

### **13.2.4 Test piece for the tensile test on the weld**

The test piece for the tensile test on the weld shall be taken transverse to the weld with the weld at the centre of the test piece.

### **13.2.5 Test piece for the weld bend test**

The test pieces for the weld bend test at the root and face shall be taken and prepared in accordance with EN 910.

### **13.2.6 Test piece for the impact test**

Three standard Charpy V-notch test pieces in accordance with EN 10045-1 shall be prepared. If the specified thickness is such that standard test pieces cannot be produced without flattening of the section, then test pieces of width less than 10 mm, but not less than 5 mm shall be prepared, the largest obtainable width shall be used.

The test pieces shall be taken transverse (where possible) to the fitting axis unless  $D_{min}$ , as calculated by the following equation, is greater than the specified outside diameter, in which case longitudinal test pieces shall be used :

$$D_{min} = (T - 5) + [756,25/(T-5)]$$

where

$T$  is the specified wall thickness, in millimetres.

It is the responsibility of the purchaser to specify the location of the impacting testing e.g. base material, HAZ, weld.

**Option 17:** *Impact test transverse to the weld in the HAZ or in the weld shall be specified.*

### **13.2.7 Test piece for the intergranular corrosion test**

The test piece for the intergranular corrosion test shall be taken in accordance with the requirements of EN ISO 3651-2.

## **14 Test methods**

### **14.1 Chemical analysis**

The elements to be determined and reported shall be those in table 2 or 3 in accordance with the steel grade concerned.

### **14.2 Tensile test on the base material**

#### **14.2.1 At room temperature**

The test shall be carried out at room temperature in accordance with EN 10002-1, and the following shall be determined:

- the tensile strength ( $R_m$ );
- the 0,2 % proof strength ( $R_{p0,2}$ ) and where applicable, the 1,0 % proof strength ( $R_{p1,0}$ );
- the percentage elongation after fracture with a reference to a gauge length ( $L_0$ ) of  $5,65 \sqrt{S_0}$ ; if a non proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length  $L_0 = 5,65 \sqrt{S_0}$  using the conversion tables in EN ISO 2566-1.

For fittings with OD ≤ 100 mm hardness testing shall be performed on 10 % of the fittings, at least on 3 items. For these fittings tensile strength, proof strength and percentage elongation after fracture of the starting material shall be reported to the purchaser.

On cold formed fittings of OD < 100 mm which have not received additional heat treatment, tensile testing may be replaced by a ring expanding test in accordance with EN 10234. To equate to the minimum post cold forming residual elongation "A", an expansion rate of 20 % must be achieved and confirmed on at least 1 fitting per test unit.

#### 14.2.2 At elevated temperature

The test shall be carried out in accordance with EN 10002-5 at the temperature agreed in the order, and the 0,2 % proof strength ( $R_{p0,2}$ ) and, where applicable , the 1,0 % proof strength ( $R_{p1,0}$ ) shall be determined.

### 14.3 Transverse tensile test on the weld

The test shall be carried out in accordance with EN 10002-1 at room temperature and the tensile strength ( $R_m$ ) shall be determined.

### 14.4 Weld bend test

The test shall be carried out in accordance with EN 910 using a mandrel of a diameter of 3T. After testing the test piece shall show no cracks or flaws but slight premature failure at its edges shall not be regarded as a justification for rejection.

NOTE This test is only applicable for fittings made from sheet/plate or strip where welding is a part of the production.

### 14.5 Impact testing

**14.5.1** The test shall be carried out in accordance with EN 10045-1 at the temperature agreed in the applicable option.

**14.5.2** The mean value of the three test pieces shall meet the specified minimum average value given in Table 5 or 6 for the steel grade concerned. One individual value may be below the specified value, provided that it is not less than 70 % of that value.

**14.5.3** If the width ( $W$ ) of the test piece is less than 10 mm, the measured impact energy ( $KVp$ ) shall be converted to impact energy ( $KVc$ ) using the equation:

$$KVc = 10 \times KVp/W$$

where

$KVc$  is the calculated impact energy, in joules;

$KVp$  is the measured impact energy, in joules;

$W$  is the width of the test piece.

The calculated impact energy  $KVc$  shall comply with the requirements given in 14.5.2.

**14.5.4** If the requirement of 14.5.2 is not met, then an additional set of three test pieces may be taken at the discretion of the manufacturer from the same sample and tested. To consider the test unit as complying, after testing the second test, following conditions shall be satisfied:

- the average value of six test shall be equal to or greater than the specified minimum average value;
- not more than two of six individual values may be lower than the specified minimum average value;

— not more than one of six values may be lower than 70 % of the specified minimum average value.

**14.5.5** The measured energy values and the resulting average value shall be reported.

## **14.6 Intergranular corrosion test**

The intergranular corrosion test shall be carried out in accordance with EN ISO 3651-2.

