# International Standard 2531

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

# Ductile iron pipes, fittings and accessories for pressure pipe-lines

*Tuyaux, raccords et pièces accessoires en fonte ductile pour canalisations avec pression*

**Second edition — 1979-09-01**



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**Descriptors** : iron and steel products, pipes (tubes), fittings, pressure pipes, accessories, spheroidal graphite cast iron, specifications, tests, tension tests, flanges, dimensions, tolerances (mechanical), marking.

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## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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.

International Standard ISO 2531 was developed by Technical Committee ISO/TC 5, *Metal pipes and fittings*. It has been approved by the member bodies of the following countries :

| | | |
|---|---|---|
| Austria | India | South Africa, Rep. of |
| Canada | Israel | Spain |
| Czechoslovakia | Italy | Switzerland |
| Denmark | Japan | Turkey |
| Egypt, Arab Rep. of | Korea, Rep. of | United Kingdom |
| Finland | Mexico | USA |
| France | Netherlands | USSR |
| Germany, F. R. | Poland | Yugoslavia |
| Hungary | Romania | |

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
Belgium

This second edition cancels and replaces the first edition (i.e. ISO 2531-1974). It also incorporates draft addenda 1, 2 and 3, approved by member bodies in 1978 but not published.





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**SECTION FOUR – FITTINGS**

# Ductile iron pipes, fittings and accessories for pressure pipe-lines

SECTION ONE

## GENERAL SPECIFICATION



### 0 INTRODUCTION

Ductile iron, also called nodular iron or spheroidal graphite iron, is characterized by the presence, in the resultant castings, of spheroidal graphite in a quantity sufficient to give the iron of these castings the mechanical characteristics defined in this International Standard.

The high mechanical characteristics of ductile iron make it possible to manufacture pipes and fittings having adequate strength for all uses.

Various methods of strengthening are authorized, however, particularly where high working pressures have to be applied to fittings having a large diameter branch, in which the resulting stress in the metal may be too high.

Ductile iron differs from grey iron by its greater tensile strength and by its significant proof stress and elongation after fracture. Tensile tests on machined specimens permit the measurement of these different characteristics. It is for this reason, using values compatible with the different manufacturing processes, that this test is now in general use for all pipes, fittings and accessories for ductile iron pipe-lines.

The value adopted for the density of ductile iron is 7 050 kg/m$^3$. This value is a compromise between the values measured in various manufacturing countries and provides a reasonably acceptable agreement between the calculated masses and actual masses.

The requirements of ISO 13 concerning the quality of the cast iron have been adapted to ductile iron and defined more accurately as far as both the origin of the metal and its characteristics are concerned, but leaving it to the manufacturers to choose from the various methods of processing the molten metal.

### 1 SCOPE AND FIELD OF APPLICATION

This International Standard comprises a general specification completed by specific requirements applicable to :

a) ductile iron pipes manufactured by any one of the following four processes :

1) centrifugal casting in lined or unlined metal moulds;

2) centrifugal casting in sand[1] moulds;

3) casting in sand[1] moulds;

4) casting in metal moulds.

b) ductile iron fittings and accessories manufactured by either of the following two processes:

1) casting in sand[1] moulds;

2) casting in metal moulds.

It is applicable to pipes, fittings and accessories for pressure pipe-lines for water, other liquids, or gas.

The range of diameters extends from nominal diameter DN 40 to nominal diameter DN 2000 inclusive. The diameter DN 60 shown in parentheses in the tables exists in national standards in certain countries. However, it is recommended that whenever possible it be replaced by the diameter DN 65.

### 2 REFERENCES

ISO 13, *Grey iron pipes, special castings and grey iron parts for pressure main lines.*

ISO/R 79, *Brinell hardness test for steel*, Amendment 1.

1) By sand is to be understood sand or mineral-based materials used in the foundry trade irrespective of the type of bonding agent used.

## 3 TYPES OF JOINTS

The pipes and fittings may be supplied with various types of joint.

The specification mainly concerns pipes, fittings with sockets for elastomer gasket joints and flanged fittings.

It may also be used for pipes and fittings having other types of joint — for example lead caulked joints, which are still used in certain countries. Castings with these various joints retain the same overall dimensions, making it easier for manufacturers to use interchangeable patterns.

NOTE — The standard external diameter of the spigot end of pipes and fittings remains the same for all types of joint. Furthermore, this external diameter is the same as that of the spigot end of grey iron castings (ISO 13), which makes it easier to joint the new ductile iron pipes or fittings to existing grey iron pipe-lines.

## 4 THICKNESS OF PIPES AND FITTINGS

The standard thickness of pipes and fittings is calculated as a function of their nominal diameter by the formula :

$$e = K\,(0{,}5 + 0{,}001\,DN)$$

where

$e$ is the standard wall thickness, in millimetres;

DN is the nominal diameter;

$K$ is the coefficient selected from a series of whole numbers . . . 8, 9, 10, 11, 12 . . . and as determined in the specific requirements of sections two and four of this International Standard :

$K = 9$ for the pipes in table 9,

$K = 12$ for the fittings in tables 20 to 26, 32, 33 and 41 to 43,

$K = 14$ for the fittings in tables 27 to 31 and 44 to 46.

If necessary, each particular specification shall give an additional formula applicable to small-diameter castings.

The external diameter of the pipes, expressed in millimetres, is fixed as a function of the nominal diameter and independently of the pipe wall thickness. Increases or decreases in the pipe wall thickness shall be obtained by modification of the actual internal diameter.

The wall thickness of the fittings may be adjusted to the forces acting in each point of the casting, particularly to the mechanical stresses induced by internal pressure. In bends, for example, the wall thickness at the inner radius may be greater than that at the outer radius.

Increases or decreases in the wall thickness of fittings may be obtained by modifications to either the internal or the external diameter of the fittings.

The thickness $e$ indicated in each table and on the drawings of the fittings shall be a mean thickness corresponding to the mass of each casting. The actual thickness at any particular point may be varied to meet local stresses, depending on the shape of the fitting.

## 5 MARKING

Each pipe, fitting or accessory shall bear the mark of the manufacturer, an indication that the casting is of ductile iron, and an indication of its nominal diameter. If necessary, each fitting shall bear an indication of its main characteristics. Pipes, fittings and accessories with a nominal diameter greater than DN 300 shall also bear the year of manufacture.

The marks may be cast on, painted or cold stamped.

## 6 PROCESSING OF THE IRON

The iron to be used for the casting of pipes, fittings and accessories shall be prepared, at the choice of the manufacturer, in a cupola, an active mixer or any other suitable metallurgical apparatus, and shall be made, as the case may be, from pig iron or molten iron, iron or steel scrap, with such ferro-alloy and other additives as shall be necessary because of the manufacturing process to produce in the resultant castings a ductile iron complying with the requirements of this International Standard.

## 7 QUALITY OF PIPES, FITTINGS AND ACCESSORIES

After casting, ductile iron pipes, fittings and accessories may be subjected, when necessary, to a suitable heat treatment in order to give them the required mechanical characteristics.

Pipes, fittings and accessories shall not have any defects likely to be detrimental to their use.

Pipes, fittings and accessories showing small imperfections inseparable from the method of manufacture and in no way affecting their use, shall not be rejected. On his own responsibility, the manufacturer may remedy such slight surface imperfections in a suitable manner.

With the previous agreement of the purchaser or his representative, certain defects may be repaired by any proven process such as welding. In such cases, the purchaser may require one of the tests described below to be carried out.

The pipes should be such that they can be cut, drilled or machined; in case of dispute they shall be considered as acceptable provided that the superficial hardness does not exceed 230 HB. The superficial hardness of fittings and accessories shall not exceed 250 HB.

## 8 TOLERANCES ON JOINTS

The tolerances on joints depend on the characteristics peculiar to each type of joint, and shall be specified in the national standards, or, when not so specified, in the manufacturers' catalogues for the type of joint and the nominal diameter considered.

NOTE — As a general rule, the tolerances on the sockets are more restricted than the tolerances on the barrel because of the greater thickness and the greater rigidity of the sockets.

## 9 TOLERANCES ON THICKNESS

The tolerances on wall thickness and flange thickness are as given in table 1, where

*b* is the standard thickness of the flange, in millimetres;

DN is the nominal diameter.

TABLE 1

Dimensions in millimetres

| Type of casting | Dimension | Tolerance |
|---|---|---|
| Pipes centrifugally cast in sand or metal moulds | Wall thickness<br>Flange thickness | $-(1{,}3 + 0{,}001\ DN)$ [1)]<br>$\pm (2 + 0{,}05\ b)$ |
| Pipes cast in sand or metal moulds | Wall thickness<br>Flange thickness | $-(2{,}3 + 0{,}001\ DN)$ [1)]<br>$\pm (3 + 0{,}05\ b)$ |
| Fittings and accessories | Wall thickness<br>Flange thickness | $-(2{,}3 + 0{,}001\ DN)$ [1)]<br>$\pm (3 + 0{,}05\ b)$ |

1) No limit for the plus tolerance has been set (see note to clause 12).

## 10 MANUFACTURING LENGTHS AND TOLERANCES ON LENGTH

The tolerances on length for the pipes and fittings take into account variations due to shrinkage and growth, depending on the composition and heat treatment of the ductile iron. These tolerance limits have been generously chosen to make it possible, by using interchangeable patterns, to manufacture castings which may have slightly different working lengths, depending on the type of joint with which they are provided.

### 10.1 Spigot and socket pipes

The standard manufacturing lengths of spigot and socket pipes are as shown in table 2.

TABLE 2

| Nominal diameters DN | Standard lengths m |
|---|---|
| 40 to 65 | 2 – 3 – 4 – 5 – 5,5 – 6 |
| 80 to 500 | 4 – 5 – 5,5 – 6 |
| 600 to 1000 | 4 – 5 – 5,5 – 6 – 7 |
| 1200 to 2000 | 6 – 7 – 8 – 9 |

Of the total number of spigot and socket pipes to be supplied in each diameter, the manufacturer may supply up to 10 % in lengths shorter than the standard lengths specified, the allowed reduction in length being given in table 3.

TABLE 3

Dimensions in metres

| Specified length | Reduction in length |
|---|---|
| 4 | 0,5 – 1 |
| over 4 | 0,5 – 1 – 1,5 – 2 |

The tolerances on the standard manufacturing lengths of pipes are indicated in section two.

### 10.2 Fittings

The standard manufacturing lengths of fittings and the permitted tolerances on these lengths are indicated in section four.

## 11 TOLERANCES ON THE STRAIGHTNESS OF CENTRIFUGALLY CAST PIPES

When the pipes are rolled along two gantries separated by approximately two-thirds of the length *L* of the pipe to be checked, the maximum deviation $f_m$, in millimetres, shall not be greater than 1,25 times the length *L*, in metres, of this pipe, i.e. :

$$f_m \leqslant 1{,}25\ L$$

## 12 TOLERANCES ON MASSES

The values of the masses of the sockets appearing in the tables of this International Standard are approximate.

The masses of pipes and fittings corresponding to each type of joint shall be specified in the national standards or, when not so specified, in the manufacturers' catalogues; these shall have been calculated by taking the density of cast iron as 7 050 kg/m$^3$.

The mass of the pipes for each working length, and the mass of the fittings shown in the tables have been calculated taking into account in each case a socket mass fixed by a linear formula corresponding to average socket masses as manufactured in practice in various countries.

The values indicated for the mass per metre of pipe and the masses of the sockets are rounded off to the nearest 0,1 kg.

The values indicated for the masses of accessories are rounded off

– to the nearest 0,1 kg for masses less than 20 kg;

– to the nearest 0,5 kg for masses between 20 and 100 kg;

– to the nearest kilogram for masses above 100 kg.

The tolerances on the standard masses are given in table 4.

TABLE 4

| Type of casting | Tolerance on standard mass % |
|---|---|
| Pipes centrifugally cast — up to DN 200 inclusive | ± 8 |
| Pipes centrifugally cast — above DN 200 | ± 5 |
| Pipes cast in sand or metal moulds<br>Standard fittings except as stated below | ± 8 |
| Bends, fittings with branches, and non-standard fittings | ± 12 |

NOTE – Castings of a greater mass than the maximum shall be accepted provided that they comply in every other respect with the requirements of this International Standard.

## 13 TENSILE TESTS – TEST BARS

### 13.1 Pipes centrifugally cast in sand or metal moulds

The machined test bar for the tensile test shall be taken from the spigot end of the pipe, at approximately mid-thickness of the wall, and its axis shall be parallel to the axis of the pipe.

The test bar shall include a cylindrical part, the gauge length of which shall be equal to five times its diameter; the latter shall be as given in table 5, according to the thickness of the pipe.

TABLE 5

Dimensions in millimetres

| Thickness of pipe | Diameter of test bar |
|---|---|
| less than 5 | 2,0 |
| 5 and above, but below 6 | 2,5 |
| 6 and above, but below 7 | 3,0 |
| 7 and above, but below 8 | 3,5 |
| 8 and above, but below 10 | 4,0 |
| 10 and above, but below 12 | 5,0 |
| 12 and above | 6,0 |

### 13.2 Pipes, fittings and accessories cast in sand or metal moulds

The machined bar for the tensile test shall be taken from a sample cast separately, but from the same iron as that used for the castings, and, if necessary, having been subjected to the same heat treatment. The choice of the method used for casting the sample shall be left to the manufacturer with a view to obtaining soundly cast test bars. The thickness of the sample and the diameter of the bar are given in table 6, dependent on the mean thickness of the casting.

TABLE 6

Dimensions in millimetres

| Mean thickness of casting | Thickness of sample | Diameter of test bar |
|---|---|---|
| less than 12 | 12,5 | 6 |
| 12 or above | 25 | 12 |

The gauge length of the machined bar shall be equal to five times its diameter.

In all cases, the ends of the test bars shall be such that they will fit the testing machine.

## 14 TENSILE TESTS – METHOD AND RESULTS

The manufacturer's mechanical tests shall be carried out during manufacture.

The mechanical acceptance tests shall be carried out on castings grouped in batches as follows :

a) **Pipes centrifugally cast in sand or metal moulds**

Each batch shall be made up of pipes cast successively as follows :

- DN 40 to 300 : 100 pipes
- DN 350 to 600 : 50 pipes
- DN 700 to 1000 : 25 pipes
- DN 1200 to 2000 : 10 pipes

b) **Pipes, fittings and accessories cast in sand or metal moulds**

Castings made from iron of substantially the same composition and, if necessary, having been subjected to the same heat treatment, shall be considered as one batch. The size of such batches shall be limited to 4 tonnes of crude castings, excluding the mass of the risers.

