INTERNATIONAL STANDARD

ISO 6412-1

First edition
1989-10-15

Technical drawings — Simplified representation of pipelines —

Part 1 :
General rules and orthogonal representation

Dessins techniques — Représentation simplifiée des tuyaux et lignes du tuyauteries — Partie 1 : Règles générales et représentation orthogonale

Reference number
ISO 6412-1 : 1989 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

International Standard ISO 6412-1 was prepared by Technical Committee ISO/TC 10, *Technical drawings.*

ISO 6412 consists of the following parts, under the general title *Technical drawings — Simplified representation of pipelines*:

— *Part 1: General rules and orthogonal representation*

— *Part 2: Isometric projection*

Annex A of this part of ISO 6412 is for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Introduction

Depending on the information it is intended to convey and the form of representation required, a distinction has to be made between graphical representation by means of orthogonal and that by means of isometric representation.

This part of ISO 6412 deals, therefore, with general rules used for both representations (orthogonal and isometric). Rules applicable only to isometric representation are given in ISO 6412-2.

For the purposes of this part of ISO 6412, all dimensions and tolerances on the drawings have been stencilled in upright lettering. It should be understood that these indications could just as well be written in free-hand or inclined (italic) lettering without altering the meaning of the indications.

For the presentation of lettering (proportions and dimensions), see 4.4.

Technical drawings — Simplified representation of pipelines —

Part 1 :
General rules and orthogonal representation

1 Scope

This part of ISO 6412 specifies rules and conventions for the execution of simplified drawings for the representation of all kinds of pipes and pipelines made of all sorts of materials (rigid and flexible).

It shall be used whenever pipes or pipelines have to be represented in a simplified manner.

For the purposes of this part of ISO 6412, the figures illustrate the text only and should not be considered as design examples.

NOTE — This part of ISO 6412 might also be of some use for the representation of similar installations, such as ventilation or air-conditioning systems; in such cases, the term "duct", etc. should be substituted for the term "pipe".

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6412. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6412 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 128 : 1982, *Technical drawings — General principles of presentation.*

ISO 129 : 1985, *Technical drawings — Dimensioning — General principles, definitions, methods of execution and special indications.*

ISO 406 : 1987, *Technical drawings — Tolerancing of linear and angular dimensions.*

ISO 1219 : 1976, *Fluid power systems and components — Graphic symbols.*

ISO 3098-1 : 1974, *Technical drawings — Lettering — Part 1: Currently used characters.*

ISO 3461-2 : 1987, *General principles for the creation of graphical symbols — Part 2: Graphical symbols for use in technical product documentation.*

ISO 3545 : 1981, *Steel tubes and tubular shaped accessories with circular cross-section — Symbols to be used in specifications.*

ISO 4067-1 : 1984, *Technical drawings — Installations — Part 1 : Graphical symbols for plumbing, heating, ventilation and ducting.*

ISO 5261 : 1981, *Technical drawings for structural metal work.*

ISO 5455 : 1979, *Technical drawings — Scales.*

ISO 6428 : 1982, *Technical drawings — Requirements for microcopying.*

ISO 7573 : 1983, *Technical drawings — Item lists.*

3 Definitions

For the purposes of ISO 6412, the following definitions apply.

3.1 orthogonal representation: Projection method in which the projectors are at right angles to the projection plane.

3.2 isometric representation: Projection method in which each of the three coordinate axes is inclined at the same angle to the projection plane.

3.3 flow line: Representation of the flow path of the inlet or outlet streams or of material, energy or energy carriers.

4 General principles

In this clause all general principles are specified which are common to the methods of projection and to the pictorial representations, as recommended in this part of ISO 6412.

4.1 Representation of pipes, etc.

The flow line representing a pipe, etc. (irrespective of its diameter), shall be a single continuous thick line (type A, see table 1 and ISO 128), coinciding with the central line of the pipe (see ISO 4067-1).

Bends may be simplified by extending the straight length of the flow line to the vertex (see figure 1). However, bends may be shown for sake of clarity in the form illustrated in figure 2. In this case, if projections of bends would otherwise have been elliptical, these projections may be simplified by drawing circular arcs (see figure 3).

4.2 Scale

If the drawing is to scale, this shall be indicated in accordance with ISO 5455.