## **14.7 Dimensional testing**

The dimension of the fittings shall conform to the requirement stated in 11.1, 11.2, 11.3 and 11.4. It is the manufacturers responsibility to decide, frequency of testing.

## **14.8 Visual inspection**

Fittings shall be visually examined and shall conform to the requirements stated in clause 10. It is the responsibility of the manufacturers to decide, frequency of inspection.

## **14.9 Non destructive testing**

### **14.9.1 Personnel**

Level 1 and 2 personnel and NDT operations shall be authorised by a level 3 individual and approved by the employer and certified in accordance with EN 473.

### **14.9.2 NDT of the weld**

All weld seams on fittings shall be non-destructively tested either prior to or after forming.

The manufacturer shall demonstrate full traceability to each individual fitting.

Following methods of examination can be used :

- radiographic examination ;
- eddy current examination for fittings with wall thickness not greater than 6 mm ;
- ultrasonic examination.

**Option 18:** *Liquid penetrant examinations of welds and weld ends.*

**Option 19:** *Liquid penetrant examination of surfaces, extent shall be specified at the time of enquiry and order.*

**Option 20:** *Ultrasonic testing of strip or plates used for the manufacture of fittings, for the detection of laminar imperfections.*

## **14.10 Material identification**

Each fitting shall be tested by an appropriate method to assure that the correct grade is being supplied.

## **14.11 Optional tests**

These tests are carried out if agreed at the time of enquiry and order and in accordance with Table 11.

## 15 Marking

### 15.1 Marking to be applied

The marking shall include the following minimum information:

- the manufacturer's mark or trade mark;
- the number of this European Standard: EN 10253-4;
- "A" or "B" for the type of fitting;
- the steel name or number;
- the cast number or a code number which shows the correlation with the inspection document;
- outside diameter D;
- wall thickness T;
- the mark of the inspection representative ; it may be omitted if the relevant inspector can be identified in another way;
- the country of forming shall be mentioned in the inspection certificate (12.2.2) and/or marked on the fitting.

For reducing tees or reducers, the marking shall include D 1 and T 1.

**Option 21:** *Additional marking and methods of marking, as agreed upon the time of enquiry or order shall be applied.*

Methods of marking may be e.g.:

- ink jet marking;
- electrochemical etching;
- fibro-marking;
- laser marking.

## 16 Handling and packaging

The fittings are supplied in the manufacturers normal packaging and without any protective coating or end plugs.

**Option 22:** *Special packaging, coating or end plugs as agreed at the time of enquiry or order shall be applied.*

## Annex A

(informative)

### Specific dimensions of fittings

The specific dimensions of fittings listed below are based on ISO 5251 and ISO 3419.

**Table A.1 — Below is specific dimensions for elbows with bending radius R~1 D, R~1,5 D and R~2,5 D listed**

| DN   | D<br>mm | R~ D    |         |         | R~1,5 D |         |         | R~2,5 D |
|------|---------|---------|---------|---------|---------|---------|---------|---------|
|      |         | F<br>mm | C<br>mm | B<br>mm | F<br>mm | C<br>mm | B<br>mm | F<br>mm |
| 15   | 21,3    |         |         |         | 28      | 56      | 38      | 45      |
| 20   | 26,9    |         |         |         | 29      | 58      | 43      | 57      |
| 25   | 33,7    |         |         |         | 38      | 76      | 55      | 72      |
| 32   | 42,4    |         |         |         | 48      | 96      | 69      | 93      |
| 40   | 48,3    |         |         |         | 57      | 114     | 81      | 108     |
| 50   | 60,3    | 51      | 102     | 81      | 76      | 152     | 106     | 135     |
| 65   | 76,1    | 63      | 127     | 102     | 95      | 190     | 133     | 175     |
| 80   | 88,9    | 76      | 152     | 121     | 114     | 228     | 159     | 205     |
| 100  | 114,3   | 102     | 203     | 159     | 152     | 304     | 209     | 270     |
| 125  | 139,7   | 127     | 254     | 197     | 190     | 380     | 260     | 330     |
| 150  | 168,3   | 152     | 305     | 237     | 229     | 458     | 313     | 390     |
| 200  | 219,1   | 203     | 406     | 313     | 305     | 610     | 414     | 510     |
| 250  | 273,0   | 254     | 508     | 391     | 381     | 762     | 518     | 650     |
| 300  | 323,9   | 305     | 610     | 467     | 457     | 914     | 619     | 775     |
| 350  | 355,6   | 356     | 711     | 533     | 533     | 1066    | 711     | 850     |
| 400  | 406,4   | 406     | 813     | 610     | 610     | 1220    | 813     | 970     |
| 450  | 457,0   | 457     | 914     | 686     | 686     | 1372    | 914     | 1122    |
| 500  | 508,0   | 508     | 1016    | 762     | 762     | 1524    | 1016    | 1245    |
| 600  | 610,0   | 610     | 1220    | 914     | 914     | 1828    | 1219    | 1524    |
| 700  | 711,0   |         |         |         | 1067    | 2134    | 1422    | 1778    |
| 800  | 813,0   |         |         |         | 1219    | 2438    | 1625    | 2033    |
| 900  | 914,0   |         |         |         | 1372    | 2744    | 1829    | 2285    |
| 1000 | 1016,0  |         |         |         | 1524    | 3048    | 2032    | 2540    |