For one pipe, or from one sample of each batch in the case of fittings and accessories, the manufacturer shall take one test bar, which shall satisfy the requirements of table 7.

If the results of this test are below the specified minimum values, two other test bars shall be taken from the same pipe, or from the same sample in the case of fittings and accessories, and these shall satisfy the same specified requirements.

Pipes from which test bars have been cut shall be accepted by the purchaser as complete lengths.

NOTE – The provisions made for dividing the pipes and fittings into batches and for the heat treatment of the castings, together with the specifying of different diameters of a test bar according to the thickness and type of the casting, contribute towards the accuracy of this test.

TABLE 7

| Type of casting | Minimum tensile strength $R_m$ | Minimum 0,2 % proof stress[1] $R_{p0,2}$ | Minimum elongation after fracture $A$ | |
|---|---|---|---|---|
| | N/mm² | N/mm² | % | |
| | DN 40 to 2000 | DN 40 to 2000 | DN 40 to 1000 | DN 1200 to 2000 |
| Pipes centrifugally cast | 420 | 300 | 10 | 7 |
| Pipes cast in sand or metal moulds<br>Fittings | 400 | 300 | 5 | — |

1) The proof stress shall be measured only upon special agreement and under conditions which shall be specified in the order.

## 15 BRINELL HARDNESS TEST

The Brinell hardness, HB, specified in clause 7, shall be checked by means of a test carried out on the outer surface of the castings after slight grinding.

The Brinell hardness test shall be carried out in accordance with ISO/R 79, Amendment 1, with a steel ball of 10 mm or 5 mm diameter.

## 16 MAXIMUM WORKING PRESSURE AND INTERNAL PRESSURE PROOF TEST

### 16.1 Maximum working pressure

The maximum working pressures for these pipes, fittings and accessories shall be determined according to the regulations in operation in each country as a function of the works proof test pressure and the anticipated working conditions : type of liquid transported, static and transitory overloads, etc.

### 16.2 Internal pressure proof test

#### 16.2.1 *Spigot and socket pipes*

Pipes shall be subjected to a works hydrostatic test for a duration of 15 s at a minimum pressure defined by the corresponding specific requirements.

It is recommended that this pressure $p$, expressed in bars[1] as a function of the coefficient $K$ (clause 4), be calculated using the following formulae :

- DN 40 to 300 : $p = 0{,}5\ (K + 1)^2$
- DN 350 to 600 : $p = 0{,}5\ K^2$
- DN 700 to 1000 : $p = 0{,}5\ (K - 1)^2$
- DN 1200 to 2000 : $p = 0{,}5\ (K - 2)^2$

The actual test pressures shall not exceed the following values :

- DN 40 to 300 : $p$ = 100 bar
- DN 350 to 600 : $p$ = 80 bar
- DN 700 to 1000 : $p$ = 60 bar
- DN 1200 to 2000 : $p$ = 40 bar

#### 16.2.2 *Fittings*

Fittings shall be subjected to a leak-tightness test carried out with water or air, under the conditions indicated by the relevant specific requirements.

NOTE – Because of their great mechanical strength, ductile iron pipes and fittings may be used for a very wide range of working conditions. The hydrostatic test or leak-tightness test pressures are indicated, therefore, in the specific requirements applicable to each type of casting. For gas pipes, special tests may be required.

## 17 COATING

Except when otherwise specified, all pipes, fittings and accessories shall be coated inside and outside.

The coating shall dry rapidly with good adherence, and shall not scale off.

The inside coating shall not contain any constituent soluble in water or any ingredient liable to impart any taste or smell to the water after suitable washing out of the mains. For pipe-lines carrying potable water, or alimentary fluids, the inside coating shall not contain any toxic constituent.

NOTE – The requirements concerning the coating of the various castings are based on similar requirements in ISO 13 for grey iron pipes and fittings. Technical specifications concerning cement mortar internal linings for pipes will be the subject of a separate International Standard.

1) 1 bar = 0,1 MPa

## 18 INSPECTION

If the purchaser wishes to inspect the pipes, fittings and accessories, such inspection shall be undertaken at the works of the manufacturer. The equipment and labour necessary for the carrying out of the inspection shall be provided by the manufacturer.

The inspector appointed by the purchaser and accredited to the manufacturer shall be advised previously of the time at which the operations of inspection will normally take place.

The inspector may witness the sampling, the preparation and testing of the test pieces, the checking of dimensions and masses, and the hydraulic tests.

The inspection and weighing of the pipes, fittings and accessories may be carried out after coating.

Should the purchaser or his representative not be present when these operations are carried out at the time agreed upon, the manufacturer shall be entitled to proceed with the inspection without the purchaser or his representative being present.

NOTE – The requirements concerning inspection of the various castings are based on similar requirements in ISO 13 for grey iron pipes and fittings.



# SECTION TWO

# SPIGOT AND SOCKET PIPES

## 19 GENERAL – PIPES

Section two of this International Standard defines (see table 9) a range of ductile iron pipes which satisfy most of the normal needs, particularly in the conveyance and distribution of water or gas under pressure.

The thickness of the pipes is defined as a function of their diameter by linear formulae, as given in ISO 13 for grey iron pipes.

In case of particular needs, other pipe ranges, having smaller or greater wall thicknesses, could be envisaged.

Table 9 deals with ductile iron spigot and socket pipes used for the transportation and distribution of water or other liquids, or gas under pressure. It applies equally to double spigot pipes.

Their thickness $e$ has been calculated as a function of the nominal diameter DN, by the formula given in clause 4, using 9 as the value for $K$, thus

$$e = 4{,}5 + 0{,}009\ DN$$

However, for pipes DN 40 to 200, the thickness is given by the additional formula

$$e = 5{,}8 + 0{,}003\ DN$$

with a minimum of 6 mm for pipes DN 40 to 65.

In these formulae

$e$ is the standard wall thickness, in millimetres;

DN is the nominal diameter.

The hydrostatic works test pressure for these pipes is shown in table 8.

TABLE 8

| **Nominal diameters** DN | **Hydrostatic works test pressure** bar |
|---|---|
| **40** to **300** | 50 |
| **350** to **600** | 40 |
| **700** to **1000** | 32 |
| **1200** to **2000** | 25 |

## 20 DIMENSIONS AND MASSES

$e = \begin{cases} 5{,}8 + 0{,}003\ DN, \text{ with a minimum value of 6, for DN 40 to 65} \\ 5{,}8 + 0{,}003\ DN \text{ for DN 80 to 200} \\ 4{,}5 + 0{,}009\ DN \text{ for DN 250 to 2000} \end{cases}$

Tolerance on $L = \pm 30$[1)]

Symbol :

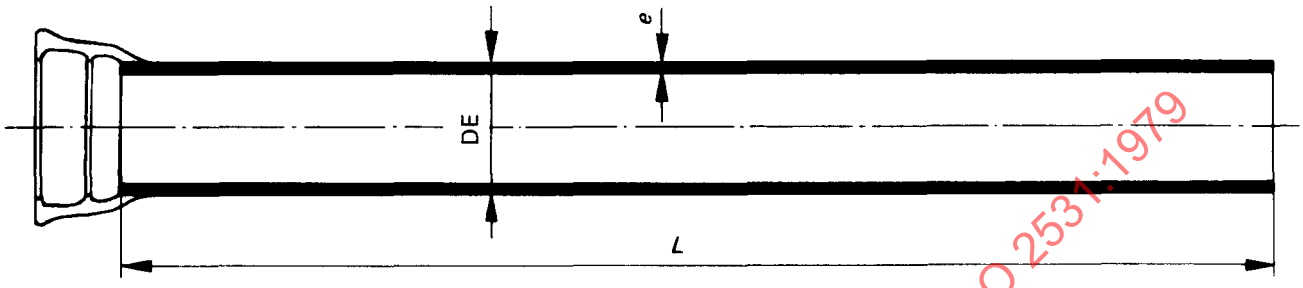



TABLE 9

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | Barrel | | | Socket mass (approximate) | Total mass (approximate) for one working length $L$ of : | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DE | $e$ | Mass per metre (approximate) | | 2 m | 3 m | 4 m | 5 m | 5,5 m | 6 m | 7 m | 8 m | 9 m |
| 40 | 56 | 6 | 6,6 | 1,7 | 15 | 21,5 | 28 | – | – | – | – | – | – |
| 50 | 66 | 6 | 8 | 2,1 | 18 | 26 | 34 | – | – | – | – | – | – |
| (60) | 77 | 6 | 9,4 | 2,5 | – | – | 40 | 49,5 | 54 | 59 | – | – | – |
| 65 | 82 | 6 | 10,1 | 2,7 | – | – | 43 | 53 | 58,5 | 63,5 | – | – | – |
| 80 | 98 | 6 | 12,2 | 3,4 | – | – | 52 | 64,5 | 70,5 | 76,5 | – | – | – |
| 100 | 118 | 6,1 | 15,1 | 4,3 | – | – | 64,5 | 80 | 87,5 | 95 | – | – | – |
| 125 | 144 | 6,2 | 18,9 | 5,7 | – | – | 81,5 | 100 | 110 | 119 | – | – | – |
| 150 | 170 | 6,3 | 22,8 | 7,1 | – | – | 98,5 | 121 | 133 | 144 | – | – | – |
| 200 | 222 | 6,4 | 30,6 | 10,3 | – | – | 133 | 163 | 179 | 194 | – | – | – |
| 250 | 274 | 6,8 | 40,2 | 14,2 | – | – | 175 | 215 | 235 | 255 | – | – | – |
| 300 | 326 | 7,2 | 50,8 | 18,6 | – | – | 222 | 273 | 298 | 323 | – | – | – |
| 350 | 378 | 7,7 | 63,2 | 23,7 | – | – | 277 | 340 | 371 | 403 | – | – | – |
| 400 | 429 | 8,1 | 75,5 | 29,3 | – | – | 331 | 407 | 445 | 482 | – | – | – |
| 500 | 532 | 9 | 104,3 | 42,8 | – | – | 460 | 564 | 616 | 669 | – | – | – |
| 600 | 635 | 9,9 | 137,1 | 59,3 | – | – | 608 | 745 | 813 | 882 | 1 019 | – | – |
| 700 | 738 | 10,8 | 173,9 | 79,1 | – | – | 775 | 949 | 1 036 | 1 123 | 1 296 | – | – |
| 800 | 842 | 11,7 | 215,2 | 102,6 | – | – | 963 | 1 179 | 1 286 | 1 394 | 1 609 | – | – |
| 900 | 945 | 12,6 | 260,2 | 129,9 | – | – | 1 171 | 1 431 | 1 561 | 1 691 | 1 951 | – | – |
| 1000 | 1 048 | 13,5 | 309,3 | 161,3 | – | – | 1 399 | 1 708 | 1 862 | 2 017 | 2 326 | – | – |
| 1200 | 1 255 | 15,3 | 420,1 | 237,7 | – | – | – | – | 2 548 | 2 758 | 3 178 | 3 799 | 4 019 |
| 1400 | 1 462 | 17,1 | 547,2 | 279,3 | – | – | – | – | – | 3 563 | 4 110 | 4 637 | 5 204 |
| 1600 | 1 668 | 18,9 | 690,3 | 375,4 | – | – | – | – | – | 4 517 | 5 208 | 5 898 | 6 588 |
| 1800 | 1 875 | 20,7 | 850,1 | 490,6 | – | – | – | – | – | 5 591 | 6 441 | 7 291 | 8 142 |
| 2000 | 2 082 | 22,5 | 1 026,3 | 626,4 | – | – | – | – | – | 6 784 | 7 811 | 8 837 | 9 863 |

1) According to the type of joint, the difference between the working length $L$ and the working manufacturing length may reach 100 mm for DN 40 to 1000, and 250 mm for DN 1200 to 2000.

# SECTION THREE

# FLANGES

## 21 GENERAL – FLANGES

In ISO 13, only one type of flange has been adopted for grey iron pipe-lines. The increase in pressures permissible in ductile iron pipe-lines, and the extension of the range of uses to which they may be put, have led to the inclusion of four types of flange corresponding to the nominal pressures PN 10, PN 16, PN 25 and PN 40 respectively.

Because they have identical drilling details, it has been possible to adopt a single design for flanges DN 40 and 50 for nominal pressures PN 10-16-25 and 40, and, for DN 60 and 65, a common design for nominal pressures PN 10 and 16 on the one hand and PN 25 and 40 on the other hand.

Moreover, since a degree of rationalization of flange dimensions and/or drilling details already exists for DN 80 to 200, for the above nominal pressures, and since this rationalization of flange dimensions has been extended to include DN 250 and 300 for nominal pressures PN 10 and PN 16, the multiplicity of designs has been reduced as shown in table 10.

TABLE 10

| Nominal diameters DN | Identical flange dimensions for nominal pressures | Identical drilling details for nominal pressures |
|---|---|---|
| **40** and **50** | | PN 10–16–25–40 |
| **60** and **65** | PN 10–16/PN 25–40 | |
| **80** | PN 10–16–25 | PN 16–25 |
| **100** to **150** | PN 10–16 | PN 10–16 |
| **200** to **300** | PN 10–16 | |

As specified in ISO 13, PN 10 flanges (see tables 11 and 12) may be used on socket pipe-lines up to pressures of approximately 15 bar.

The flanges may have a machined raised face and drilled holes; they may also be supplied as cast where particularly accurate moulding processes are used, while respecting the dimensional requirements shown in one of the tables 11 to 18 hereafter for a selected nominal diameter and nominal pressure.

It should be noted that the diameters of bolt holes of the various types of flange are 1 mm larger than those envisaged for pipe-lines not laid in the ground. This increase makes it easier to assemble the castings, which is sometimes difficult in the case of underground pipe-lines. It also permits the use of larger diameter bolts whenever this is justified by considerations of resistance to corrosion.

The diameter of the holes has been fixed according to the diameter of the bolts in accordance with the following rule :

for a bolt diameter $\leqslant 52$ : diameter of the bolt + 4 mm;

for a bolt diameter $> 52$ : diameter of the bolt + 6 mm.