4.3 Lines

4.3.1 Thickness of lines

In general, only one thickness of line shall be used. However, in cases where more than one line thickness has to be used, the line thicknesses shall be chosen from ISO 128; the relative proportions of line thicknesses **a**:**b**:**c** shall be $2:\sqrt{2}:1$. Different line thicknesses shall then be used as follows (see also 4.3.2):

- line thickness **a**: main flow lines;
- line thickness **b**: secondary flow lines, lettering;
- line thickness **c**: leader lines, dimension lines, etc.

4.3.2 Types of line

The types and thicknesses of line shown in table 1 shall be used.

Table 1

Line type in accordance with with ISO 128	Description	Application
A	Continuous thick	A1 Flow lines and connected parts
B	Continuous thin	B1 Hatching B2 Dimensioning B3 Leader lines B4 Isometric grid lines
C	Continuous thin freehand	C1/D1 Limits of partial or interrupted views and sections
D	Continuous thin with zigzags	
E	Dashed thick	E1 Flow lines specified on other drawing
F	Dashed thin	F1 Floor F2 Walls F3 Ceilings F4 Holes (hole punchings)
G	Chain thin	G1 Centrelines
EJ	Extra thick chain line[1)]	EJ1 Contract boundary
K	Chain thin double-dashed	K1 Outlines of adjacent parts K2 Parts situated in front of the cutting plane

1) Four times the thickness of line type G.

4.3.3 Spacing of lines

In accordance with ISO 6428, the space between parallel lines (including hatching) shall not be less than twice the thickness of the heaviest of these lines, with a minimum spacing of 0,7 mm.

The minimum spacing between adjacent flow lines and between flow lines and other lines should be 10 mm.

4.4 Lettering

Lettering shall be in accordance with ISO 3098-1; lettering type B vertical is preferred. The line thickness of the lettering shall be the same as the line thickness of those tpd-symbols to which the lettering is close or associated (see ISO 3461-2).

4.5 Dimensioning

4.5.1 In general, dimensioning shall be in accordance with ISO 129. Nominal dimensions may be indicated in accordance with ISO 3545 using the short designation "DN" (see figure 1).

The outer diameter (d) and the wall thickness (t) of pipes may be indicated in accordance with ISO 5261 (see figure 2). If necessary, an item list (see ISO 7573) giving additional information on the pipes, including the associated equipment, may be added to the drawing. Lengths shall start from the outer faces of the pipe ends, flanges, or centre of the joint, whenever appropriate.

4.5.2 Pipes with bends should be generally dimensioned from central line to central line of the pipelines (see figures 1 and 2).

If it is necessary to specify the dimension from the outside or inside external protection or surface of the pipe, the dimension may be specified by arrows pointing to short thin strokes parallel to the projection line (see figure 3).

The dimensions from outer to outer, from inner to inner and from inner to outer vertex are shown in figures 3a), 3b) and 3c), respectively.

4.5.3 Radii and angles of bends may be indicated as shown in figure 4.

The functional angle shall be indicated; in general, angles of 90° are not indicated.

