UDC 744.42 : 515.69

December 1970

Drawing Practice
Axonometric Projections
Isometric Projection

DIN 5 Part 1

Zeichnungen; Axonometrische Projektionen, Isometrische Projektion

Dimensions in mm

The isometric projection is used for drawings in which the essential features must be shown clearly in three views.
It has become increasingly used for tender, manufacturing and assembly drawings in pipework construction and also in machine and plant construction, since it provides an economy in drafting labour and gives a clearer representation. When it is used for pipework and fittings, symbols to DIN 2429 should be employed.

1. Drafting aids

Drafting aids for drawing in isometric projection are:
drawing machine, isometric grid (Figure 4).

For the preparation of drawings in pipework construction it is also customary to use computer-controlled curve plotters. When a drawing machine is used without a grid, it is advisable to work with the following detent settings:

A vertical
B at angle α (-30° to the horizontal)
C at angle β (+30° to the horizontal)

The lines in the isometric grid are arranged as indicated under A, B and C.

2. Representation without a grid

The representation of a cube and of circles in 3 views is shown in Figure 1. Dimensioning examples are shown in Figures 2 and 3.

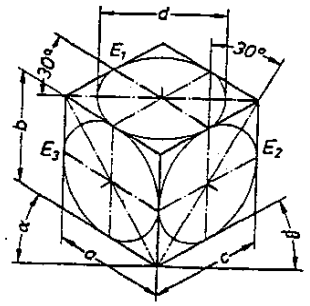

Figure 1

Ratio of sides a : b : c = 1 : 1 : 1
α = 30°
β = 30°

Ratio of edges : diameter d = 1 : 0.82
Ellipse E_1.. major axis horizontal
Ellipse E_2.. major axis at right angles to 30°
Ellipse E_3.. major axis at right angles to 30°
Ratio of the axes with all ellipses = 1 : 1.7

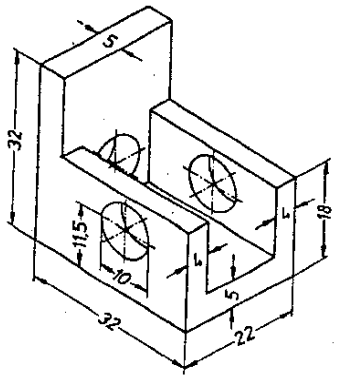

Figure 2

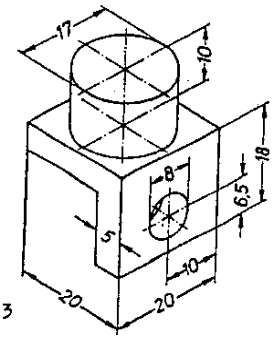

Figure 3

Other relevant standards

Pre-printed sheets for isometric representation of pipework drawings, see DIN 2428
Axonometric projections, dimetric projection, see DIN 5 Part 2

Continued on pages 2 to 4
Explanations on page 3

3. Representation using a grid

Figure 4 shows the representation of a component on an isometric grid.

4. Co-ordinates

For the purpose of standardizing calculations and manufacturing processes, it is desirable to define the principal directions of the co-ordinates.
The positive direction of the Z axis is the direction in which a right-hand thread screw would move if turned by its positive X axis towards the positive Y axis.
All co-ordinate values taken from the origin in the direction of the arrow are positive and those in the opposite direction are negative (Figure 5).
The directions of the co-ordinates X, Y, Z are called the principal directions and the areas enclosed by them are called the principal planes.

5. Representation in the system of co-ordinates

In order to provide an unambiguous representation of lines (e.g. pipe bends) in isometric projection, it is necessary to show the principal planes by hatching. The planes of the side view (co-ordinates Y, Z) and front view (co-ordinates X, Z) should be hatched vertically and the planes of the top view (co-ordinates X, Y) should be hatched at -30° (Figure 6).