## 22 DIMENSIONS AND DRILLING DETAILS OF PN 10 FLANGES

### 22.1 Dimensions

$b = \begin{cases} 10 + 0{,}035\ DN, \text{ with a minimum value of 16, for DN 40 to 300} \\ 10 + 0{,}025\ DN, \text{ with a minimum value of 20,5, for DN 350 to 1200} \\ 20 + 0{,}015\ DN \text{ for DN 1400 to 2000} \end{cases}$

$s = \begin{cases} 0{,}8\ a \text{ for DN 40 to 600} \\ 0{,}7\ a \text{ for DN 700 to 2000} \end{cases}$

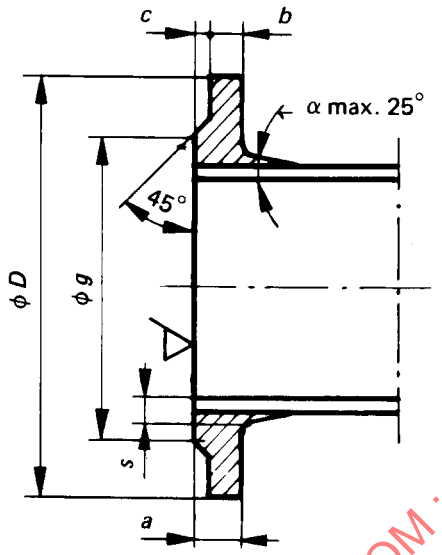


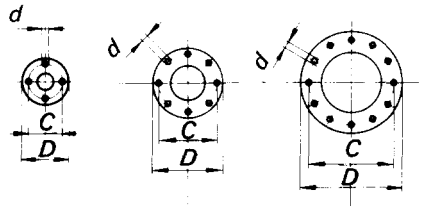

TABLE 11

Dimensions in millimetres — Masses in kilograms

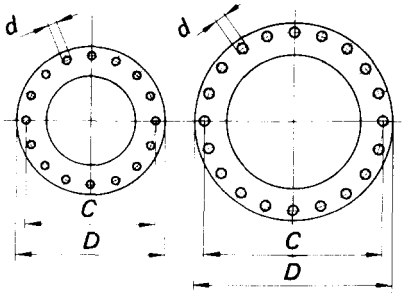
| Nominal diameter DN | *D* | *g* | *a* | *b* | *c* | *s* | Approximate flange mass (hatched part) |
|---|---|---|---|---|---|---|---|
| **40** | 150 | 83 | 19 | 16 | 3 | 16 | 1,7 |
| **50** | 165 | 98 | 19 | 16 | 3 | 16 | 2,1 |
| **(60)** | 175 | 108 | 19 | 16 | 3 | 16 | 2,2 |
| **65** | 185 | 118 | 19 | 16 | 3 | 16 | 2,5 |
| **80** | 200 | 133 | 19 | 16 | 3 | 15 | 3 |
| **100** | 220 | 153 | 19 | 16 | 3 | 15 | 3,3 |
| **125** | 250 | 183 | 19 | 16 | 3 | 15 | 4 |
| **150** | 285 | 209 | 19 | 16 | 3 | 15 | 4,9 |
| **200** | 340 | 264 | 20 | 17 | 3 | 16 | 6,8 |
| **250** | 400 | 319 | 22 | 19 | 3 | 17,5 | 9,6 |
| **300** | 455 | 367 | 24,5 | 20,5 | 4 | 19,5 | 12,8 |
| **350** | 505 | 427 | 24,5 | 20,5 | 4 | 19,5 | 14,1 |
| **400** | 565 | 477 | 24,5 | 20,5 | 4 | 19,5 | 16,3 |
| **500** | 670 | 582 | 26,5 | 22,5 | 4 | 21 | 21,8 |
| **600** | 780 | 682 | 30 | 25 | 5 | 24 | 30,8 |
| **700** | 895 | 797 | 32,5 | 27,5 | 5 | 23 | 40,5 |
| **800** | 1 015 | 904 | 35 | 30 | 5 | 24,5 | 54,8 |
| **900** | 1 115 | 1 004 | 37,5 | 32,5 | 5 | 26,5 | 64,3 |
| **1000** | 1 230 | 1 111 | 40 | 35 | 5 | 28 | 81,4 |
| **1200** | 1 455 | 1 330 | 45 | 40 | 5 | 31,5 | 120,9 |
| **1400** | 1 675 | 1 530 | 46 | 41 | 5 | 32 | 147,8 |
| **1600** | 1 915 | 1 750 | 49 | 44 | 5 | 34,5 | 206,4 |
| **1800** | 2 115 | 1 950 | 52 | 47 | 5 | 36,5 | 236,3 |
| **2000** | 2 325 | 2 150 | 55 | 50 | 5 | 38,5 | 279,4 |

## 22.2 Drilling details

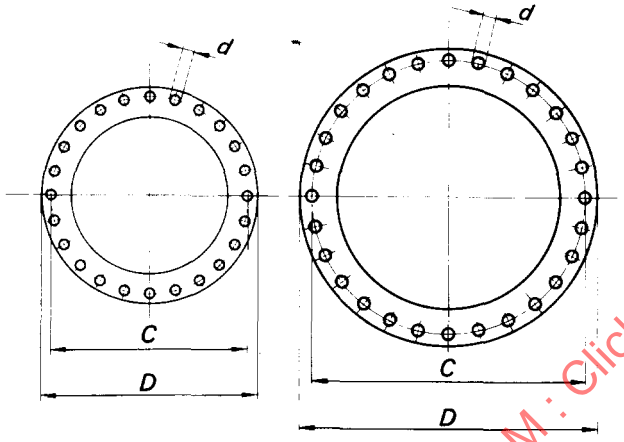
DN 40 to 65 80 to 200 250 and 300



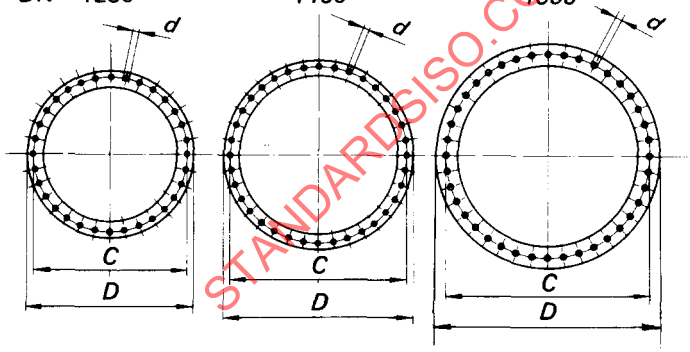

DN 350 and 400 500 and 600




DN 700 and 800 900 and 1000




DN 1200 1400 1600




DN 1800 2000

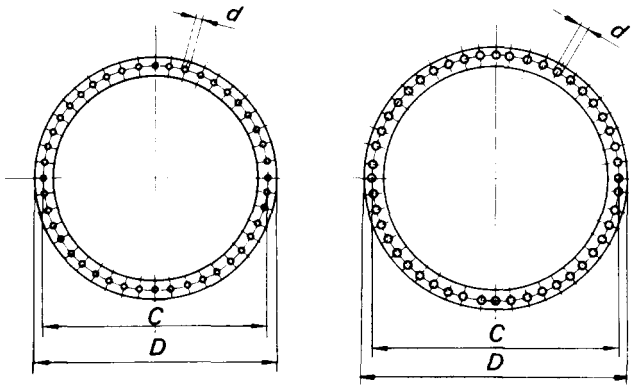



TABLE 12

Dimensions in millimetres

| Nominal diameter DN | D | C | Holes | | Bolts |
|---|---|---|---|---|---|
| | | | Number | Diameter d | Diameter |
| **40** | 150 | 110 | 4 | 19 | 16 |
| **50** | 165 | 125 | 4 | 19 | 16 |
| **(60)** | 175 | 135 | 4 | 19 | 16 |
| **65** | 185 | 145 | 4 | 19 | 16 |
| **80** | 200 | 160 | 8[1)] | 19 | 16 |
| **100** | 220 | 180 | 8 | 19 | 16 |
| **125** | 250 | 210 | 8 | 19 | 16 |
| **150** | 285 | 240 | 8 | 23 | 20 |
| **200** | 340 | 295 | 8 | 23 | 20 |
| **250** | 400 | 350 | 12 | 23 | 20 |
| **300** | 455 | 400 | 12 | 23 | 20 |
| **350** | 505 | 460 | 16 | 23 | 20 |
| **400** | 565 | 515 | 16 | 28 | 24 |
| **500** | 670 | 620 | 20 | 28 | 24 |
| **600** | 780 | 725 | 20 | 31 | 27 |
| **700** | 895 | 840 | 24 | 31 | 27 |
| **800** | 1 015 | 950 | 24 | 34 | 30 |
| **900** | 1 115 | 1 050 | 28 | 34 | 30 |
| **1000** | 1 230 | 1 160 | 28 | 37 | 33 |
| **1200** | 1 455 | 1 380 | 32 | 40 | 36 |
| **1400** | 1 675 | 1 590 | 36 | 43 | 39 |
| **1600** | 1 915 | 1 820 | 40 | 49 | 45 |
| **1800** | 2 115 | 2 020 | 44 | 49 | 45 |
| **2000** | 2 325 | 2 230 | 48 | 49 | 45 |

1) For flanges with nominal diameter DN 80 and nominal pressure PN 10, the number of holes may be reduced to 4 at the purchaser's request, in order to permit coupling with an existing flange of an old pipe-line.

## 23 DIMENSIONS AND DRILLING DETAILS OF PN 16 FLANGES

### 23.1 Dimensions

$b = \begin{cases} 10 + 0{,}035\ DN, \text{ with a minimum value of 16, for DN 40 to 1200} \\ 20 + 0{,}025\ DN \text{ for DN 1400 to 2000} \end{cases}$

$s = \begin{cases} 0{,}8\ a \text{ for DN 40 to 600} \\ 0{,}7\ a \text{ for DN 700 to 2000} \end{cases}$

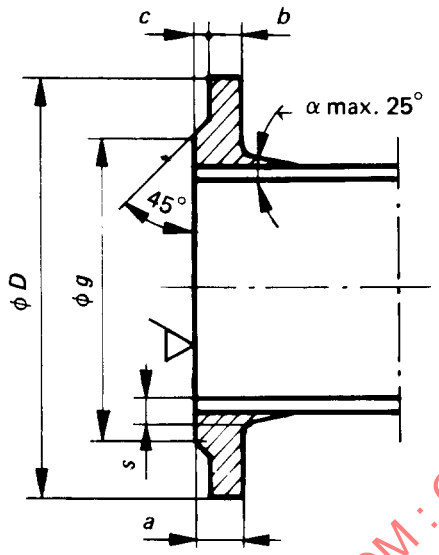


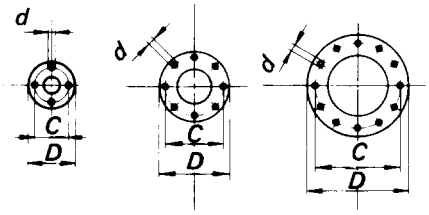

TABLE 13

Dimensions in millimetres — Masses in kilograms

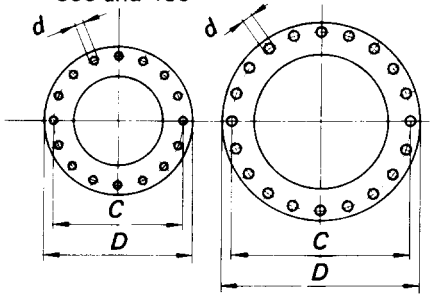
| Nominal diameter DN | D | g | a | b | c | s | Approximate flange mass (hatched part) |
|---|---|---|---|---|---|---|---|
| **40** | 150 | 83 | 19 | 16 | 3 | 16 | 1,7 |
| **50** | 165 | 98 | 19 | 16 | 3 | 16 | 2,1 |
| **(60)** | 175 | 108 | 19 | 16 | 3 | 16 | 2,2 |
| **65** | 185 | 118 | 19 | 16 | 3 | 16 | 2,5 |
| **80** | 200 | 133 | 19 | 16 | 3 | 15 | 2,9 |
| **100** | 220 | 153 | 19 | 16 | 3 | 15 | 3,3 |
| **125** | 250 | 183 | 19 | 16 | 3 | 15 | 4 |
| **150** | 285 | 209 | 19 | 16 | 3 | 15 | 4,9 |
| **200** | 340 | 264 | 20 | 17 | 3 | 16 | 6,6 |
| **250** | 400 | 319 | 22 | 19 | 3 | 17,5 | 9,2 |
| **300** | 455 | 367 | 24,5 | 20,5 | 4 | 19,5 | 12,4 |
| **350** | 520 | 432 | 26,5 | 22,5 | 4 | 21 | 17,2 |
| **400** | 580 | 484 | 28 | 24 | 4 | 22,5 | 21,9 |
| **500** | 715 | 606 | 31,5 | 27,5 | 4 | 25 | 37 |
| **600** | 840 | 721 | 36 | 31 | 5 | 29 | 57,3 |
| **700** | 910 | 791 | 39,5 | 34,5 | 5 | 27,5 | 55,6 |
| **800** | 1 025 | 898 | 43 | 38 | 5 | 30 | 74 |
| **900** | 1 125 | 998 | 46,5 | 41,5 | 5 | 32,5 | 88,2 |
| **1000** | 1 255 | 1 115 | 50 | 45 | 5 | 35 | 122,9 |
| **1200** | 1 485 | 1 330 | 57 | 52 | 5 | 40 | 185,2 |
| **1400** | 1 685 | 1 530 | 60 | 55 | 5 | 42 | 215,9 |
| **1600** | 1 930 | 1 750 | 65 | 60 | 5 | 45,5 | 308,4 |
| **1800** | 2 130 | 1 950 | 70 | 65 | 5 | 49 | 362,2 |
| **2000** | 2 345 | 2 150 | 75 | 70 | 5 | 52,5 | 432,2 |