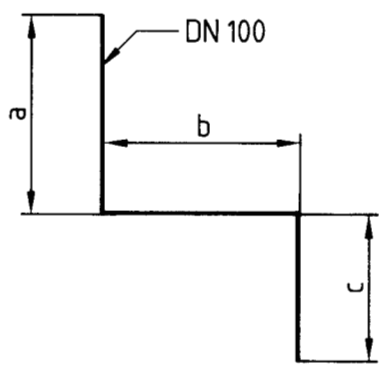


Figure 1

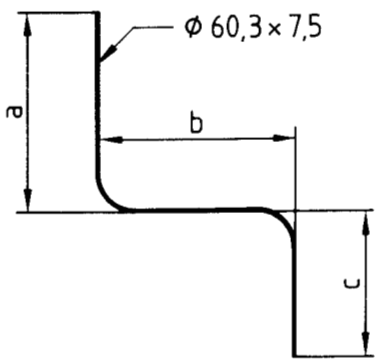


Figure 2

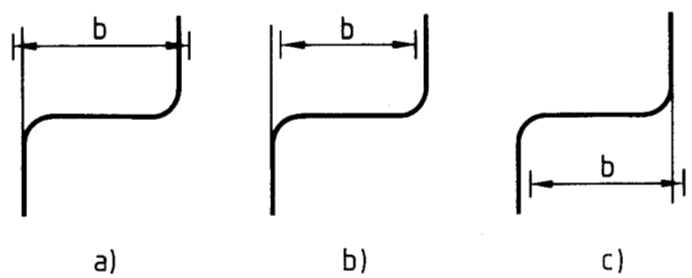


Figure 3

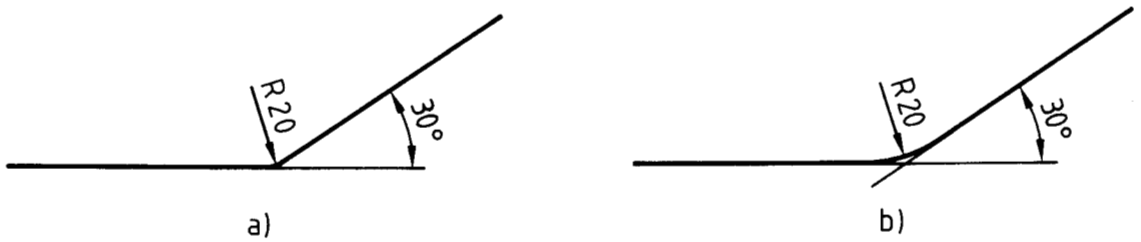


Figure 4

4.5.4 Levels refer generally to the centre of the pipe and should be indicated in accordance with ISO 129 (see figure 5). If, in special cases, it is necessary to specify the level to the bottom of a pipe this shall be indicated by the reference arrow pointing to short thin strokes, as specified in 4.5.2 [see figures 3 and 8a)].

A similar rule shall be applied to indicate levels to the top of the pipe [see figure 8c)].

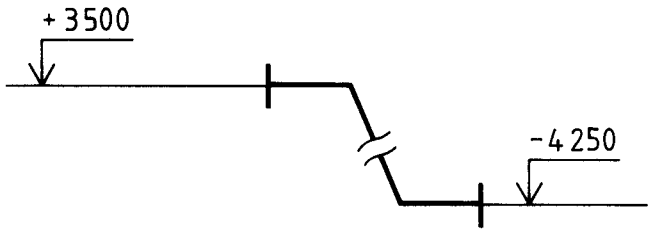


Figure 5

4.5.5 The direction of slope shall be indicated by a right-angled triangle above the flow line, pointing from the higher down to the lower level.

The amount of slope shall be indicated in accordance with the methods shown in figures 6 to 8.

It may be useful to specify the level of the sloping pipe, either at its higher or at its lower end, or at any convenient point, by referring to a datum level (see figure 8).

4.5.6 The positions of the ends of the pipe shall be specified by indicating the coordinates referring to the centres of the end faces.

4.6 Tolerances

Tolerances shall be indicated in accordance with ISO 406.

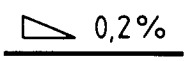


Figure 6

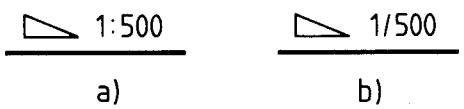


Figure 7

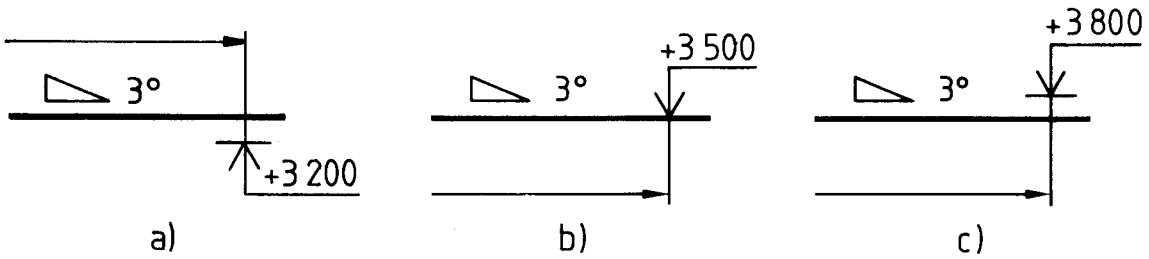


Figure 8

5 Crossings and connections

5.1 Crossings without connections shall normally be depicted without interrupting the flow line representing the hidden pipe (see figure 9; see also ISO 4067-1); if, however, it is absolutely necessary to indicate that one pipe has to pass behind the other, the flow line representing the hidden pipe shall be interrupted (see figure 10). The width of each interruption shall not be less than five times the thickness of the continuous line (see figure 11).

