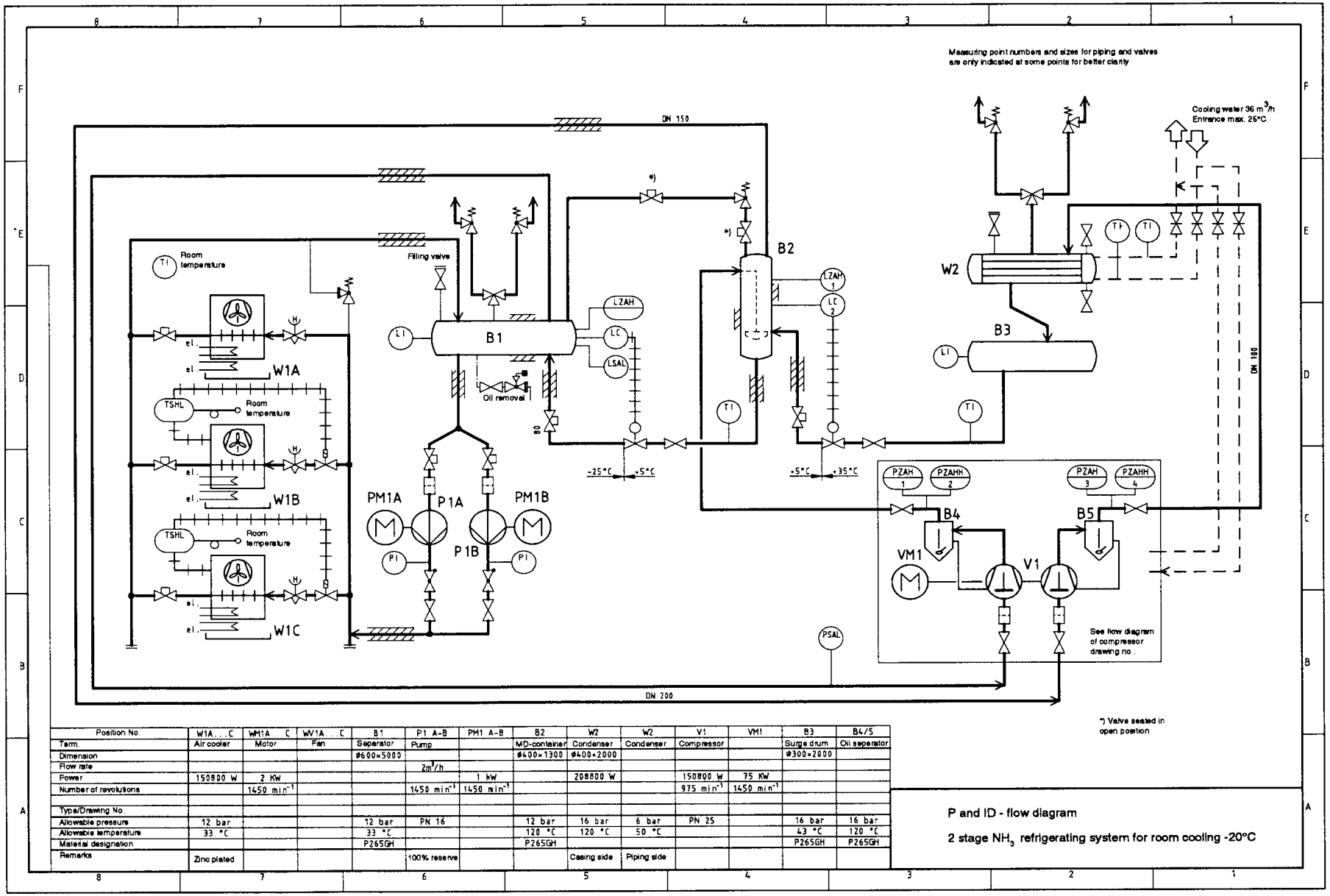
## Annex A (informative)
## Examples of flow diagrams for refrigerating systems