### 23.2 Drilling details

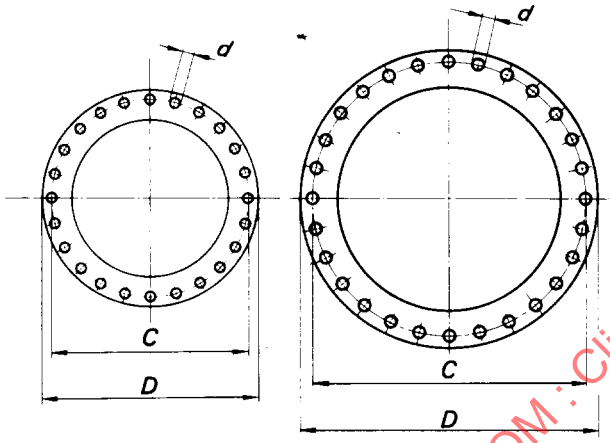
DN 40 to 65 80 to 150 200 to 300



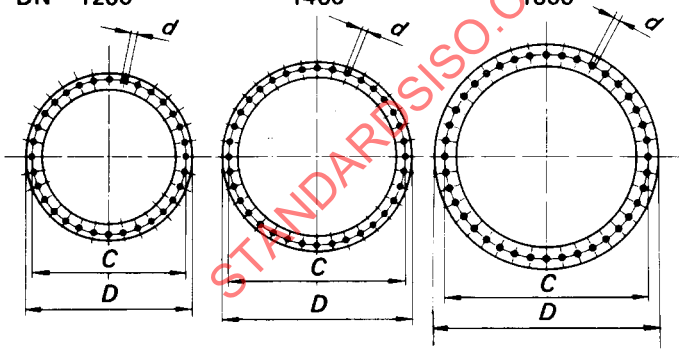

DN 350 and 400 500 and 600




DN 700 and 800 900 and 1000




DN 1200 1400 1600




DN 1800 2000

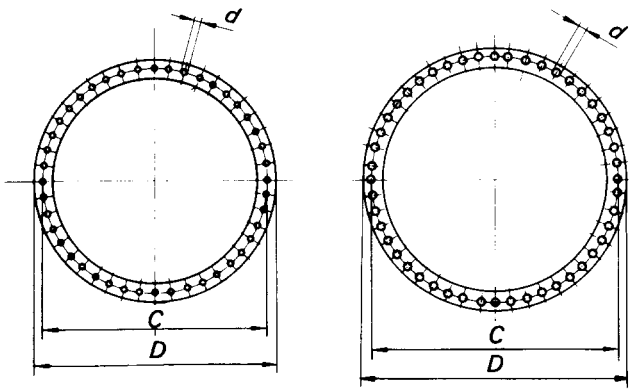



TABLE 14

Dimensions in millimetres

| Nominal diameter DN | D | C | Holes | | Bolts |
|---|---|---|---|---|---|
| | | | Number | Diameter d | Diameter |
| 40 | 150 | 110 | 4 | 19 | 16 |
| 50 | 165 | 125 | 4 | 19 | 16 |
| (60) | 175 | 135 | 4 | 19 | 16 |
| 65 | 185 | 145 | 4 | 19 | 16 |
| 80 | 200 | 160 | 8 | 19 | 16 |
| 100 | 220 | 180 | 8 | 19 | 16 |
| 125 | 250 | 210 | 8 | 19 | 16 |
| 150 | 285 | 240 | 8 | 23 | 20 |
| 200 | 340 | 295 | 12 | 23 | 20 |
| 250 | 400 | 355 | 12 | 28 | 24 |
| 300 | 455 | 410 | 12 | 28 | 24 |
| 350 | 520 | 470 | 16 | 28 | 24 |
| 400 | 580 | 525 | 16 | 31 | 27 |
| 500 | 715 | 650 | 20 | 34 | 30 |
| 600 | 840 | 770 | 20 | 37 | 33 |
| 700 | 910 | 840 | 24 | 37 | 33 |
| 800 | 1 025 | 950 | 24 | 40 | 36 |
| 900 | 1 125 | 1 050 | 28 | 40 | 36 |
| 1000 | 1 255 | 1 170 | 28 | 43 | 39 |
| 1200 | 1 485 | 1 390 | 32 | 49 | 45 |
| 1400 | 1 685 | 1 590 | 36 | 49 | 45 |
| 1600 | 1 930 | 1 820 | 40 | 56 | 52 |
| 1800 | 2 130 | 2 020 | 44 | 56 | 52 |
| 2000 | 2 345 | 2 230 | 48 | 62 | 56 |

## 24 DIMENSIONS AND DRILLING DETAILS OF PN 25 FLANGES

### 24.1 Dimensions

$b = \begin{cases} 10 + 0{,}045\ DN, \text{ with a minimum value of 16, for DN 40 to 1200} \\ 20 + 0{,}035\ DN \text{ for DN 1400 to 2000} \end{cases}$

$s = \begin{cases} 0{,}8\ a \text{ for DN 40 to 600} \\ 0{,}7\ a \text{ for DN 700 to 2000} \end{cases}$

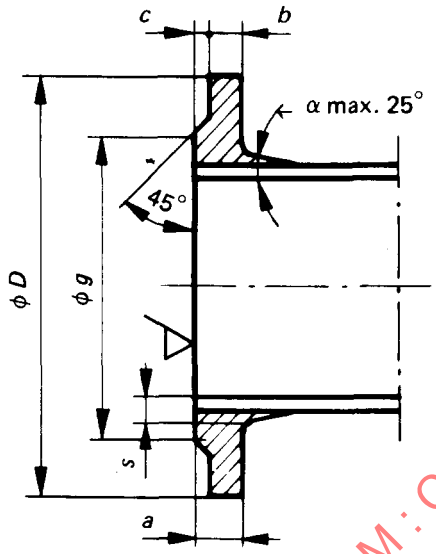



TABLE 15

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | D | g | a | b | c | s | Approximate flange mass (hatched part) |
|---|---|---|---|---|---|---|---|
| 40 | 150 | 83 | 19 | 16 | 3 | 16 | 1,7 |
| 50 | 165 | 98 | 19 | 16 | 3 | 16 | 2,1 |
| (60) | 175 | 108 | 19 | 16 | 3 | 16 | 2,1 |
| 65 | 185 | 118 | 19 | 16 | 3 | 16 | 2,4 |
| 80 | 200 | 133 | 19 | 16 | 3 | 15 | 2,9 |
| 100 | 235 | 159 | 19 | 16 | 3 | 15 | 3,8 |
| 125 | 270 | 184 | 19 | 16 | 3 | 15 | 4,6 |
| 150 | 300 | 214 | 20 | 17 | 3 | 16 | 5,9 |
| 200 | 360 | 274 | 22 | 19 | 3 | 17,5 | 8,7 |
| 250 | 425 | 331 | 24,5 | 21,5 | 3 | 19,5 | 13,1 |
| 300 | 485 | 389 | 27,5 | 23,5 | 4 | 22 | 18 |
| 350 | 555 | 446 | 30 | 26 | 4 | 24 | 25,5 |
| 400 | 620 | 503 | 32 | 28 | 4 | 25,5 | 33,2 |
| 500 | 730 | 613 | 36,5 | 32,5 | 4 | 29 | 48,7 |
| 600 | 845 | 718 | 42 | 37 | 5 | 33,5 | 71,5 |
| 700 | 960 | 820 | 46,5 | 41,5 | 5 | 32,5 | 90,3 |
| 800 | 1 085 | 929 | 51 | 46 | 5 | 35,5 | 123,2 |
| 900 | 1 185 | 1 029 | 55,5 | 50,5 | 5 | 39 | 148,6 |
| 1000 | 1 320 | 1 142 | 60 | 55 | 5 | 42 | 200,7 |
| 1200 | 1 530 | 1 350 | 69 | 64 | 5 | 48,5 | 284,7 |
| 1400 | 1 755 | 1 560 | 74 | 69 | 5 | 52 | 368,1 |
| 1600 | 1 975 | 1 780 | 81 | 76 | 5 | 56,5 | 485,5 |
| 1800 | 2 195 | 1 985 | 88 | 83 | 5 | 61,5 | 601,9 |
| 2000 | 2 425 | 2 210 | 95 | 90 | 5 | 66,5 | 784,9 |

### 24.2 Drilling details

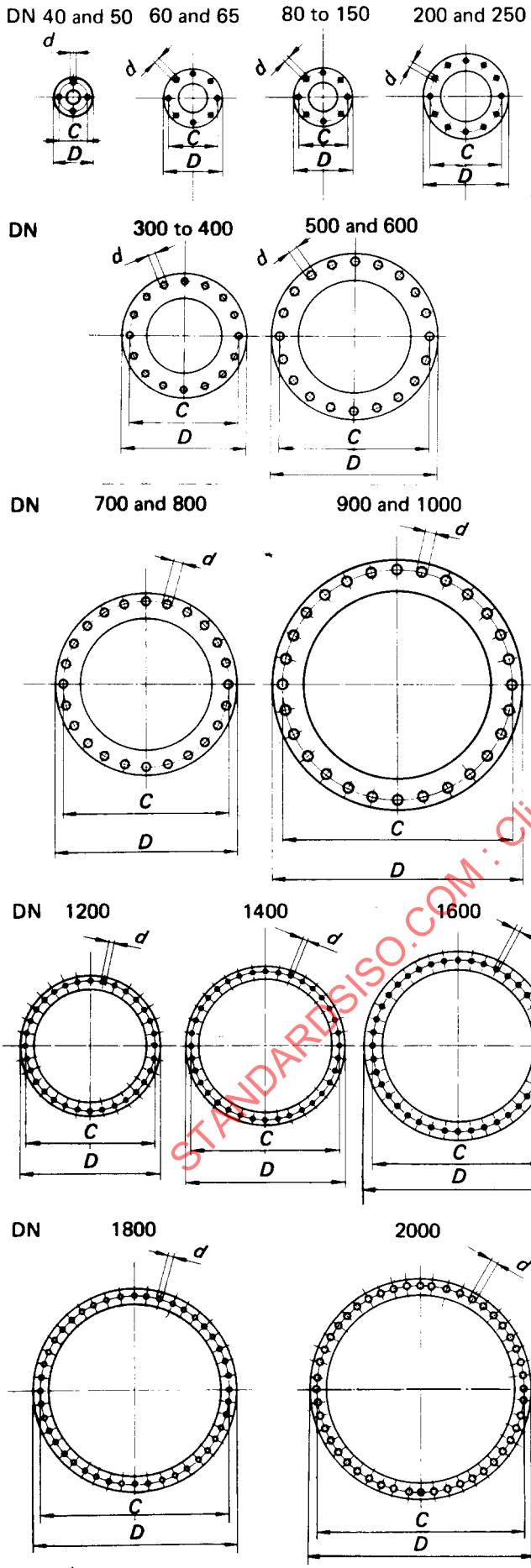



TABLE 16

Dimensions in millimetres

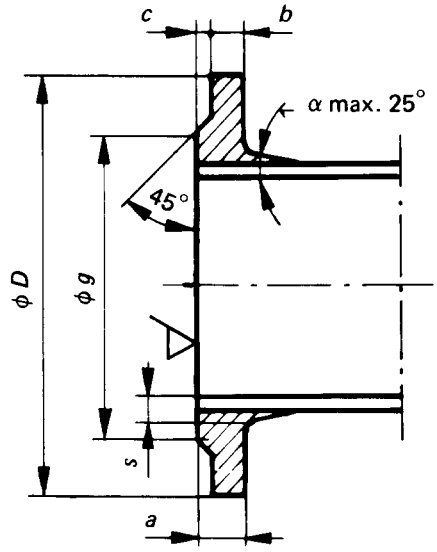
| Nominal diameter DN | D | C | Holes | | Bolts |
|---|---|---|---|---|---|
| | | | Number | Diameter d | Diameter |
| **40** | 150 | 110 | 4 | 19 | 16 |
| **50** | 165 | 125 | 4 | 19 | 16 |
| **(60)** | 175 | 135 | 8 | 19 | 16 |
| **65** | 185 | 145 | 8 | 19 | 16 |
| **80** | 200 | 160 | 8 | 19 | 16 |
| **100** | 235 | 190 | 8 | 23 | 20 |
| **125** | 270 | 220 | 8 | 28 | 24 |
| **150** | 300 | 250 | 8 | 28 | 24 |
| **200** | 360 | 310 | 12 | 28 | 24 |
| **250** | 425 | 370 | 12 | 31 | 27 |
| **300** | 485 | 430 | 16 | 31 | 27 |
| **350** | 555 | 490 | 16 | 34 | 30 |
| **400** | 620 | 550 | 16 | 37 | 33 |
| **500** | 730 | 660 | 20 | 37 | 33 |
| **600** | 845 | 770 | 20 | 40 | 36 |
| **700** | 960 | 875 | 24 | 43 | 39 |
| **800** | 1 085 | 990 | 24 | 49 | 45 |
| **900** | 1 185 | 1 090 | 28 | 49 | 45 |
| **1000** | 1 320 | 1 210 | 28 | 56 | 52 |
| **1200** | 1 530 | 1 420 | 32 | 56 | 52 |
| **1400** | 1 755 | 1 640 | 36 | 62 | 56 |
| **1600** | 1 975 | 1 860 | 40 | 62 | 56 |
| **1800** | 2 195 | 2 070 | 44 | 70 | 64 |
| **2000** | 2 425 | 2 300 | 48 | 70 | 64 |

## 25 DIMENSIONS AND DRILLING DETAILS OF PN 40 FLANGES

### 25.1 Dimensions

$$b = \begin{cases} 10 + 0{,}045\ DN, \text{ with a minimum value of 16, for DN 40 to 100} \\ 10 + 0{,}085\ DN \text{ for DN 125 to 400} \\ 20 + 0{,}055\ DN \text{ for DN 500 and 600} \end{cases}$$

$$s = \begin{cases} 0{,}8\ a \text{ for DN 40 to 65} \\ 0{,}7\ a \text{ for DN 80 to 600} \end{cases}$$