**Table A.2 — Below is specific dimensions for tees, equal and reduced listed.**

| <b>DN</b> | <b>D<br/>mm</b> | <b>DN1</b> | <b>D1<br/>mm</b> | <b>F<br/>mm</b> | <b>G<br/>mm</b> | <b>DN</b> | <b>D<br/>mm</b> | <b>DN1</b> | <b>D1<br/>mm</b> | <b>F<br/>mm</b> | <b>G<br/>mm</b> |
|-----------|-----------------|------------|------------------|-----------------|-----------------|-----------|-----------------|------------|------------------|-----------------|-----------------|
| 15        | 21,3            | 15         | 21,3             | 25              | -               | 300       | 323,9           | 300        | 323,9            | 254             | -               |
| 20        | 26,9            | 20         | 26,9             | 29              | -               |           |                 | 250        | 273              |                 | 241             |
|           |                 | 15         | 21,3             |                 | 29              |           |                 | 200        | 219,1            |                 | 229             |
| 25        | 33,7            | 25         | 33,7             | 38              | -               |           |                 | 150        | 168,3            |                 | 219             |
|           |                 | 20         | 26,9             |                 | 38              | 350       | 355,6           | 350        | 355,6            | 279             | -               |
|           |                 | 15         | 21,3             |                 | 38              |           |                 | 300        | 323,9            |                 | 270             |
| 32        | 42,4            | 32         | 42,4             | 48              | -               |           |                 | 250        | 273              |                 | 257             |
|           |                 | 25         | 33,7             |                 | 48              |           |                 | 200        | 219,1            |                 | 248             |
|           |                 | 20         | 26,9             |                 | 48              | 400       | 406,4           | 400        | 406,4            | 305             | -               |
|           |                 | 15         | 21,3             |                 | 48              |           |                 | 350        | 355,6            |                 | 305             |
| 40        | 48,3            | 40         | 48,3             | 57              | -               |           |                 | 300        | 323,9            |                 | 295             |
|           |                 | 32         | 42,4             |                 | 57              |           |                 | 250        | 273              |                 | 283             |
|           |                 | 25         | 33,7             |                 | 57              | 450       | 457             | 450        | 457              | 343             | -               |
|           |                 | 20         | 26,9             |                 | 57              |           |                 | 400        | 406,4            |                 | 330             |
| 50        | 60,3            | 50         | 60,3             | 64              | -               |           |                 | 350        | 355,6            |                 | 330             |
|           |                 | 40         | 48,3             |                 | 60              |           |                 | 300        | 323,9            |                 | 321             |
|           |                 | 32         | 42,4             |                 | 57              | 500       | 508             | 500        | 508              | 381             | -               |
|           |                 | 25         | 33,7             |                 | 51              |           |                 | 450        | 457              |                 | 368             |
| 65        | 76,1            | 65         | 76,1             | 76              | -               |           |                 | 400        | 406,4            |                 | 356             |
|           |                 | 50         | 60,3             |                 | 70              |           |                 | 350        | 355,6            |                 | 356             |
|           |                 | 40         | 48,3             |                 | 67              | 600       | 610             | 600        | 610              | 432             | -               |
|           |                 | 32         | 42,4             |                 | 64              |           |                 | 500        | 508              |                 | 432             |
| 80        | 88,9            | 80         | 88,9             | 86              | -               |           |                 | 450        | 457              |                 | 419             |
|           |                 | 65         | 76,1             |                 | 83              |           |                 | 400        | 406,4            |                 | 406             |
|           |                 | 50         | 60,3             |                 | 76              | 700       | 711             | 700        | 711              | 521             | -               |
|           |                 | 40         | 48,3             |                 | 73              |           |                 | 800        | 813              |                 | 597             |
| 100       | 114,3           | 100        | 114,3            | 105             | -               | 900       | 914             | 900        | 914              | 673             | -               |
|           |                 | 80         | 88,9             |                 | 98              | 1000      | 1016            | 1000       | 1016             | 749             | -               |
|           |                 | 65         | 76,1             |                 | 95              |           |                 |            |                  |                 |                 |
|           |                 | 50         | 60,3             |                 | 89              |           |                 |            |                  |                 |                 |
| 125       | 139,7           | 125        | 139,7            | 124             | -               |           |                 |            |                  |                 |                 |
|           |                 | 100        | 114,3            |                 | 117             |           |                 |            |                  |                 |                 |
|           |                 | 80         | 88,9             |                 | 111             |           |                 |            |                  |                 |                 |
|           |                 | 65         | 76,1             |                 | 108             |           |                 |            |                  |                 |                 |
| 150       | 168,3           | 150        | 168,3            | 143             | -               |           |                 |            |                  |                 |                 |
|           |                 | 125        | 139,7            |                 | 137             |           |                 |            |                  |                 |                 |
|           |                 | 100        | 114,3            |                 | 130             |           |                 |            |                  |                 |                 |
|           |                 | 80         | 88,9             |                 | 124             |           |                 |            |                  |                 |                 |
| 200       | 219,1           | 200        | 219,1            | 178             | -               |           |                 |            |                  |                 |                 |
|           |                 | 150        | 168,3            |                 | 168             |           |                 |            |                  |                 |                 |
|           |                 | 125        | 139,7            |                 | 162             |           |                 |            |                  |                 |                 |
|           |                 | 100        | 114,3            |                 | 156             |           |                 |            |                  |                 |                 |
| 250       | 273             | 250        | 273              | 216             | -               |           |                 |            |                  |                 |                 |
|           |                 | 200        | 219,1            |                 | 203             |           |                 |            |                  |                 |                 |
|           |                 | 150        | 168,3            |                 | 194             |           |                 |            |                  |                 |                 |
|           |                 | 125        | 139,7            |                 | 191             |           |                 |            |                  |                 |                 |