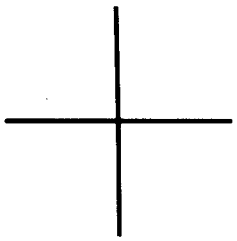


Figure 9

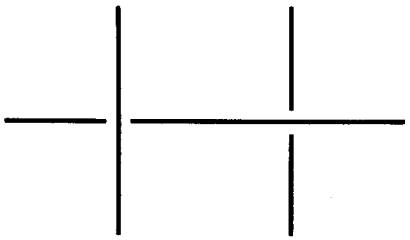


Figure 10

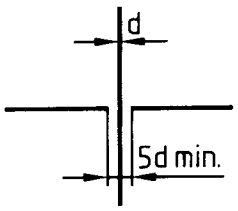


Figure 11

5.2 Permanent junctions (whether made by welding or other processes) shall be marked by a prominent dot in accordance with ISO 1219 (see figure 12). The diameter of the dot shall be five times the thickness of the line.

5.3 Detachable connections should be represented in accordance with ISO 4067-1[1].

6 Representation of equipment

6.1 General

All items of equipment, machinery, valves, etc. shall be represented by means of graphical symbols with the same line thickness as the flow line (see ISO 3461-2).

The graphical symbols used shall be in accordance with the International Standards given in clause 2 and in annex A.

6.2 Fittings

6.2.1 Fittings such as nozzles, tee-pieces and bends, should be drawn with the same line thickness as the flow line.

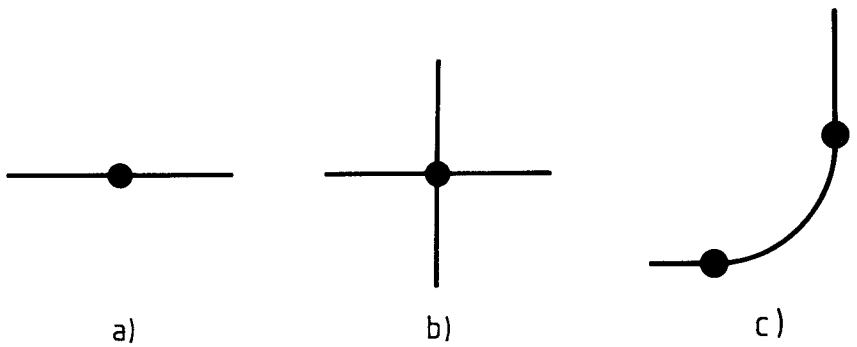
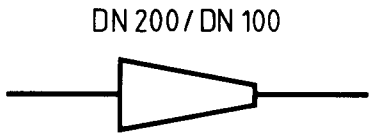


Figure 12

1) It is envisaged to enlarge ISO 4067 to include all other graphical symbols used for piping systems.

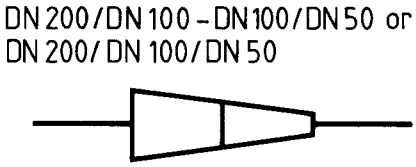
6.2.2 Transition pieces for changing the cross-section shall be represented in accordance with figures 13 to 15.

The relevant nominal sizes shall be indicated above the symbols.



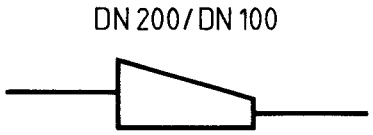
Concentric single

Figure 13



Concentric multiple

Figure 14



Eccentric single

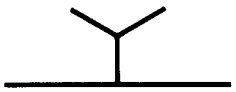
Figure 15

6.3 Supports and hangers

Supports and hangers shall be represented by their appropriate symbols in accordance with figures 16 to 19.

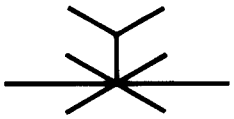
The representation of repeated accessories may be simplified as shown in figure 20.

NOTE — Figures 16 to 19 refer to hangers only. It should be understood that in the case of supports, the same symbols should be used, but in the reverse position.