### 25.2 Drilling details

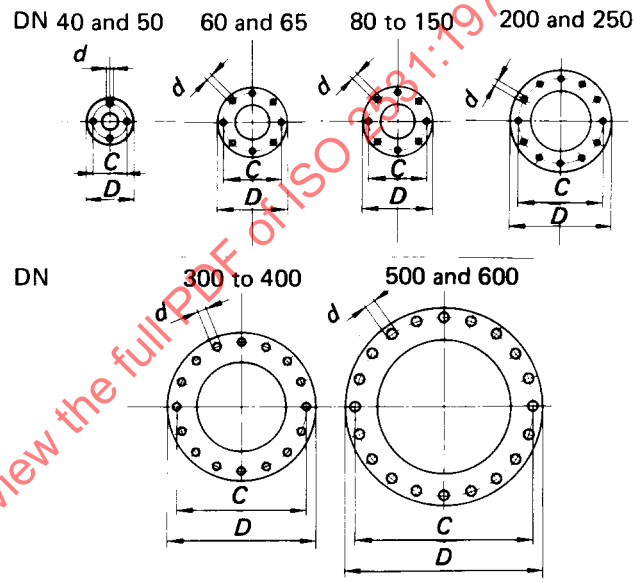



TABLE 17

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | D | g | a | b | c | s | Approximate flange mass (hatched part) |
|---|---|---|---|---|---|---|---|
| **40** | 150 | 83 | 19 | 16 | 3 | 16 | 1,7 |
| **50** | 165 | 98 | 19 | 16 | 3 | 16 | 2,1 |
| **(60)** | 175 | 108 | 19 | 16 | 3 | 16 | 2,1 |
| **65** | 185 | 118 | 19 | 16 | 3 | 16 | 2,4 |
| **80** | 200 | 133 | 19 | 16 | 3 | 15 | 2,9 |
| **100** | 235 | 159 | 19 | 16 | 3 | 15 | 3,8 |
| **125** | 270 | 184 | 23,5 | 20,5 | 3 | 16,5 | 5,9 |
| **150** | 300 | 214 | 26 | 23 | 3 | 18 | 8 |
| **200** | 375 | 281 | 30 | 27 | 3 | 21 | 14 |
| **250** | 450 | 343 | 34,5 | 31,5 | 3 | 24 | 23,2 |
| **300** | 515 | 406 | 39,5 | 35,5 | 4 | 27,5 | 33,5 |
| **350** | 580 | 463 | 44 | 40 | 4 | 31 | 46,7 |
| **400** | 660 | 535 | 48 | 44 | 4 | 33,5 | 66,9 |
| **500** | 755 | 617 | 52 | 48 | 4 | 36,5 | 82,3 |
| **600** | 890 | 734 | 58 | 53 | 5 | 40,5 | 124,1 |

TABLE 18

Dimensions in millimetres

| Nominal diameter DN | D | C | Holes | | Bolts |
|---|---|---|---|---|---|
| | | | Number | Diameter d | Diameter |
| **40** | 150 | 110 | 4 | 19 | 16 |
| **50** | 165 | 125 | 4 | 19 | 16 |
| **(60)** | 175 | 135 | 8 | 19 | 16 |
| **65** | 185 | 145 | 8 | 19 | 16 |
| **80** | 200 | 160 | 8 | 19 | 16 |
| **100** | 235 | 190 | 8 | 23 | 20 |
| **125** | 270 | 220 | 8 | 28 | 24 |
| **150** | 300 | 250 | 8 | 28 | 24 |
| **200** | 375 | 320 | 12 | 31 | 27 |
| **250** | 450 | 385 | 12 | 34 | 30 |
| **300** | 515 | 450 | 16 | 34 | 30 |
| **350** | 580 | 510 | 16 | 37 | 33 |
| **400** | 660 | 585 | 16 | 40 | 36 |
| **500** | 755 | 670 | 20 | 43 | 39 |
| **600** | 890 | 795 | 20 | 49 | 45 |

SECTION FOUR

# FITTINGS

## 26 GENERAL – FITTINGS

In general, the ductile iron fittings are of designs similar to those of grey iron fittings (see ISO 13) and their ends are flanged or, preferably, socketed.[1)]

The greater mechanical strength of ductile iron has made it possible to improve the design of fittings and to reduce their dimensions. This makes it easier to lay mains in congested urban areas of large towns, and results in a reduction in the size of valve chambers, the dimensions of which depend mainly on the space occupied by the fittings.

The flange-socket pieces (see table 20) and the straight collars (see table 22) have an internal diameter enlarged sufficiently to allow the adjacent pipes to slide through, facilitating the dismantling and the longitudinal adjustment of the pipe-line sections.

The double socket bends (see tables 23 to 26) have lengths increasing in proportion to their angle of deviation, their bearing surface on the thrust blocks thus being adjusted to the size of the lateral forces which they exert on these thrust blocks.

The introduction of reducing flanges (see tables 38 to 40) has made it possible to simplify the range of flanged-branch tees (see tables 27 to 30 and 44 to 46); the use of a combination of these fittings makes it possible to provide users with the greatest number of possibilities with the smallest number of types of castings.

The effect of this arrangement, based on market statistics, is to reduce stores both at the manufacturer's works and at the customers' premises and also to make supply easier.

Up to and including DN 200, the range of the branches of double-socket tees with flanged branches (see tables 27 to 30) specifies all diameters smaller than and equal to the nominal diameter of the body of the tee, with the exception of DN 125, which is in less common use; the range of the branches of all-flanged tees (see tables 44 to 46) is substantially the same; that of all-socket tees (see table 31) is limited to the most common smaller nominal diameters i.e. : DN 80, 100 and 150, and to the nominal diameter of the body of the tee.

Above DN 200, only tees with flanged branches are specified, the range of these branches including all the principal diameters up to the diameter of the body.

The range of tees with flanged branch specifies, for all the diameters, the branch with DN 600 corresponding to the "manhole" and only specifies branches with a nominal diameter greater than DN 1000 where the cross-section is close to half that of the body.

The connection of a pipe-line of another diameter with these tees is achieved through a double-flanged taper (see table 33) or a reducing flange (see tables 38 to 40).

Double-socket tapers (see table 32), used mainly for a reduction in diameter, have the shortest practicable lengths.

Double-flanged tapers (see table 33), generally placed between two successive diameters, have a length in proportion to the variation in diameter, each side being sloped at 5° to the centre line, and chosen so as to reduce the pressure loss when the tapers are used to increase the diameter.

Table 20 and those following are for ductile iron fittings for pressure pipe-lines for the transportation and distribution of water or other liquids, or gas under pressure.



1) This preference for fittings with sockets is justified by many advantages, defined below :

In a main, the position of the fittings – bends, tees, etc. – is nearly always governed by the layout of the pipe-line and rarely coincides with the end of a pipe.

It is generally necessary to insert, between the last standard-length pipe and the fitting, a shorter section obtained by cutting a standard-length pipe into two pieces. The first piece is used before the fitting and the second immediately after, one of these pieces being without a socket. The double-socket fittings provide the pipe-line with the additional socket which would otherwise be missing and, because of this, it is not necessary to abandon certain lengths of double-spigot pipe on the site.

Double-socket fittings, as compared with the other fittings, have the following advantages :

- mechanical strength increased by the presence at each of their ends of a very strong socket;
- excellent stability on thrust-blocks which can extend over the whole length of the fittings;
- complete accessibility of joints which are clear of thrust blocks;
- simplification of orders and of the supply of spares by the elimination of numerous duplicating types of fittings;
- facility of moulding on symmetrical pattern plates giving good conditions of accuracy and productivity.

The thickness of fittings has been calculated as a function of the nominal diameter DN by using the formula in clause 4, with the following values for $K$ :

$K = 14$ for tees, thus $e = 7 + 0{,}014$ DN

$K = 12$ for other fittings, thus $e = 6 + 0{,}012$ DN

For DN 40 to 65, the thickness of the fittings has been limited to 7 mm, so that, taking the tolerances into account, the thickness of the fittings is always at least equal to that of the pipes of the same nominal diameter.

The fittings shall be submitted at the works to a leak-tightness test carried out either with air at a pressure of 1 bar or with water at the pressure indicated in table 19.

TABLE 19

| **Nominal diameters DN** | **Hydrostatic leak-tightness test pressure** bar |
|---|---|
| **40** to **300** | 25 |
| **350** to **600** | 16 |
| **700** to **2000** | 10 |

## 27 FLANGED SOCKET

$e =$ { 12 (0,5 + 0,001 DN), with a minimum value of 7, for DN 40 to 65
12 (0,5 + 0,001 DN) for DN 80 to 2000

$d =$ { 25 + 1,05 DN for DN 40 to 1200
30 +1,0333 DN for DN 1400 to 2000

$L =$ { 120 + 0,1 DN (rounded off to ± 5) for DN 40 to 1200
170 + 0,1 DN (rounded off to ± 5) for DN 1400 to 2000

Tolerances on $L =$ { ± 25 for DN 40 to 1200
± 35 for DN 1400 to 2000

Symbol :

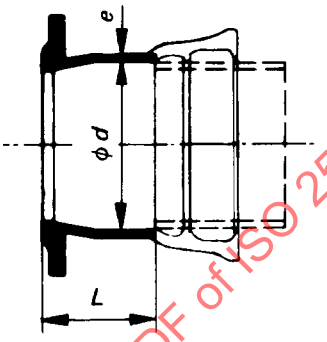



TABLE 20

Dimensions in millimetres — Masses in kilograms

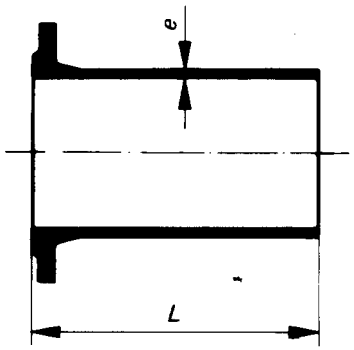
| Nominal diameter DN | e | d | L | Mass (approximate) with flange : PN 10 | PN 16 | PN 25 | PN 40 |
|---|---|---|---|---|---|---|---|
| 40 | 7 | 67 | 125 | 4,5 | 4,5 | 4,5 | 4,5 |
| 50 | 7 | 78 | 125 | 5,4 | 5,4 | 5,4 | 5,4 |
| (60) | 7 | 88 | 125 | 6,0 | 6,0 | 5,9 | 5,9 |
| 65 | 7 | 93 | 125 | 6,4 | 6,4 | 6,3 | 6,3 |
| 80 | 7 | 109 | 130 | 7,5 | 7,4 | 7,3 | – |
| 100 | 7,2 | 130 | 130 | 9 | 9 | 9,5 | – |
| 125 | 7,5 | 156 | 135 | 11,5 | 11,5 | 12,1 | – |
| 150 | 7,8 | 183 | 135 | 14,2 | 14,2 | 15,2 | – |
| 200 | 8,4 | 235 | 140 | 20,5 | 20 | 22 | – |
| 250 | 9 | 288 | 145 | 28 | 27,5 | 31,5 | – |
| 300 | 9,6 | 340 | 150 | 37 | 36,5 | 42 | – |
| 350 | 10,2 | 393 | 155 | 45 | 48 | 56 | – |
| 400 | 10,8 | 445 | 160 | 55 | 60 | 71 | – |
| 500 | 12 | 550 | 170 | 78 | 93 | 104 | – |
| 600 | 13,2 | 655 | 180 | 108 | 135 | 149 | – |
| 700 | 14,4 | 760 | 190 | 144 | 159 | – | – |
| 800 | 15,6 | 865 | 200 | 189 | 208 | – | – |
| 900 | 16,8 | 970 | 210 | 235 | 258 | – | – |
| 1000 | 18 | 1 075 | 220 | 293 | 324 | – | – |
| 1200 | 20,4 | 1 285 | 240 | 456 | 521 | – | – |
| 1400 | 22,8 | 1 477 | 310 | 654 | 723 | – | – |
| 1600 | 25,2 | 1 683 | 330 | 887 | 989 | – | – |
| 1800 | 27,6 | 1 890 | 350 | 1 125 | 1 251 | – | – |
| 2000 | 30 | 2 097 | 370 | 1 414 | 1 567 | – | – |

## 28 FLANGED SPIGOT

$e =$ { 12 (0,5 + 0,001 DN), with a minimum value of 7, for DN 40 to 65
12 (0,5 + 0,001 DN) for DN 80 to 2000

$L =$ { 320 + 0,4 DN (rounded off to ± 5) for DN 40 to 65
320 + 0,4 DN (rounded off to ± 5), with a maximum value of 600, for DN 80 to 1200
220 + 0,35 DN for DN 1400 to 2000

Tolerances on $L =$ { ± 25 for DN 40 to 1200
± 35 for DN 1400 to 2000




Symbol :

TABLE 21

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | e | L | Mass (approximate) with flange : PN 10 | PN 16 | PN 25 | PN 40 |
|---|---|---|---|---|---|---|
| 40 | 7 | 335 | 4,2 | 4,2 | 4,2 | 4,2 |
| 50 | 7 | 340 | 5,2 | 5,2 | 5,2 | 5,2 |
| (60) | 7 | 345 | 5,8 | 5,8 | 5,7 | 5,7 |
| 65 | 7 | 345 | 6,5 | 6,5 | 6,4 | 6,4 |
| 80 | 7 | 350 | 7,9 | 7,8 | 7,8 | – |
| 100 | 7,2 | 360 | 9,6 | 9,6 | 10,2 | – |
| 125 | 7,5 | 370 | 12,4 | 12,4 | 13 | – |
| 150 | 7,8 | 380 | 15,6 | 15,6 | 16,6 | – |
| 200 | 8,4 | 400 | 22,5 | 22,5 | 24,5 | – |
| 250 | 9 | 420 | 31,5 | 32 | 35,5 | – |
| 300 | 9,6 | 440 | 41,5 | 42,5 | 47,5 | – |
| 350 | 10,2 | 460 | 52 | 55 | 64 | – |
| 400 | 10,8 | 480 | 64 | 70 | 81 | – |
| 500 | 12 | 520 | 94 | 109 | 121 | – |
| 600 | 13,2 | 560 | 133 | 159 | 173 | – |
| 700 | 14,4 | 600 | 179 | 194 | – | – |
| 800 | 15,6 | 600 | 226 | 245 | – | – |
| 900 | 16,8 | 600 | 272 | 295 | – | – |
| 1000 | 18 | 600 | 328 | 369 | – | – |
| 1200 | 20,4 | 600 | 456 | 520 | – | – |
| 1400 | 22,8 | 710 | 664 | 732 | – | – |
| 1600 | 25,2 | 780 | 922 | 1 024 | – | – |
| 1800 | 27,6 | 850 | 1 196 | 1 322 | – | – |
| 2000 | 30 | 920 | 1 534 | 1 687 | – | – |