**Table A.3 — Below is specific dimensions for reducers, concentric and eccentric listed**

| <b>DN</b> | <b>D<br/>mm</b> | <b>DN1</b> | <b>D1<br/>mm</b> | <b>L<br/>mm</b> | <b>DN</b> | <b>D<br/>mm</b> | <b>DN1</b> | <b>D1<br/>mm</b> | <b>L<br/>mm</b> |
|-----------|-----------------|------------|------------------|-----------------|-----------|-----------------|------------|------------------|-----------------|
| 20        | 26,9            | 15         | 21,3             | 38              | 450       | 457             | 400        | 406,4            | 381             |
| 25        | 33,7            | 20         | 26,9             | 51              |           |                 | 350        | 355,6            |                 |
|           |                 | 15         | 21,3             |                 |           |                 | 300        | 323,9            |                 |
| 32        | 42,4            | 25         | 33,7             | 51              | 500       | 508             | 450        | 457              | 508             |
|           |                 | 20         | 26,9             |                 |           |                 | 400        | 406,4            |                 |
|           |                 | 15         | 21,3             |                 |           |                 | 350        | 355,6            |                 |
| 40        | 48,3            | 32         | 42,4             | 64              | 600       | 610             | 500        | 508              | 508             |
|           |                 | 25         | 33,7             |                 |           |                 | 450        | 457              |                 |
|           |                 | 20         | 26,9             |                 |           |                 | 400        | 406,4            |                 |
| 50        | 60,3            | 40         | 48,3             | 76              | 700       | 711             | 600        | 610              | 610             |
|           |                 | 32         | 42,4             |                 |           |                 | 500        | 508              |                 |
|           |                 | 25         | 33,7             |                 |           |                 | 450        | 457              |                 |
| 65        | 76,1            | 50         | 60,3             | 89              | 800       | 813             | 700        | 711              | 610             |
|           |                 | 40         | 48,3             |                 |           |                 | 600        | 610              |                 |
|           |                 | 32         | 42,4             |                 |           |                 | 500        | 508              |                 |
| 80        | 88,9            | 65         | 76,1             | 89              | 900       | 914             | 800        | 813              | 610             |
|           |                 | 50         | 60,3             |                 |           |                 | 700        | 711              |                 |
|           |                 | 40         | 48,3             |                 |           |                 | 600        | 610              |                 |
| 100       | 114,3           | 80         | 88,9             | 102             | 1000      | 1016            | 900        | 914              | 610             |
|           |                 | 65         | 76,1             |                 |           |                 | 800        | 813              |                 |
|           |                 | 50         | 60,3             |                 |           |                 | 700        | 711              |                 |
| 125       | 139,7           | 100        | 114,3            | 127             |           |                 |            |                  |                 |
|           |                 | 80         | 88,9             |                 |           |                 |            |                  |                 |
|           |                 | 65         | 76,1             |                 |           |                 |            |                  |                 |
| 150       | 168,3           | 125        | 139,7            | 140             |           |                 |            |                  |                 |
|           |                 | 100        | 114,3            |                 |           |                 |            |                  |                 |
|           |                 | 80         | 88,9             |                 |           |                 |            |                  |                 |
| 200       | 219,1           | 150        | 168,3            | 152             |           |                 |            |                  |                 |
|           |                 | 125        | 139,7            |                 |           |                 |            |                  |                 |
|           |                 | 100        | 114,3            |                 |           |                 |            |                  |                 |
| 250       | 273             | 200        | 219,1            | 178             |           |                 |            |                  |                 |
|           |                 | 150        | 168,3            |                 |           |                 |            |                  |                 |
|           |                 | 125        | 139,7            |                 |           |                 |            |                  |                 |
| 300       | 323,9           | 250        | 273              | 203             |           |                 |            |                  |                 |
|           |                 | 200        | 219,1            |                 |           |                 |            |                  |                 |
|           |                 | 150        | 168,3            |                 |           |                 |            |                  |                 |
| 350       | 355,6           | 300        | 323,9            | 330             |           |                 |            |                  |                 |
|           |                 | 250        | 273              |                 |           |                 |            |                  |                 |
|           |                 | 200        | 219,1            |                 |           |                 |            |                  |                 |
| 400       | 406,4           | 350        | 355,6            | 356             |           |                 |            |                  |                 |
|           |                 | 300        | 323,9            |                 |           |                 |            |                  |                 |
|           |                 | 250        | 273              |                 |           |                 |            |                  |                 |