Figure 7 shows a bent pipe in isometric projection in the co-ordinate system.

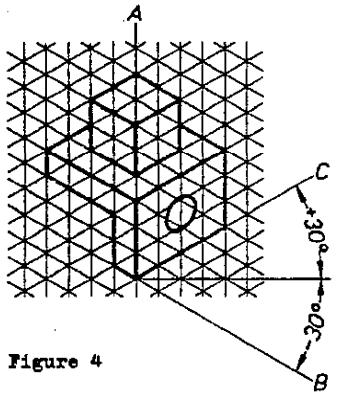

Figure 4

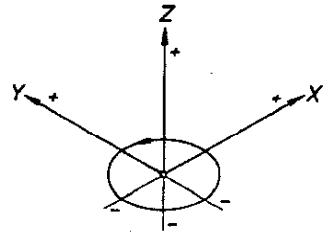

Figure 5

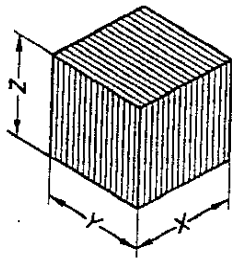

Figure 6

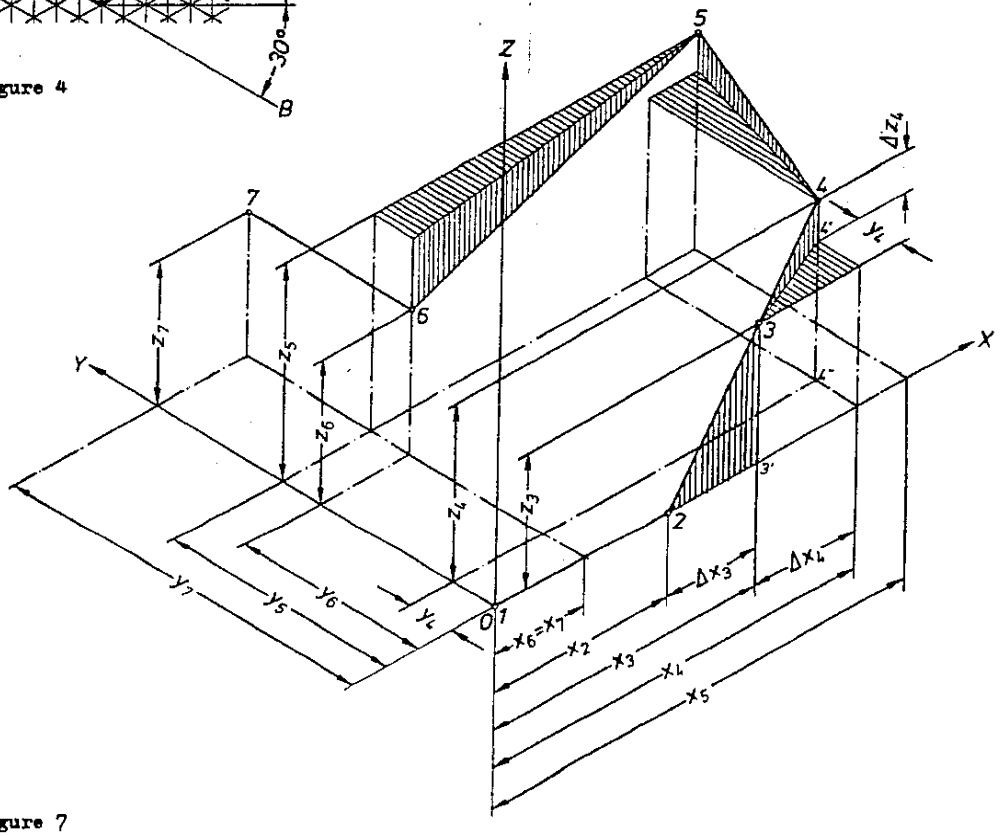

Figure 7

The starting point for the drawing and the dimensioning is Point 1 (P_1) with co-ordinates $x_1 = 0, y_1 = 0, z_1 = 0$.
The section 1 - 2 lies on the X co-ordinate and has co-ordinates $x_2 = +50$, $y_2 = 0$ and $z_2 = 0$.