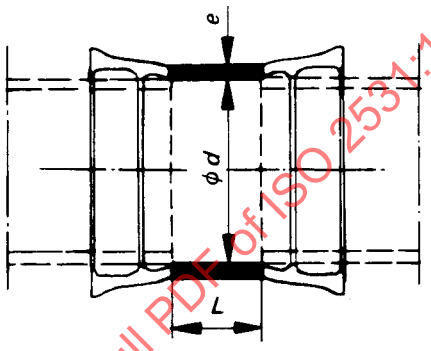
## 29 COLLAR

$e =$ { 12 (0,5 + 0,001 DN), with a minimum value of 7, for DN 40 to 65
12 (0,5 + 0,001 DN) for DN 80 to 2000

$d =$ { 25 + 1,05 DN for DN 40 to 1200
35 + 1,03 DN for DN 1400 to 2000

$L =$ { 150 + 0,1 DN (rounded off to ± 5) for DN 40 to 1200
200 + 0,1 DN for DN 1400 to 2000

Tolerances on $L =$ { ± 25 for DN 40 to 1200
± 35 for DN 1400 to 2000




Symbol :

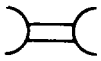


TABLE 22

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | e | d | L | Mass (approximate) |
|---|---|---|---|---|
| 40 | 7 | 67 | 155 | 4,6 |
| 50 | 7 | 78 | 155 | 5,4 |
| (60) | 7 | 88 | 155 | 6,3 |
| 65 | 7 | 93 | 155 | 6,6 |
| 80 | 7 | 109 | 160 | 7,9 |
| 100 | 7,2 | 130 | 160 | 9,9 |
| 125 | 7,5 | 156 | 165 | 12,9 |
| 150 | 7,8 | 183 | 165 | 15,9 |
| 200 | 8,4 | 235 | 170 | 23 |
| 250 | 9 | 288 | 175 | 31,5 |
| 300 | 9,6 | 340 | 180 | 41 |
| 350 | 10,2 | 393 | 185 | 52 |
| 400 | 10,8 | 445 | 190 | 64 |
| 500 | 12 | 550 | 200 | 93 |
| 600 | 13,2 | 655 | 210 | 129 |
| 700 | 14,4 | 760 | 220 | 172 |
| 800 | 15,6 | 865 | 230 | 223 |
| 900 | 16,8 | 970 | 240 | 282 |
| 1000 | 18 | 1 075 | 250 | 349 |
| 1200 | 20,4 | 1 285 | 270 | 560 |
| 1400 | 22,8 | 1 477 | 340 | 816 |
| 1600 | 25,2 | 1 683 | 360 | 1 094 |
| 1800 | 27,6 | 1 890 | 380 | 1 427 |
| 2000 | 30 | 2 097 | 400 | 1 818 |

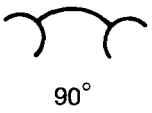
## 30 DOUBLE-SOCKET 1/4 BEND

$e = \begin{cases} 12\ (0{,}5 + 0{,}001\ DN), \text{ with a minimum value of 7, for DN 40 to 65} \\ 12\ (0{,}5 + 0{,}001\ DN) \text{ for DN 80 to 300} \end{cases}$

$t = 20 + DN$

Tolerances on $t = \pm\ (15 + 0{,}03\ DN)$

Symbol :



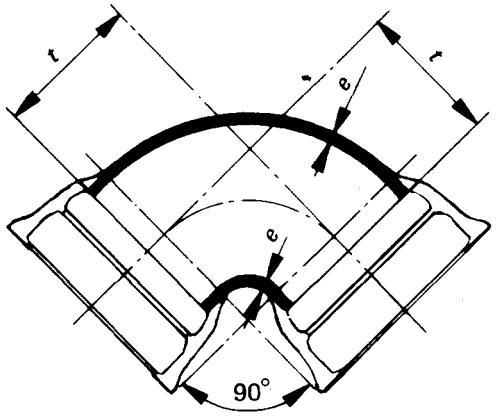




TABLE 23

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | e | t | Mass (approxi-mate) |
|---|---|---|---|
| 40 | 7 | 60 | 4,2 |
| 50 | 7 | 70 | 5,3 |
| (60) | 7 | 80 | 6,3 |
| 65 | 7 | 85 | 6,9 |
| 80 | 7 | 100 | 8,6 |
| 100 | 7,2 | 120 | 11,4 |
| 125 | 7,5 | 145 | 15,7 |
| 150 | 7,8 | 170 | 20,5 |
| 200 | 8,4 | 220 | 33 |
| 250 | 9 | 270 | 48,5 |
| 300 | 9,6 | 320 | 68 |

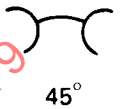
## 31 DOUBLE-SOCKET 1/8 BEND

$e = \begin{cases} 12\ (0{,}5 + 0{,}001\ DN), \text{ with a minimum value of 7, for DN 40 to 65} \\ 12\ (0{,}5 + 0{,}001\ DN) \text{ for DN 80 to 2000} \end{cases}$

$t = \begin{cases} 20 + 0{,}44\ DN \text{ (rounded off to } \pm 5) \text{ for DN 40 to 1200} \\ 180 + 0{,}24\ DN \text{ (rounded off to } \pm 5) \text{ for DN 1400 to 2000} \end{cases}$

Tolerances on $t = \pm\ (10 + 0{,}025\ DN)$

Symbol :



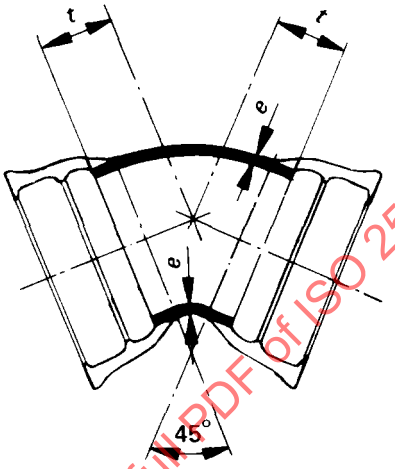




TABLE 24

Dimensions in millimetres — Masses in kilograms

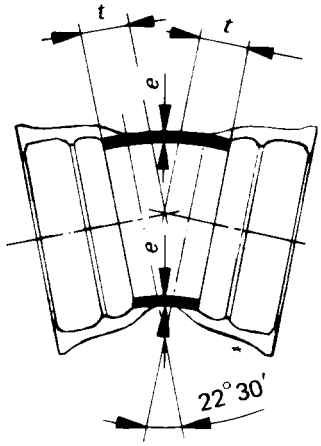
| Nominal diameter DN | e | t | Mass (approxi-mate) |
|---|---|---|---|
| 40 | 7 | 40 | 4 |
| 50 | 7 | 40 | 5 |
| (60) | 7 | 45 | 5,8 |
| 65 | 7 | 50 | 6,3 |
| 80 | 7 | 55 | 7,7 |
| 100 | 7,2 | 65 | 10,1 |
| 125 | 7,5 | 75 | 13,6 |
| 150 | 7,8 | 85 | 17,4 |
| 200 | 8,4 | 110 | 27 |
| 250 | 9 | 130 | 38,5 |
| 300 | 9,6 | 150 | 53 |
| 350 | 10,2 | 175 | 70 |
| 400 | 10,8 | 195 | 89 |
| 500 | 12 | 240 | 139 |
| 600 | 13,2 | 285 | 202 |
| 700 | 14,4 | 330 | 282 |
| 800 | 15,6 | 370 | 378 |
| 900 | 16,8 | 415 | 496 |
| 1000 | 18 | 460 | 635 |
| 1200 | 20,4 | 550 | 986 |
| 1400 | 22,8 | 515 | 1 273 |
| 1600 | 25,2 | 565 | 1 740 |
| 1800 | 27,6 | 610 | 2 296 |
| 2000 | 30 | 660 | 2 970 |

## 32 DOUBLE-SOCKET 1/16 BEND

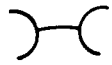
$e =$ { 12 (0,5 + 0,001 DN), with a minimum value of 7, for DN 40 to 65
12 (0,5 + 0,001 DN) for DN 80 to 2000

$t =$ { 20 + 0,22 DN (rounded off to ± 5) for DN 40 to 1200
90 + 0,12 DN (rounded off to ± 5) for DN 1400 to 2000

Tolerances on $t =$ { ± (10 + 0,02 DN) for DN 40 to 1000
± (10 + 0,025 DN) for DN 1200 to 2000




Symbol :



22°30′

TABLE 25

Dimensions in millimetres — Masses in kilograms

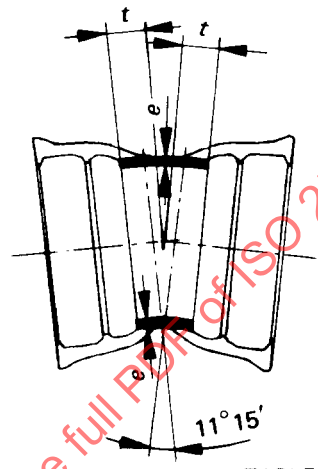
| Nominal diameter DN | e | t | Mass (approximate) |
|---|---|---|---|
| 40 | 7 | 30 | 3,8 |
| 50 | 7 | 30 | 4,8 |
| (60) | 7 | 35 | 5,5 |
| 65 | 7 | 35 | 6,0 |
| 80 | 7 | 40 | 7,3 |
| 100 | 7,2 | 40 | 9,3 |
| 125 | 7,5 | 50 | 12,6 |
| 150 | 7,8 | 55 | 15,9 |
| 200 | 8,4 | 65 | 24 |
| 250 | 9 | 75 | 33,5 |
| 300 | 9,6 | 85 | 44,5 |
| 350 | 10,2 | 95 | 58 |
| 400 | 10,8 | 110 | 74 |
| 500 | 12 | 130 | 111 |
| 600 | 13,2 | 150 | 157 |
| 700 | 14,4 | 175 | 217 |
| 800 | 15,6 | 195 | 287 |
| 900 | 16,8 | 220 | 373 |
| 1000 | 18 | 240 | 470 |
| 1200 | 20,4 | 285 | 716 |
| 1400 | 22,8 | 260 | 933 |
| 1600 | 25,2 | 280 | 1 259 |
| 1800 | 27,6 | 305 | 1 663 |
| 2000 | 30 | 330 | 2 144 |

## 33 DOUBLE-SOCKET 1/32 BEND

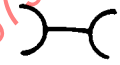
$e =$ { 12 (0,5 + 0,001 DN), with a minimum value of 7, for DN 40 to 65
12 (0,5 + 0,001 DN) for DN 80 to 2000

$t =$ { 20 + 0,11 DN (rounded off to ± 5) for DN 40 to 1200
45 + 0,06 DN (rounded off to ± 5) for DN 1400 to 2000

Tolerances on $t =$ { ± (10 + 0,02 DN) for DN 40 to 1000
± (10 + 0,025 DN) for DN 1200 to 2000




Symbol :



11°15′

TABLE 26

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | e | t | Mass (approximate) |
|---|---|---|---|
| 40 | 7 | 25 | 3,7 |
| 50 | 7 | 25 | 4,7 |
| (60) | 7 | 25 | 5,4 |
| 65 | 7 | 25 | 5,9 |
| 80 | 7 | 30 | 7,1 |
| 100 | 7,2 | 30 | 8,9 |
| 125 | 7,5 | 35 | 11,9 |
| 150 | 7,8 | 35 | 14,8 |
| 200 | 8,4 | 40 | 22 |
| 250 | 9 | 50 | 30,5 |
| 300 | 9,6 | 55 | 40,5 |
| 350 | 10,2 | 60 | 52 |
| 400 | 10,8 | 65 | 65 |
| 500 | 12 | 75 | 96 |
| 600 | 13,2 | 85 | 134 |
| 700 | 14,4 | 95 | 181 |
| 800 | 15,6 | 110 | 239 |
| 900 | 16,8 | 120 | 305 |
| 1000 | 18 | 130 | 381 |
| 1200 | 20,4 | 150 | 568 |
| 1400 | 22,8 | 130 | 747 |
| 1600 | 25,2 | 140 | 1 007 |
| 1800 | 27,6 | 155 | 1 331 |
| 2000 | 30 | 165 | 1 702 |

## 34 DOUBLE-SOCKET TEE WITH FLANGED BRANCH

### 34.1 DN 40 to 200

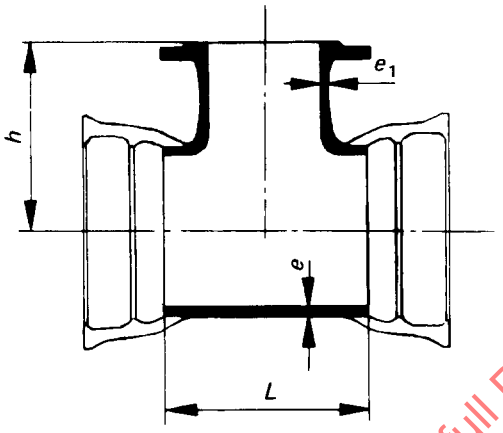
$e = 14\ (0{,}5 + 0{,}001\ DN)$

$e_1 = 14\ (0{,}5 + 0{,}001\ dn)$

$L = 70 + 0{,}06\ DN + 1{,}16\ dn$ (rounded off to ± 5)

$h = 100 + 0{,}6\ DN + 0{,}2\ dn$ (rounded off to ± 5)

Tolerances on $L$ and $h = \begin{matrix} +\ 50 \\ -\ 25 \end{matrix}$




Symbol :