**Table A.4 — Below is specific dimensions for caps listed**

| <b>DN</b> | <b>D<br/>mm</b> | <b>K<sub>2</sub><br/>mm</b> |
|-----------|-----------------|-----------------------------|
| 15        | 21,3            | 25,0                        |
| 20        | 26,9            | 25,0                        |
| 25        | 33,7            | 38,0                        |
| 32        | 42,4            | 38,0                        |
| 40        | 48,3            | 38,0                        |
| 50        | 60,3            | 38,0                        |
| 65        | 76,1            | 38,0                        |
| 80        | 88,9            | 51,0                        |
| 100       | 114,3           | 64,0                        |
| 125       | 139,7           | 76,0                        |
| 150       | 168,3           | 89,0                        |
| 200       | 219,1           | 102,0                       |
| 250       | 273,0           | 127,0                       |
| 300       | 323,9           | 152,0                       |
| 350       | 355,6           | 165,0                       |
| 400       | 406,4           | 178,0                       |
| 450       | 457,0           | 203,0                       |
| 500       | 508,0           | 229,0                       |
| 600       | 610,0           | 267,0                       |
| 700       | 711,0           | 267,0                       |
| 800       | 813,0           | 267,0                       |
| 900       | 914,0           | 267,0                       |
| 1000      | 1016,0          | 305,0                       |

## Annex B (informative)

### Determination of wall thickness

#### B.1 General

Annex B defines wall thickness requirements of fittings. This is done by establishing appropriate calculation procedures in detail.

The wall thicknesses are established so that the fittings will, in general, withstand the same pressure as a straight pipe with the same dimensions (diameter, wall thickness, wall thickness tolerance) and material. Wall thickness tolerance of this corresponding pipe is assumed to be the same as the wall thickness tolerances at the welding ends of the fitting.

**NOTE** The calculation procedures are based on the design rules laid down in EN 13480-3:2002 and EN 13445-3:2002.

#### B.2 Symbols and units

For the purposes of annex B and C, the symbols given in Table B.1 shall apply in addition to those given in clause 4.

**Table B.1 — Additional symbols for the purposes of annexes B and C**

| Symbol        | Description   |
|---------------|---|
| $A_f$         | Stress loaded cross sectional area (calculation of tee)   |
| $A_p$         | Pressure loaded area (calculation of tee)   |
| $D_s$         | Outside diameter at the body of the run of a tee  |
| $D_b$         | Outside diameter at the body of the branch of a tee   |
| $l_s$         | Reinforcing length of run (calculation of tee)  |
| $l_b$         | Reinforcing length of branch (calculation of tee)   |
| $L2_{min}$    | Minimum length of cylindrical part at the large end of a reducer  |
| $L4_{min}$    | Minimum length of cylindrical part at the small end of a reducer  |
| $r$           | Bending radius of elbows and return bends referring to the internal diameter  |
| $r_c$         | Crotch radius of a tee  |
| $T_{min}$     | Minimum wall thickness at the welding ends for elbows, return bends and equal tees or on the D end for reducers and reducing tees |
| $T1_{min}$    | Minimum wall thickness at the D1 welding end of reducers and reducing tees,   |
| $T_{ext}$     | Wall thickness at the extrados of an elbow (including tolerances)   |
| $T_{int}$     | Wall thickness at the intrados of an elbow (including tolerances)   |
| $T_{min,ext}$ | Minimum wall thickness at the extrados of an elbow  |
| $T_{min,int}$ | Minimum wall thickness at the intrados of an elbow  |
| $T_s$         | Wall thickness at the run of a tee  |