The section 2 - 3 lies in the principal plane X, Z and has dimensions x_3 and z_3 and co-ordinates $x_3 = +75$, $y_3 = 0$ and $z_3 = +34$. The vertical hatching (see Figure 6) shows clearly that the plane of bending of the pipe lies in the principal plane X, Z.
Although in the representation, section 3-4 is a continuation of 2 - 3, Point 4 is outside the principal plane X, Z and has dimensions x_4, y_4 and z_4; their co-ordinates are $x_4 = +104$, $y_4 = +12$ and $z_4 = +45$. To show the three-dimensional bending clearly in the representation it is necessary to project the co-ordinate Point 4 together with Point 4' onto the corresponding principal planes and to use hatching as shown in Figure 6. Sections 4 - 5 and 5 - 6 are represented in a similar manner whilst section 6 - 7 lies in the direction of the Y co-ordinate.

6. Dimensioning in the co-ordinate system

Co-ordinate dimensioning is useful for mechanical calculation of developed lengths, for bending and twisting angles using data processing and for programme-controlled machine tools. The co-ordinates can have positive and negative values (in accordance with Figure 5 Section 4).
The co-ordinate values for the bent pipe run shown in Figure 7 are given in Table 1.

Table 1

P_1	$x_1 = 0$	$y_1 = 0$	$z_1 = 0$
P_2	$x_2 = +50$	$y_2 = 0$	$z_2 = 0$
P_3	$x_3 = +75$	$y_3 = 0$	$z_3 = +34$
P_4	$x_4 = +104$	$y_4 = +12$	$z_4 = +45$
P_5	$x_5 = +118$	$y_5 = +62$	$z_5 = +54$
P_6	$x_6 = +26$	$y_6 = +52$	$z_6 = +36$
P_7	$x_7 = +26$	$y_7 = +100$	$z_7 = +36$

7. Representation of auxiliary views

Auxiliary views are necessary when edges of solids or surfaces lie in the viewing direction of the isometric projection. It is advisable to represent the auxiliary view in orthographic projection (Figure 8).

8. Example of drawing

Figure 9 shows a drawing of a bent pipe in isometric projection with co-ordinate values.

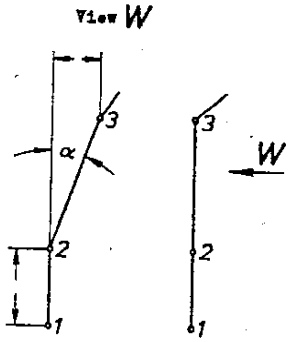

Figure 8. Auxiliary view in orthographic projection

Explanations

The Drawings Committee considered it necessary to prepare stipulations on the use of the isometric projection since the latter is being increasingly used in practice for tender, manufacturing and assembly drawings. Besides providing greater clarity, the isometric projection also results in savings in design time, particularly in pipework construction and for pipe runs in mechanical plant such as compressors, turbines etc.
In order to provide a standardized method of representation, stipulations are necessary. It was therefore, among other things, decided to hatch the three co-ordinate planes so that it can be clearly seen, for example in a bent piping system, how a particular line runs out three-dimensionally from the projection plane.
Dimensioning of isometrically represented parts is carried out according to DIN 406 Part 2. Co-ordinate dimensioning as shown in Figure 7 has been found useful in practice particularly when the co-ordinate dimensions are used as input values in numerically controlled machine tools.
To provide a clear differentiation of axonometric projections and permit the adoption of further projections as necessary, the Standard was divided into Part 1 "Axonometric projections; isometric projection" and Part 2 "Axonometric projections; dimetric projection".