| Flow-No | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product | | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $NH_3$ | $H_2O$ |
| Operating pressure, abs | bar | 13,8 | 13,8 | 13,8 | 5,2 | 5,2 | 5,2 | 5,2 | 1,6 | 1,6 | 1,6 | 2,6 | 2,6 | 2,6 | 2,6 | 1,6 | 1,6 | 1,6 | 1,6 | 3 |
| Operating temperature | °C | 122 | 35 | 35 | 15 | 5 | 5 | 82 | -25 | -25 | -25 | -25 | -25 | -25 | -25 | -25 | -25 | -25 | -25 | max. 25 |
| Mass flow | kg/s | 0,154 | 0,154 | 0,154 | 0,154 | 0,154 | 0,125 | 0,125 | 0,125 | 0,125 | 0,376 | 0,376 | 0,087 | 0,174 | 0,116 | 0,087 | 0,174 | 0,116 | 0,376 | 10 |
| Remarks | | | | | | | | | | | | | | | | | | | | |

| Position No. | W1A | W1B | W1C | B1 | P1 | B2 | W2 | B3 | V1 |
|---|---|---|---|---|---|---|---|---|---|
| Term | Air cooler | Air cooler | Air cooler | Separator | Pump | MD-container | Condenser | Surge drum | Compressor |
| Dimension | | | | | | ⌀400×1300 | ⌀400×2000 | ⌀300×2000 | |
| Flow rate | | | | | $2m^3/h$ | | | | |
| Power | 34800 W | 69600 W | 46400 W | | | 1 kW | 208800 W | | 150800 W |
| Number of revolutions | | | | | 1450 $min^{-1}$ | | | | 975 $min^{-1}$ |
| Type/Drawing No. | | | | | | | | | |
| Allowable pressure | 12 bar | 12 bar | 12 bar | 12 bar | PN 16 | 12 bar | 16 bar | 16 bar | |
| Allowable temperature | 33 °C | 33 °C | 33 °C | 33 °C | | 120 °C | 120 °C | 43 °C | |
| Material designation | | | | P265GH | | P265GH | | P265GH | |
| Remarks | Zinc plated | Zinc plated | Zinc plated | | | | | | |

**Figure A.1 — Example of a system flow d** **l information** (reduced scale)




| Position No. | W1A...C | WM1A C | WV1A...C | B1 | P1 A-B | PM1 A-B | B2 | W2 | W2 | V1 | VM1 | B3 | B4/5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Term. | Air cooler | Motor | Fan | Separator | Pump | | MD-container | Condenser | Condenser | Compressor | | Surge drum | Oil seperator |
| Dimension | | | | ø600×5000 | | | ø400×1300 | ø400×2000 | | | | ø300×2000 | |
| Flow rate | | | | | 2m³/h | | | | | | | | |
| Power | 150800 W | 2 KW | | | | 1 kW | | 208800 W | | 150800 W | 75 KW | | |
| Number of revolutions | | 1450 min⁻¹ | | | 1450 min⁻¹ | 1450 min⁻¹ | | | | 975 min⁻¹ | 1450 min⁻¹ | | |
| Type/Drawing No. | | | | | | | | | | | | | |
| Allowable pressure | 12 bar | | | 12 bar | PN 16 | | 12 bar | 16 bar | 6 bar | PN 25 | | 16 bar | 16 bar |
| Allowable temperature | 33 °C | | | 33 °C | | | 120 °C | 120 °C | 50 °C | | | 43 °C | 120 °C |
| Material designation | | | | P265GH | | | P265GH | | | | | P265GH | P265GH |
| Remarks | Zinc plated | | | | 100% reserve | | | Casing side | Piping side | | | | |

P and ID - flow diagram

2 stage $NH_3$ refrigerating system for room cooling -20°C

**Figure A.2 — Example of a piping and instrument diagram (P and ID) with basic and additional information** (reduced scale)

# Annex B (informative)

## Letter code, general symbols and examples of measurement and control symbols

This annex B contains a letter code for the identification of instrument functions as well as examples of measurement and control symbols in accordance with ISO 3511-1 and ISO 3511-2.