|                           |  |
|---------------------------|--|
| $T_{s,min}$               | Minimum wall thickness at the run of a tee                                   |
| $T_b$                     | Wall thickness at the branch of a tee  |
| $T_{b,min}$               | Minimum wall thickness at the branch of a tee                                |
| $T_{c,min}$               | Minimum wall thickness at the crotch zone of a tee                           |
| $T_{co,min}$              | Minimum wall thickness of a cone   |
| $T_2$                     | Wall thickness of the cylindrical part of a reducer at its large end         |
| $T_{2,min}$               | Minimum wall thickness of the cylindrical part of a reducer at its large end |
| $T_3$                     | Wall thickness of the conical part of a reducer                              |
| $T_{3,min}$               | Minimum wall thickness of the conical part of a reducer                      |
| $T_4$                     | Wall thickness of the cylindrical part of a reducer at its small end         |
| $T_{4,min}$               | Minimum wall thickness of the cylindrical part of a reducer at its small end |
| $\alpha$                  | Semi angle of reducer  |
| $\beta, \beta_H, s, \tau$ | Factors (calculation of reducer)   |

### B.3 Minimal and nominal wall thickness

The design rules given in EN 13480-3 and EN 13445-3 are based on minimal required wall thicknesses. Therefore, in a first step these minimal wall thickness have to be derived from the nominal wall thickness of the fitting. Taking into account the negative tolerances given in Table 9 the minimal wall thickness are calculated:

$$T_{min} = \begin{cases} T \cdot (100 - 12,5) / 100 & \text{if } D \leq 610 \text{ mm} \\ T - 0,35 \text{ mm} & \text{if } D > 610 \text{ mm and } T \leq 10 \text{ mm} \\ T - 0,5 \text{ mm} & \text{if } D > 610 \text{ mm and } T > 10 \text{ mm} \end{cases} \quad (\text{B.1})$$

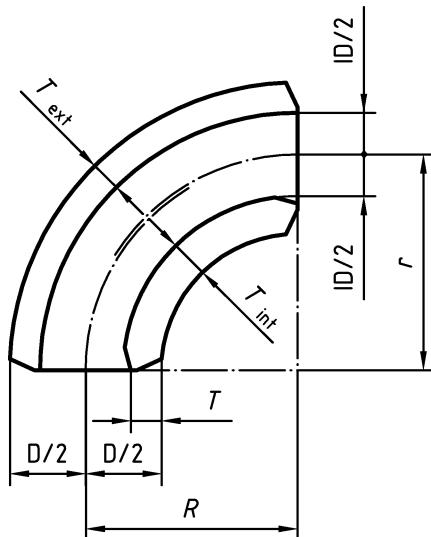
To obtain a wall thickness including wall thickness tolerances from a minimal wall thickness the following equation is used :

$$T = \begin{cases} T_{min} \cdot 100 / (100 - 12,5) & \text{if } D \leq 610 \text{ mm} \\ T_{min} + 0,35 \text{ mm} & \text{if } D > 610 \text{ mm and } T \leq 9,65 \text{ mm} \\ T_{min} + 0,5 \text{ mm} & \text{if } D > 610 \text{ mm and } T > 9,65 \text{ mm} \end{cases} \quad (\text{B.2})$$

If other tolerances are specified for the fitting, these values have to be used in above formulas.

### B.4 Elbows

Wall thicknesses and other dimension of an elbow are illustrated in Figure B.1.

**Figure B.1 — Elbow**

The wall thickness at the intrados of an elbow shall be calculated :

$$T_{\min,int} = T_{\min} \cdot \left( \frac{D}{2 \cdot T_{\min}} + \frac{r}{T_{\min}} - \left( \frac{D}{2 \cdot T_{\min}} + \frac{r}{T_{\min}} - 1 \right) \cdot \sqrt{\frac{\left( \frac{r}{T_{\min}} \right)^2 - \left( \frac{D}{2 \cdot T_{\min}} \right)^2}{\left( \frac{r}{T_{\min}} \right)^2 - \frac{D}{2 \cdot T_{\min}} \cdot \left( \frac{D}{2 \cdot T_{\min}} - 1 \right)}} \right) \quad (B.3)$$

where

$$\frac{r}{T_{\min}} = \sqrt{\frac{1}{2} \cdot \left\{ \left( \frac{D}{2 \cdot T_{\min}} \right)^2 + \left( \frac{R}{T_{\min}} \right)^2 \right\} + \sqrt{\frac{1}{4} \cdot \left( \left( \frac{D}{2 \cdot T_{\min}} \right)^2 + \left( \frac{R}{T_{\min}} \right)^2 \right)^2 - \left( \frac{D}{2 \cdot T_{\min}} \right) \cdot \left( \frac{D}{2 \cdot T_{\min}} - 1 \right) \cdot \left( \frac{R}{T_{\min}} \right)^2}} \quad (B.4)$$

The wall thickness at the extrados of an elbow shall be equal to the wall thickness of the corresponding pipe :

$$T_{\min,ext} = T_{\min} \quad (B.5)$$

**NOTE** Setting  $T_{\min, ext} = T_{\min}$  ensures that the design requirements of EN 13480-3 and EN 13445-3 are met for all corrosion/erosion allowances.