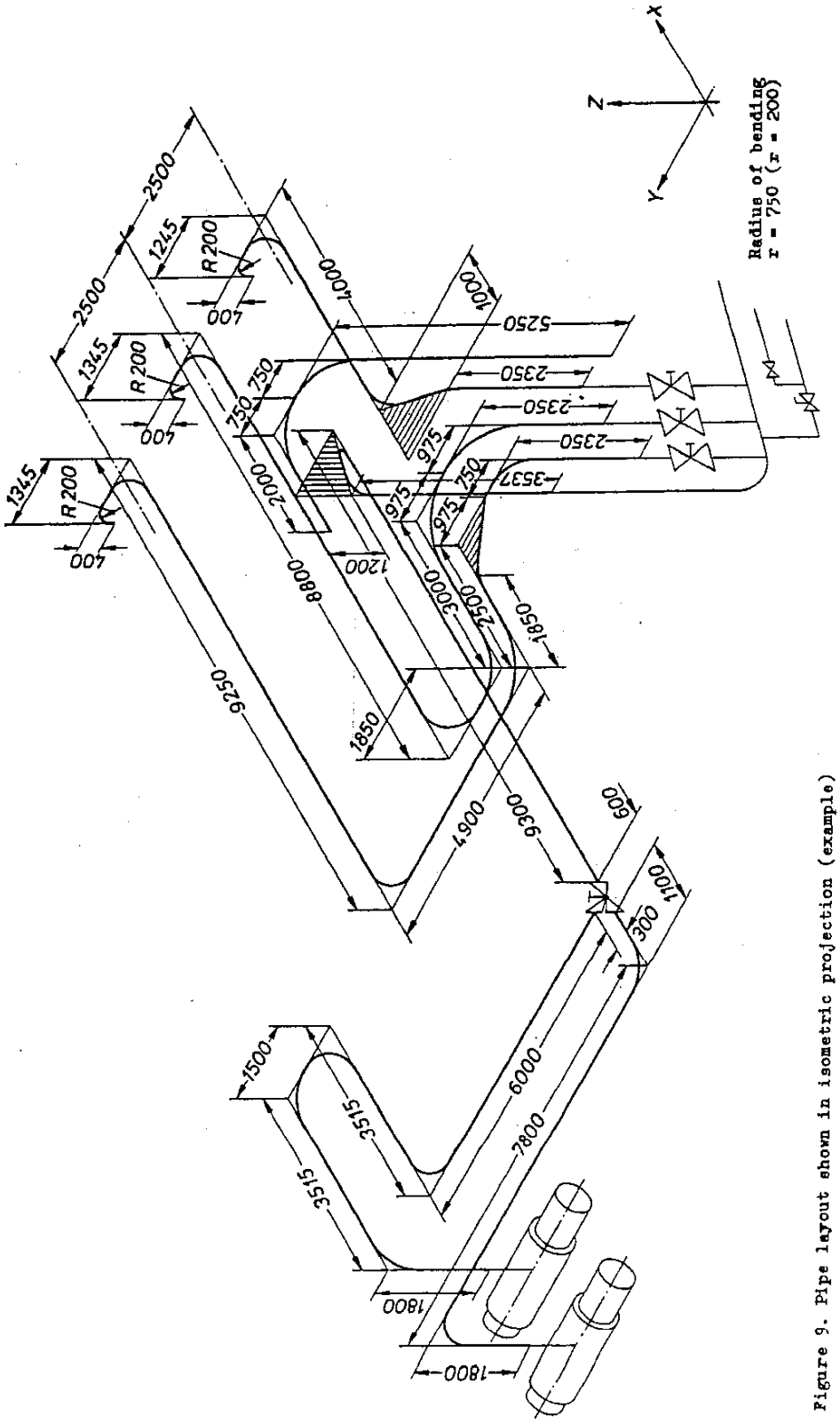

Figure 9. Pipe layout shown in isometric projection (example)