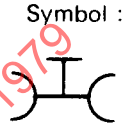


TABLE 27

Dimensions in millimetres — Masses in kilograms

| Body | | | Branch | | | Mass (approximate) with flange : | | | |
|---|---|---|---|---|---|---|---|---|---|
| Nominal diameter DN | $e$ | $L$ | Nominal diameter dn | $e_1$ | $h$ | PN 10 | PN 16 | PN 25 | PN 40 |
| 40 | 7,6 | 120 | 40 | 7,6 | 130 | 6,9 | 6,9 | 6,9 | 6,9 |
| 50 | 7,7 | 130 | 50 | 7,7 | 140 | 8,6 | 8,6 | 8,6 | 8,6 |
| (60) | 7,8 | 145 | (60) | 7,8 | 150 | 10 | 10 | 9,9 | 9,9 |
| 65 | 7,9 | 150 | 65 | 7,9 | 150 | 10,9 | 10,9 | 10,8 | 10,8 |
| 80 | 8,1 | 120 | 40 | 7,6 | 155 | 10,8 | 10,8 | 10,8 | 10,8 |
| | | 130 | 50 | 7,7 | 160 | 11,6 | 11,6 | 11,6 | 11,6 |
| | | 145 | (60) | 7,8 | 160 | 12,1 | 12,1 | 12 | 12 |
| 100 | 8,4 | 120 | 40 | 7,6 | 170 | 13 | 13 | 13 | 13 |
| | | 135 | 50 | 7,7 | 170 | 13,8 | 13,8 | 13,8 | 13,8 |
| | | 145 | (60) | 7,8 | 170 | 14,3 | 14,3 | 14,2 | 14,2 |
| | | 150 | 65 | 7,9 | 175 | 14,9 | 14,9 | 14,8 | 14,8 |
| 125 | 8,8 | 125 | 40 | 7,6 | 185 | 16 | 16 | 16 | 16 |
| | | 145 | (60) | 7,3 | 190 | 17,4 | 17,4 | 17,3 | 17,3 |
| 150 | 9,1 | 125 | 40 | 7,6 | 200 | 19,4 | 19,4 | 19,4 | 19,4 |
| | | 135 | 50 | 7,7 | 200 | 20,3 | 20,3 | 20,3 | 20,3 |
| | | 150 | (60) | 7,8 | 200 | 21 | 21 | 20,9 | 20,9 |
| 200 | 9,8 | 130 | 40 | 7,6 | 230 | 27,1 | 27,1 | 27,1 | 27,1 |
| | | 150 | (60) | 7,8 | 230 | 28,9 | 28,9 | 28,8 | 28,8 |

### 34.2 DN 250 to 600

$e = 14\ (0{,}5 + 0{,}001\ DN)$

$e_1 = 14\ (0{,}5 + 0{,}001\ dn)$

$L = 70 + 0{,}06\ DN + 1{,}16\ dn$ (rounded off to ± 5)

$h = 100 + 0{,}6\ DN + 0{,}2\ dn$ (rounded off to ± 5)

Tolerances on $L$ and $h = {}^{+\ 50}_{-\ 25}$

Symbol :

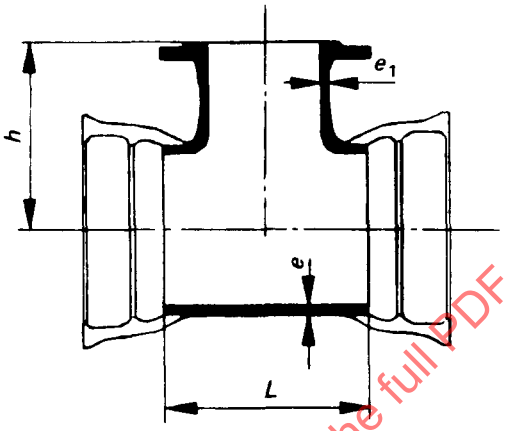



TABLE 28

Dimensions in millimetres — Masses in kilograms

| Body | | | Branch | | | Mass (approximate) with flange : | | |
|---|---|---|---|---|---|---|---|---|
| Nominal diameter DN | $e$ | $L$ | Nominal diameter dn | $e_1$ | $h$ | PN 10 | PN 16 | PN 25 |
| **250** | 10,5 | 200 | **100** | 8,4 | 270 | 43,5 | 43,5 | 44 |
| | 10,5 | 315 | **200** | 9,8 | 290 | 57 | 57 | 59 |
| | 10,5 | 375 | **250** | 10,5 | 300 | 65 | 66 | 69 |
| **300** | 11,2 | 205 | **100** | 8,4 | 300 | 55 | 55 | 56 |
| | 11,2 | 320 | **200** | 9,8 | 320 | 71 | 70 | 73 |
| | 11,2 | 435 | **300** | 11,2 | 340 | 89 | 91 | 95 |
| **350** | 11,9 | 205 | **100** | 8,4 | 330 | 68 | 68 | 68 |
| | 11,9 | 325 | **200** | 9,8 | 350 | 86 | 86 | 88 |
| | 11,9 | 495 | **350** | 11,9 | 380 | 117 | 120 | 129 |
| **400** | 12,6 | 210 | **100** | 8,4 | 360 | 83 | 83 | 83 |
| | 12,6 | 325 | **200** | 9,8 | 380 | 103 | 102 | 104 |
| | 12,6 | 560 | **400** | 12,6 | 420 | 150 | 156 | 167 |
| **500** | 14 | 215 | **100** | 8,4 | 420 | 116 | 116 | 117 |
| | 14 | 330 | **200** | 9,8 | 440 | 142 | 141 | 143 |
| | 14 | 565 | **400** | 12,6 | 480 | 199 | 205 | 216 |
| | 14 | 680 | **500** | 14 | 500 | 232 | 247 | 259 |
| **600** | 15,4 | 340 | **200** | 9,8 | 500 | 189 | 189 | 191 |
| | 15,4 | 570 | **400** | 12,6 | 540 | 258 | 263 | 274 |
| | 15,4 | 800 | **600** | 15,4 | 580 | 340 | 366 | 380 |

### 34.3 DN 700 to 1200

$e = 14\ (0{,}5 + 0{,}001\ DN)$

$e_1 = 14\ (0{,}5 + 0{,}001\ dn)$

$L = 70 + 0{,}06\ DN + 1{,}16\ dn$ (rounded off to ± 5)[1)]

$h = 75 + 0{,}6\ DN + 0{,}15\ dn$ (rounded off to ± 5)

Tolerances on $L$ and $h = {}^{+\ 50}_{-\ 25}$

Symbol :

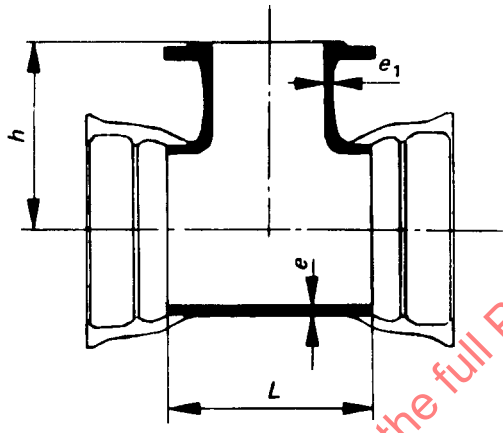



TABLE 29

Dimensions in millimetres — Masses in kilograms

| Body | | | Branch | | | Mass (approximate) with flange : | | |
|---|---|---|---|---|---|---|---|---|
| Nominal diameter DN | $e$ | $L$ | Nominal diameter dn | $e_1$ | $h$ | PN 10 | PN 16 | PN 25 |
| **700** | 16,8 | 345 | **200** | 9,8 | 525 | 242 | 242 | – |
| | 16,8 | 575 | **400** | 12,6 | 555 | 320 | 325 | – |
| | 16,8 | 925 | **700** | 16,8 | 600 | 460 | 475 | – |
| **800** | 18,2 | 350 | **200** | 9,8 | 585 | 306 | 306 | – |
| | 18,2 | 580 | **400** | 12,6 | 615 | 398 | 403 | – |
| | 18,2 | 1 045 | **600** | 15,4 | 645 | 579 | 605 | – |
| | 18,2 | 1 045 | **800** | 18,2 | 675 | 623 | 642 | – |
| **900** | 19,6 | 355 | **200** | 9,8 | 645 | 379 | 379 | – |
| | 19,6 | 590 | **400** | 12,6 | 675 | 490 | 495 | – |
| | 19,6 | 1 170 | **600** | 15,4 | 705 | 748 | 774 | – |
| | 19,6 | 1 170 | **900** | 19,6 | 750 | 814 | 838 | – |
| **1000** | 21 | 360 | **200** | 9,8 | 705 | 462 | 462 | – |
| | 21 | 595 | **400** | 12,6 | 735 | 591 | 596 | – |
| | 21 | 1 290 | **600** | 15,4 | 765 | 947 | 973 | – |
| | 21 | 1 290 | **1000** | 21 | 825 | 1 044 | 1 086 | – |
| **1200** | 23,8 | 840 | **600** | 15,4 | 885 | 1 000 | 1 027 | – |
| | 23,8 | 1 070 | **800** | 18,2 | 915 | 1 190 | 1 210 | – |
| | 23,8 | 1 300 | **1000** | 21 | 945 | 1 406 | 1 448 | – |

1) The length $L$ of tees for nominal diameters DN > 600 and for dn 600 is equal to that of tees with the same nominal diameters of the body and of the branch.

### 34.4 DN 1400 to 2000

$e = 14\ (0{,}5 + 0{,}001\ DN)$

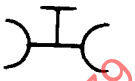
$e_1 = 14\ (0{,}5 + 0{,}001\ dn)$

$L = 250 + 0{,}06\ DN + 1{,}16\ dn$ (rounded off to ± 5)

$h = 120 + 0{,}55\ DN + 0{,}15\ dn$

Tolerances on $L$ and $h$ : $^{+\ 75}_{-\ 35}$

Symbol :



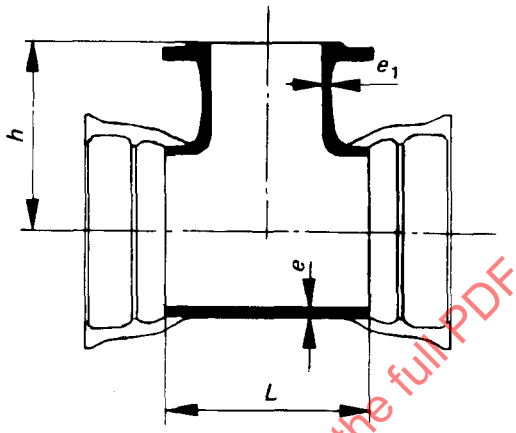



TABLE 30

Dimensions in millimetres — Masses in kilograms

| Body | | | Branch | | | Mass (approximate) with flange : | |
|---|---|---|---|---|---|---|---|
| Nominal diameter DN | $e$ | $L$ | Nominal diameter dn | $e_1$ | $h$ | PN 10 | PN 16 |
| **1400** | 26,6 | 1 030 | **600** | 15,4 | 980 | 1 478 | 1 505 |
| | 26,6 | 1 260 | **800** | 18,2 | 1 010 | 1 709 | 1 728 |
| | 26,6 | 1 495 | **1000** | 21 | 1 040 | 1 955 | 1 996 |
| **1600** | 29,4 | 1 040 | **600** | 15,4 | 1 090 | 1 908 | 1 934 |
| | 29,4 | 1 275 | **800** | 18,2 | 1 120 | 2 192 | 2 211 |
| | 29,4 | 1 505 | **1000** | 21 | 1 150 | 2 480 | 2 522 |
| | 29,4 | 1 740 | **1200** | 23,8 | 1 180 | 2 799 | 2 863 |
| **1800** | 32,2 | 1 055 | **600** | 15,4 | 1 200 | 2 414 | 2 440 |
| | 32,2 | 1 285 | **800** | 18,2 | 1 230 | 2 748 | 2 767 |
| | 32,2 | 1 520 | **1000** | 21 | 1 260 | 3 095 | 3 137 |
| | 32,2 | 1 750 | **1200** | 23,8 | 1 290 | 3 460 | 2 524 |
| **2000** | 35 | 1 065 | **600** | 15,4 | 1 310 | 2 988 | 3 015 |
| | 35 | 1 530 | **1000** | 21 | 1 370 | 3 790 | 3 832 |
| | 35 | 1 995 | **1400** | 26,6 | 1 430 | 4 645 | 4 713 |

## 35 ALL-SOCKET TEE

$e = 14\ (0{,}5 + 0{,}001\ DN)$

$L = 70 + 0{,}06\ DN + 1{,}16\ dn$ (rounded off to ± 5)

$h = 35 + 0{,}5\ DN + 0{,}11\ dn$ (rounded off to ± 5)

Tolerances on $L$ and $h = {}^{+\ 50}_{-\ 25}$

Symbol :

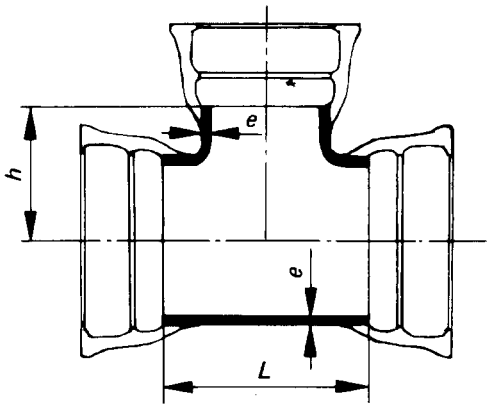



TABLE 31

Dimensions in millimetres — Masses in kilograms

| Body | | | Branch | | | Mass (approximate) |
|---|---|---|---|---|---|---|
| **Nominal diameter DN** | *e* | *L* | **Nominal diameter dn** | *e* | *h* | |
| **40** | 7,6 | 120 | **40** | 7,6 | 60 | 4,5 |
| **50** | 7,7 | 130 | **50** | 7,7 | 65 | 5,6 |
| **(60)** | 7,8 | 145 | **(60)** | 7,8 | 70 | 6,9 |
| **65** | 7,9 | 150 | **65** | 7,9 | 75 | 7,5 |
| **80** | 8,1 | 120 | **40** | 8,1 | 80 | 10,2 |
| | 8,1 | 170 | **80** | 8,1 | 85 | 12,4 |
| **100** | 8,4 | 120 | **40** | 8,4 | 90 | 12,3 |
| | 8,4 | 145 | **(60)** | 8,4 | 90 | 13,8 |
| | 8,4 | 170 | **80** | 8,4 | 95 | 14,8 |
| | 8,4 | 190 | **100** | 8,4 | 95 | 16,1 |
| **125** | 8,8 | 125 | **40** | 8,8 | 100 | 15,3 |
| | 8,8 | 225 | **125** | 8,8 | 110 | 22 |
| **150** | 9,1 | 125 | **40** | 9,1 | 115 | 18,7 |
| | 9,1 | 170 | **80** | 9,1 | 120 | 21,5 |
| | 9,1 | 195 | **100** | 9,1 | 120 | 23,5 |
| | 9,1 | 255 | **150** | 9,1 | 125 | 28 |
| **200** | 9,8 | 130 | **40** | 9,8 | 140 | 26,4 |
| | 9,8 | 175 | **80** | 9,8 | 145 | 30 |
| | 9,8 | 200 | **100** | 9,8 | 145 | 32 |
| | 9,8 | 255 | **150** | 9,8 | 150 | 37 |
| | 9,8 | 315 | **200** | 9,8 | 155 | 43 |