**Table B.1 — Letter code for identification of instrument functions**

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| | **First letter**[1] | | **Succeeding letter**[1] |
| | **Measured or initiating variable**[5] | **Modifier** | **Display or output function** |
| A | | | Alarm |
| B | | | |
| C | | | Controlling |
| D | Density | Difference | |
| E | All electrical variables[2] | | |
| F | Flow rate | Ratio | |
| G | Gauging, position or length | | |
| H | Hand (manually initiated) operated[6] | | |
| I | | | Indicating |
| J | | Scan | |
| K | Time or time programme | | |
| L | Level[6] | | |
| M | Moisture or humidity | | |
| N | User's choice[3] | | |
| O | User's choice[3] | | |
| P | Pressure or vacuum | | |
| Q | Quality[2]<br>For example: Analysis, Concentration, Conductivity | Integrate or total | Integrating or summating |
| R | Nuclear radiation | | Recording |
| S | Speed or frequency | | Switching |
| T | Temperature | | Transmitting |
| U | Multivariable[4] | | |
| V | Viscosity | | |
| W | Weight or force | | |
| X | Unclassified variables[3] | | |
| Y | User's choice[3] | | |
| Z | | | Emergency or safety acting |

[1] Upper case letters are used for the measured or initiating variable and succeeding letters for display or output function. Upper case letters are preferred for modifiers, but lower case letters can be used if this facilitates understanding.
[2] A note is added to specify the property measured.
[3] Where a user has a requirement for measured or initiating variables to which letters have not been allocated and which are required for repetitive use on a particular contract, the letters allocated to user's choice can be used provided that they are identified or defined for a particular measured or initiating variable and reserved for that variable. Where a user has a requirement for a measured or initiating variable that may be used either once or to a limited extent, the letter X can be used provided that it is suitably identified or defined.
[4] The letter U may be used instead of a series of first letters where a multiplicity of inputs representing dissimilar variables feed into a single unit.
[5] Where an instrument can have two measured or initiating variables, the letter code of the prime function is first, e.g. pressure switch with local indication PIS.
[6] Where it is required to denote high/max. or low/min., the letters H and L can be used in association with the instrument symbol, see Table B.3. When they are used, they can be placed inside the symbol circle or outside the symbol circle and adjacent to it.

**Table B.2 — General symbols**

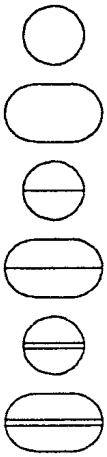
| Symbol | Explanation |
|---|---|
|  | Local instrumentation<br>Remote control panel<br>Local control panel |

**Table B.3 — Examples for measurement and control symbols**

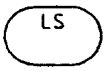
| Symbol | Explanation |
|---|---|
| **Flow** | |
|  | Safety flow switch set point/alarm min. |
| **Level** | |
|  | Level indicator |
|  | Level switch |
|  | Level transmitter |
|  | Level measurement with indication at control panel |
|  | Safety level switch set point/alarm max. |
|  | Safety level switch set point/alarm min. |
| **Pressure** | |
|  | Pressure gauge |
|  | Differential pressure gauge |
|  | Pressure switch with indication (contact pressure gauge) |
|  | Pressure transmitter |

**Table B.3 — Examples for measurement and control symbols** *(continued)*

| Symbol | Explanation |
|---|---|
| **Pressure** | |
| PIT | Pressure transmitter local indication |
| PS | Pressure limiting device |
| PSH | Pressure limiter, high |
| PSL | Pressure limiter, low |
| PC | Pressure control |
| PZH | Pressure cut out, high |
| PZHH | Safety pressure cut out, high |
| PDZAH | Safety differential pressure switch set point/alarm max. |
| PDZAL | Safety differential pressure switch set point/alarm min. |
| PZAH | Safety pressure switch set point/alarm max. |
| PZAL | Safety pressure switch set point/alarm min. |
| **Quality** | |
| QIA $NH_3$ | Gas concentration measurement with indication and alarm for $NH_3$ |
| **Temperature** | |
| TI | Thermometer |
| TT | Temperature transmitter |
| TIT | Temperature transmitter with indication |
| TIR | Thermometer with indication and recording at control panel |
| TSHL | Temperature switch |
| TISHL | Temperature switch with indication (contact thermometer) |
| TZAH | Safety temperature switch set point/alarm max. |
| TZAL | Safety temperature switch set point/alarm min. |

## Annex C (informative)
## Bibliography

ISO128, *Technical drawings — General principles of presentation.*

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