**NOTE** Formulas (B.3) and (B.4) are given in EN 13480-3 :2002 as (B.4.1-3) and (B.4.1-4).

Example :

Wall thicknesses of an elbow 1D 711 x 7.1.

R = 711 mm

$$(B.1) : T_{\min} = 7,1 \text{ mm} - 0,35 \text{ mm} = 6,75 \text{ mm}$$

$$(B.4) : r / T_{\min} = 105,66$$

$$(B.3) : T_{\min,int} = 10,07 \text{ mm}$$

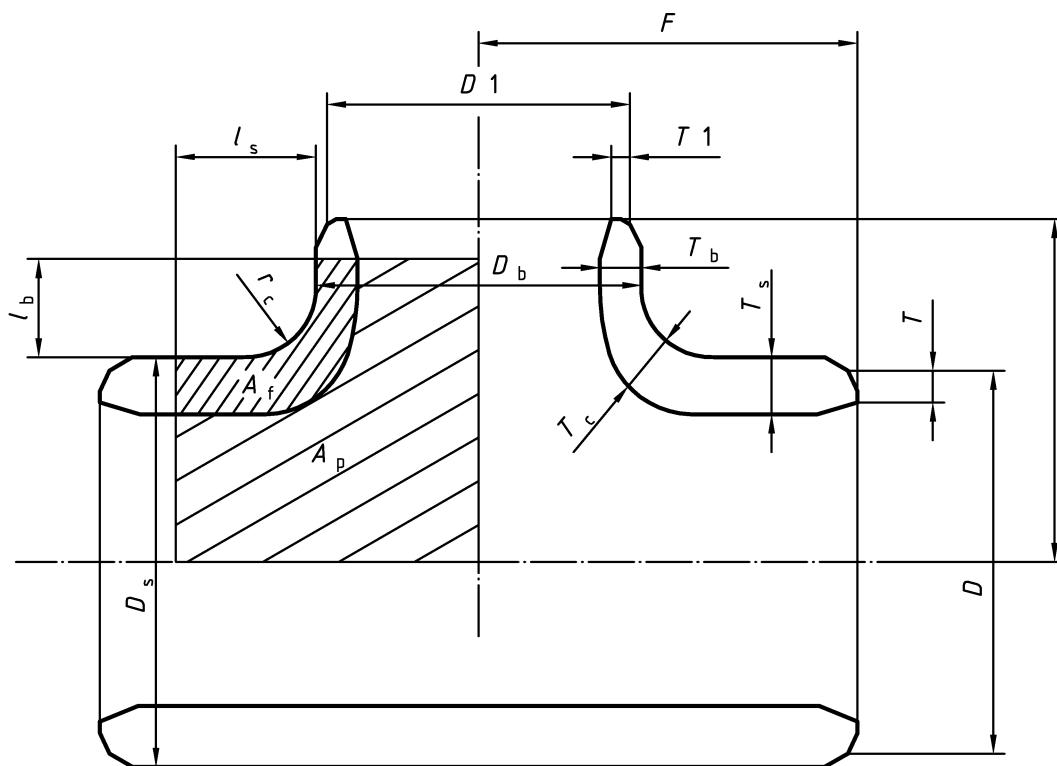
$$(B.5) : T_{\min,ext} = 6,75 \text{ mm}$$

Wall thicknesses including tolerances are :

$$(B.2) : \quad T_{\text{int}} = 10,07 \text{ mm} + 0,5 \text{ mm} = 10,57 \text{ mm}, \\ T_{\text{ext}} = 6,75 + 0,35 \text{ mm} = 7,1 \text{ mm}$$

## B.5 Tees

The wall thickness of tees cannot be calculated directly, but shall be assumed in a first step. This assumption shall then be verified by means of the method described. This method leads to a relationship between the pressure loaded area  $A_p$  and the stress loaded cross section area  $A_f$  shown in Figure B.2. Under certain circumstances, the calculation may need to be repeated using an improved assumption of the wall thickness.



**Figure B.2 — Dimensions and areas  $A_p$  and  $A_f$  of a tee**

For the tee the following condition shall apply:

$$\frac{A_p}{A_f} \leq \max \left( \frac{D - 2 \cdot T_{\min}}{2 \cdot T_{\min}}, \frac{D_1 - 2 \cdot T_{1\min}}{2 \cdot T_{1\min}} \right) \quad (B.5)$$

The reinforcing lengths are calculated:

$$l_s = \min \left( \sqrt{(D_s - T_{s,\min}) \cdot T_{s,\min}}, F - \frac{D_b}{2} - T_{\min} \right) \quad (B.6)$$

$$l_b = \min \left( \sqrt{(D_b - T_{b,\min}) \cdot T_{b,\min}}, G - \frac{D_s}{2} - T_{1\min} \right) \quad (B.7)$$