General

Figure 16

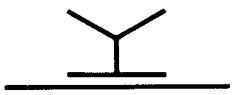


Fixed

Figure 17

Guided

Figure 18



Sliding

Figure 19

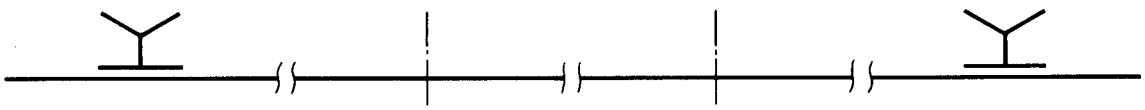
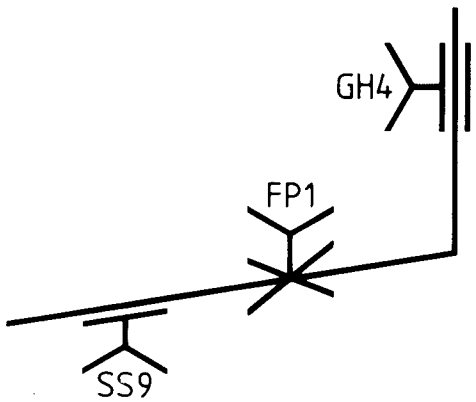


Figure 20

If necessary, an alphanumerical code giving more information about the type of supports and hangers, with their numbering, may be added to the symbols shown in figures 16 to 19. The code giving the numbering shall be given on the drawing or in associated documents (see figure 21).



FP1: Fixing point No. 1
SS9: Sliding support No. 9
GH4: Guiding hanger No. 4

Figure 21

6.4 Additional provisions

Additional provisions such as insulation, coating, stream tracer lines, etc. may be specified in writing[1].

6.5 Adjoining apparatus

If needed, adjoining apparatus, such as tanks, machinery, not belonging to the piping itself, may be represented by their outlines using chain thin double-dashed lines (type K; see table 1 and ISO 128) as shown in figure 22.

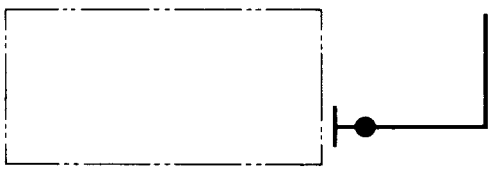


Figure 22

6.6 Direction of flow

The direction of flow shall be indicated by an arrowhead (see ISO 4067-1) on the flow line or near a graphical symbol representing a valve (see figures 23 and 24).

Figure 23

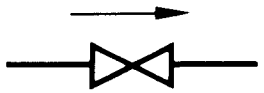


Figure 24

6.7 Flanges

Flanges shall be represented, irrespective of their type and sizes,

- by two concentric circles for the front view,
- by one circle for the rear view,
- by a stroke for the side view,

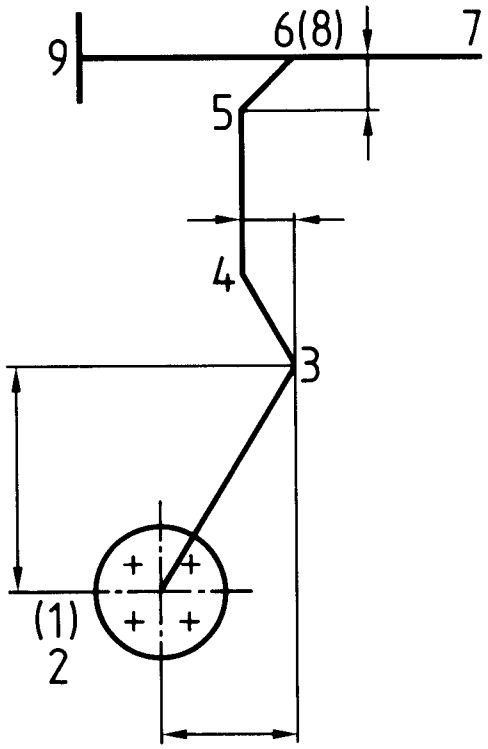
using lines of the same thickness as used for the representation of the pipes (see figures 22 and 25). A simplified representation of the flange holes may be shown by the appropriate number of crosses at their centrelines.