## 36 DOUBLE-SOCKET TAPER

$e_1$ = 12 (0,5 + 0,001 DN), with a minimum value of 7, for DN 50 to 2000

$e_2$ = 12 (0,5 + 0,001 dn), with a minimum value of 7, for DN 50 to 2000

$$L = \begin{cases} 50 + 2\,(DN - dn) \text{ for DN 50 to 300} \\ 60 + 2\,(DN - dn) \text{ for DN 350 to 600} \\ 80 + 2\,(DN - dn) \text{ for DN 700 to 1200} \\ 160 + (DN - dn) \text{ for DN 1400 to 2000} \end{cases}$$

$$\text{Tolerances on } L = \begin{cases} \pm 25 \text{ for DN 50 to 1200} \\ \pm 35 \text{ for DN 1400 to 2000} \end{cases}$$

Symbol :

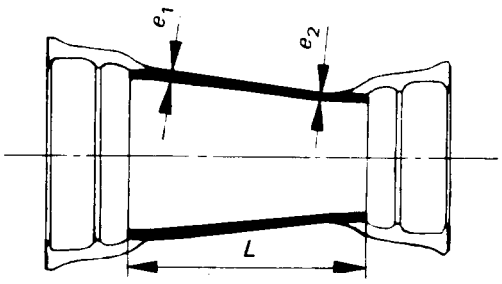



TABLE 32

Dimensions in millimetres — Masses in kilograms

| Larger diameter | | Smaller diameter | | | |
|---|---|---|---|---|---|
| Nominal diameter DN | $e_1$ | Nominal diameter dn | $e_2$ | $L$ | Mass (approximate) |
| **50** | 7 | **40** | 7 | 70 | 4,2 |
| **(60)** | 7 | **50** | 7 | 70 | 5,2 |
| **65** | 7 | **50** | 7 | 80 | 5,7 |
| **80** | 7 | **(60)** | 7 | 90 | 7,1 |
| | 7 | **65** | 7 | 80 | 6,6 |
| **100** | 7,2 | **80** | 7 | 90 | 8,5 |
| **125** | 7,5 | **80** | 7 | 140 | 10,8 |
| | 7,5 | **100** | 7,2 | 100 | 11,1 |
| **150** | 7,8 | **80** | 7 | 190 | 13,5 |
| | 7,8 | **100** | 7,2 | 150 | 13,8 |
| | 7,8 | **125** | 7,5 | 100 | 14,1 |
| **200** | 8,4 | **100** | 7,2 | 250 | 20,5 |
| | 8,4 | **125** | 7,5 | 200 | 20,5 |
| | 8,4 | **150** | 7,8 | 150 | 21 |
| **250** | 9 | **125** | 7,5 | 300 | 29 |
| | 9 | **150** | 7,8 | 250 | 29 |
| | 9 | **200** | 8,4 | 150 | 29 |
| **300** | 9,6 | **150** | 7,8 | 350 | 39,5 |
| | 9,6 | **200** | 8,4 | 250 | 39,5 |
| | 9,6 | **250** | 9 | 150 | 38,5 |
| **350** | 10,2 | **200** | 8,4 | 360 | 52 |
| | 10,2 | **250** | 9 | 260 | 51 |
| | 10,2 | **300** | 9,6 | 160 | 49,5 |
| **400** | 10,8 | **250** | 9 | 360 | 66 |
| | 10,8 | **300** | 9,6 | 260 | 64 |
| | 10,8 | **350** | 10,2 | 160 | 62 |
| **500** | 12 | **350** | 10,2 | 360 | 98 |
| | 12 | **400** | 10,8 | 260 | 94 |
| **600** | 13,2 | **400** | 10,8 | 460 | 142 |
| | 13,2 | **500** | 12 | 260 | 131 |
| **700** | 14,4 | **500** | 12 | 480 | 194 |
| | 14,4 | **600** | 13,2 | 280 | 178 |
| **800** | 15,6 | **600** | 13,2 | 480 | 252 |
| | 15,6 | **700** | 14,4 | 280 | 229 |
| **900** | 16,8 | **700** | 14,4 | 480 | 318 |
| | 16,8 | **800** | 15,6 | 280 | 288 |
| **1000** | 18 | **800** | 15,6 | 480 | 392 |
| | 18 | **900** | 16,8 | 280 | 354 |
| **1200** | 20,4 | **1000** | 18 | 480 | 570 |
| **1400** | 22,8 | **1200** | 20,4 | 360 | 711 |
| **1600** | 25,2 | **1400** | 22,8 | 360 | 951 |
| **1800** | 27,6 | **1600** | 25,2 | 360 | 1 235 |
| **2000** | 30 | **1800** | 27,6 | 360 | 1 566 |

## 37 DOUBLE-FLANGED TAPER

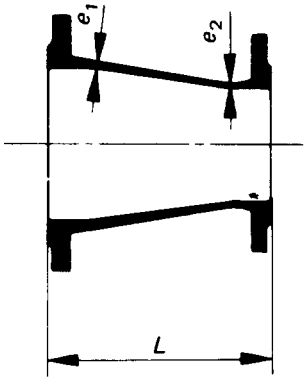
$e_1$ = 12 (0,5 + 0,001 DN), with a minimum value of 7, for DN 50 to 1000

$e_2$ = 12 (0,5 + 0,001 dn), with a minimum value of 7, for DN 50 to 1000

$L$ = { 150 for (DN − dn) = 10; 200 for 15 ⩽ (DN − dn) < 25 } for DN 50 to 80

$L$ = { 200 for (DN − dn) ⩽ 25; 300 for (DN − dn) = 50; 600 for (DN − dn) = 100 } for DN 100 to 1000

Tolerances on $L$ = ± 10




Symbol :

TABLE 33

Dimensions in millimetres — Masses in kilograms

| Larger diameter | | Smaller diameter | | | Mass (approximate) with flange : | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal diameter DN | $e_1$ | Nominal diameter dn | $e_2$ | $L$ | PN10 | PN16 | PN25 | PN40 |
| 50 | 7 | 40 | 7 | 150 | 5,1 | 5,1 | 5,1 | 5,1 |
| (60) | 7 | 50 | 7 | 150 | 5,8 | 5,8 | 5,7 | 5,7 |
| 65 | 7 | 50 | 7 | 200 | 6,7 | 6,7 | 6,6 | 6,6 |
| 80 | 7 | (60) | 7 | 200 | 7,7 | 7,5 | 7,4 | 7,4 |
| 80 | 7 | 65 | 7 | 200 | 8,1 | 7,9 | 7,8 | 7,8 |
| 100 | 7,2 | 80 | 7 | 200 | 9,4 | 9,3 | 9,8 | – |
| 125 | 7,5 | 100 | 7,2 | 200 | 11,3 | 11,3 | 12,5 | – |
| 150 | 7,8 | 125 | 7,5 | 200 | 14 | 14 | 15,5 | – |
| 200 | 8,4 | 150 | 7,8 | 300 | 22 | 21,5 | 25 | – |
| 250 | 9 | 200 | 8,4 | 300 | 30 | 29,5 | 35,5 | – |
| 300 | 9,6 | 250 | 9 | 300 | 40,5 | 39,5 | 49 | – |
| 350 | 10,2 | 300 | 9,6 | 300 | 49,5 | 52 | 66 | – |
| 400 | 10,8 | 350 | 10,2 | 300 | 58 | 67 | 86 | – |
| 500 | 12 | 400 | 10,8 | 600 | 110 | 130 | 153 | – |
| 600 | 13,2 | 500 | 12 | 600 | 149 | 190 | 216 | – |
| 700 | 14,4 | 600 | 13,2 | 600 | 195 | 236 | – | – |
| 800 | 15,6 | 700 | 14,4 | 600 | 250 | 285 | – | – |
| 900 | 16,8 | 800 | 15,6 | 600 | 308 | 352 | – | – |
| 1000 | 18 | 900 | 16,8 | 600 | 373 | 438 | – | – |

## 38 BLANK FLANGE PN 10

$b$ = { 10 + 0,035 DN, with a minimum value of 16, for DN 40 to 300; 10 + 0,025 DN, with a minimum value of 20,5, for DN 350 to 1200; 20 + 0,015 DN for DN 1400 to 2000

Symbol :

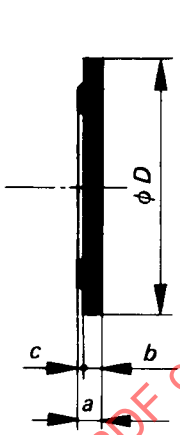



TABLE 34

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | $D$ | $a$ | $b$ | $c$ | Mass (approximate) |
|---|---|---|---|---|---|
| 40 | 150 | 19 | 16 | 3 | 2,0 |
| 50 | 165 | 19 | 16 | 3 | 2,4 |
| (60) | 175 | 19 | 16 | 3 | 2,7 |
| 65 | 185 | 19 | 16 | 3 | 3,1 |
| 80 | 200 | 19 | 16 | 3 | 3,6 |
| 100 | 220 | 19 | 16 | 3 | 4,3 |
| 125 | 250 | 19 | 16 | 3 | 5,6 |
| 150 | 285 | 19 | 16 | 3 | 7,2 |
| 200 | 340 | 20 | 17 | 3 | 11 |
| 250 | 400 | 22 | 19 | 3 | 16,9 |
| 300 | 455 | 24,5 | 20,5 | 4 | 24 |
| 350 | 505 | 24,5 | 20,5 | 4 | 29,5 |
| 400 | 565 | 24,5 | 20,5 | 4 | 36,5 |
| 500 | 670 | 26,5 | 22,5 | 4 | 56 |
| 600 | 780 | 30 | 25 | 5 | 85 |
| 700 | 895 | 32,5 | 27,5 | 5 | 123 |
| 800 | 1 015 | 35 | 30 | 5 | 172 |
| 900 | 1 115 | 37,5 | 32,5 | 5 | 224 |
| 1000 | 1 230 | 40 | 35 | 5 | 293 |
| 1200 | 1 455 | 45 | 40 | 5 | 575 |
| 1400 | 1 675 | 46 | 41 | 5 | 739 |
| 1600 | 1 915 | 49 | 44 | 5 | 1 239 |
| 1800 | 2 115 | 52 | 47 | 5 | 1 717 |
| 2000 | 2 325 | 55 | 50 | 5 | 2 272 |

NOTE — For flanges of nominal diameters ⩾ DN 350, the centre of blank flanges may be dished.

## 39 BLANK FLANGE PN 16

$b = \begin{cases} 10 + 0{,}035\ DN, \text{ with a minimum value of 16, for DN 40 to 1200} \\ 20 + 0{,}025\ DN \text{ for DN 1400 to 2000} \end{cases}$

Symbol :

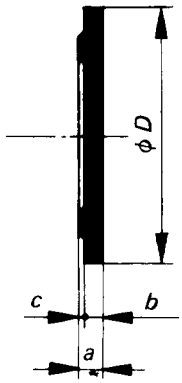



TABLE 35

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | D | a | b | c | Mass (approximate) |
|---|---|---|---|---|---|
| **40** | 150 | 19 | 16 | 3 | 2,0 |
| **50** | 165 | 19 | 16 | 3 | 2,4 |
| **(60)** | 175 | 19 | 16 | 3 | 2,7 |
| **65** | 185 | 19 | 16 | 3 | 3,1 |
| **80** | 200 | 19 | 16 | 3 | 3,5 |
| **100** | 220 | 19 | 16 | 3 | 4,3 |
| **125** | 250 | 19 | 16 | 3 | 5,6 |
| **150** | 285 | 19 | 16 | 3 | 7,2 |
| **200** | 340 | 20 | 17 | 3 | 10,8 |
| **250** | 400 | 22 | 19 | 3 | 16,6 |
| **300** | 455 | 24,5 | 20,5 | 4 | 23,5 |
| **350** | 520 | 26,5 | 22,5 | 4 | 33,5 |
| **400** | 580 | 28 | 24 | 4 | 44,5 |
| **500** | 715 | 31,5 | 27,5 | 4 | 77 |
| **600** | 840 | 36 | 31 | 5 | 121 |
| **700** | 910 | 39,5 | 34,5 | 5 | 156 |
| **800** | 1 025 | 43 | 38 | 5 | 218 |
| **900** | 1 125 | 46,5 | 41,5 | 5 | 286 |
| **1000** | 1 255 | 50 | 45 | 5 | 387 |
| **1200** | 1 485 | 57 | 52 | 5 | 662 |
| **1400** | 1 685 | 60 | 55 | 5 | 993 |
| **1600** | 1 930 | 65 | 60 | 5 | 1 462 |
| **1800** | 2 130 | 70 | 65 | 5 | 2 016 |
| **2000** | 2 345 | 75 | 70 | 5 | 2 660 |

NOTE — For flanges with nominal diameters ⩾ DN 350, the centre of blank flanges may be dished.

## 40 BLANK FLANGE PN 25

$b = 10 + 0{,}045\ DN$, with a minimum value of 16

Symbol :

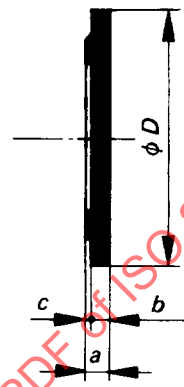



TABLE 36

Dimensions in millimetres — Masses in kilograms

| Nominal diameter DN | D | a | b | c | Mass (approximate) |
|---|---|---|---|---|---|
| **40** | 150 | 19 | 16 | 3 | 2,0 |
| **50** | 165 | 19 | 16 | 3 | 2,4 |
| **(60)** | 175 | 19 | 16 | 3 | 2,6 |
| **65** | 185 | 19 | 16 | 3 | 2,9 |
| **80** | 200 | 19 | 16 | 3 | 3,5 |
| **100** | 235 | 19 | 16 | 3 | 4,8 |
| **125** | 270 | 19 | 16 | 3 | 6,2 |
| **150** | 300 | 20 | 17 | 3 | 8,3 |
| **200** | 360 | 22 | 19 | 3 | 13,3 |
| **250** | 425 | 24,5 | 21,5 | 3 | 21 |
| **300** | 485 | 27,5 | 23,5 | 4 | 30 |
| **350** | 555 | 30 | 26 | 4 | 43,5 |
| **400** | 620 | 32 | 28 | 4 | 58 |
| **500** | 730 | 36,5 | 32,5 | 4 | 94 |
| **600** | 845 | 42 | 37 | 5 | 144 |