7 Examples

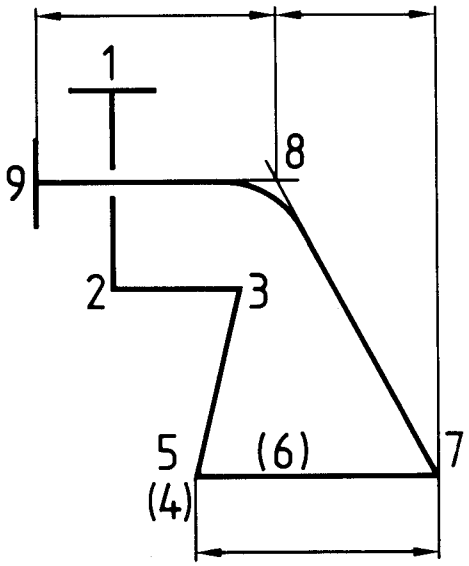
An example of orthogonal projection is given in figure 25.

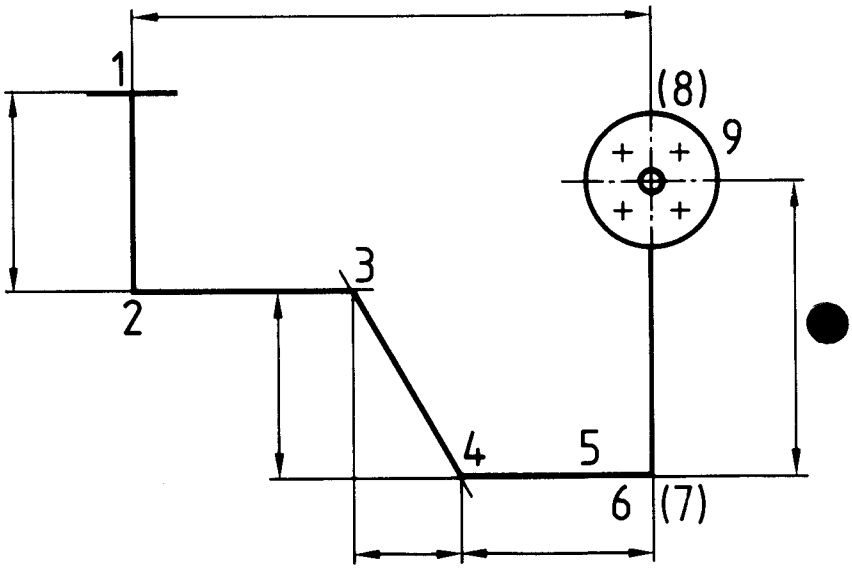
NOTE — Other examples are given in ISO 3511-3 and ISO 3753.

1) It is envisaged to enlarge ISO 4067 to include all other graphical symbols used for piping systems.



Reference number	Coordinates of the end points		
1	$x_1 = -8$	$y_1 = +72$	$z_1 = +50$
9	$x_9 = -20$	$y_9 = 0$	$z_9 = +40$





NOTE — Points at which the pipe changes direction and connections are indicated by reference numbers. The pipe and the reference numbers are identical to those in the isometric representation illustrated in ISO 6412-2 : 1989, figure 23. Reference numbers for points hidden behind other points are shown in brackets.

Figure 25

Annex A
(informative)

Bibliography

ISO 841 : 1974, *Numerical control of machines — Axis and motion nomenclature.*

ISO 1101 : 1983, *Technical drawings — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings.*

ISO 1503 : 1977, *Geometrical orientation and directions of movements.*

ISO 3511-1 : 1977, *Process measurement control functions and instrumentation — Symbolic representation — Part 1: Basic requirements.*

ISO 3511-2 : 1984, *Process measurement control functions and instrumentation — Symbolic representation — Part 2: Extension of basic requirements.*

ISO 3511-3 : 1984, *Process measurement control functions and instrumentation — Symbolic representation — Part 3: Detailed symbols for instrument interconnection diagrams.*

ISO 3511-4 : 1985, *Process measurement control functions and instrumentation — Symbolic representation — Part 4: Basic symbols for process computer, interface and shared display/control functions.*

ISO 3753 : 1977, *Vacuum technology — Graphical symbols.*

ISO 4067-6 : 1985, *Technical drawings — Installations — Part 6: Graphical symbols for water supply and drainage systems in the ground.*

UDC 744.4 : 621.644

Descriptors : pipelines, drawings, technical drawings.

Price based on 9 pages