Additionally, the wall thicknesses shall satisfy the condition

$$\frac{T_{b,\min}}{T_{s,\min}} \leq \begin{cases} 2 & \text{if } \frac{(D_b - 2 \cdot T_{b,\min})}{(D_s - 2 \cdot T_{s,\min})} \leq 0,3 \\ 2,6 - 2 \cdot \frac{(D_b - 2 \cdot T_{b,\min})}{(D_s - 2 \cdot T_{s,\min})} & \text{if } 0,3 < \frac{(D_b - 2 \cdot T_{b,\min})}{(D_s - 2 \cdot T_{s,\min})} < 0,8 \\ 1 & \text{if } \frac{(D_b - 2 \cdot T_{b,\min})}{(D_s - 2 \cdot T_{s,\min})} \geq 0,8 \end{cases} \quad (\text{B.8})$$

NOTE Formula (B.5) is derived from (8.4.3-3) and (6.1-3) of EN 13480-3,  
 Formulas (B.6) and (A-7) are based on (8.4.1-2) and (8.4.3-1) of EN 13480-3,  
 Formula (B.8) is based on Figure 8.3.1-1 of EN 13480-3.

Example :

Wall thicknesses of a reducing tee 813 x 5.6 – 508 x 4.0  
 with the geometry  $D_s = D$ ,  $D_b = D_1$ ,  $r_c = 95$  mm and  $T_{c,\min} = (T_{s,\min} + T_{b,\min}) / 2$ .

$F = 597$  mm,  $G = 533$  mm.

Assumed wall thicknesses to be checked :  $T_s = 16,0$  mm,  $T_b = 13,3$  mm

$$\begin{aligned} (8-1) : \quad T_{\min} &= 5,6 \text{ mm} - 0,35 \text{ mm} = 5,25 \text{ mm} \\ T_{1\min} &= 4,0 \text{ mm} * (100 - 12,5) / 100 = 3,50 \text{ mm} \\ T_{s,\min} &= 16,0 \text{ mm} - 0,5 \text{ mm} = 15,5 \text{ mm}, \\ T_{b,\min} &= 13,3 \text{ mm} * (100 - 12,5) / 100 = 11,64 \text{ mm} \\ T_{c,\min} &= (15,5 \text{ mm} + 11,64 \text{ mm}) / 2 = 13,57 \text{ mm} \end{aligned}$$

$$(8-6) : \quad l_s = 111,18 \text{ mm}$$

$$(8-7) : \quad l_b = 76,01 \text{ mm}$$

For the calculation of areas  $A_f$  and  $A_p$  see Figure B.3.

$$\alpha_s = \arcsin\left(\max\left(\frac{r_c - l_s}{r_c}, 0\right)\right) = 0^\circ$$

$$\alpha_b = \arcsin\left(\max\left(\frac{r_c - l_b}{r_c}, 0\right)\right) = 11,53^\circ$$

$$T_{sc,\min} = \frac{45^\circ - \alpha_s}{45^\circ} \cdot T_{s,\min} + \frac{\alpha_s}{45^\circ} \cdot T_{c,\min} = 15,5 \text{ mm}$$

$$T_{bc,\min} = \frac{45^\circ - \alpha_b}{45^\circ} \cdot T_{b,\min} + \frac{\alpha_b}{45^\circ} \cdot T_{c,\min} = 12,13 \text{ mm}$$

$$A_{fs} = \max(l_s - r_c, 0) \cdot T_{s,\min} = 250,79 \text{ mm}^2$$

$$A_{fsc} = \left( \left( r_c + \frac{T_{sc,\min} + T_{c,\min}}{2} \right)^2 - r_c^2 \right) \pi \cdot \frac{45^\circ - \alpha_s}{360^\circ} + T_{sc,\min}^2 \cdot \frac{\tan(\alpha_s)}{2} = 1167,46 \text{ mm}^2$$

$$A_{fbc} = \left( \left( r_c + \frac{T_{bc,\min} + T_{c,\min}}{2} \right)^2 - r_c^2 \right) \pi \cdot \frac{45^\circ - \alpha_b}{360^\circ} + T_{bc,\min}^2 \cdot \frac{\tan(\alpha_b)}{2} = 776,35 \text{ mm}^2$$

$$A_{fb} = \max(l_b - r_c, 0) \cdot T_{s,\min} = 0 \text{ mm}^2$$

$$A_f = A_{fs} + A_{fsc} + A_{fbc} + A_{fb} = 2194,60 \text{ mm}^2$$

$$A_{psc} = r_c^2 \cdot \left( \frac{1}{2} \cdot (1 - \sin(\alpha_s))^2 - \pi \cdot \frac{45^\circ - \alpha_s}{360^\circ} + \frac{1}{2} \sin(\alpha_s) (\cos(\alpha_s) - \sin(\alpha_s)) \right) = 968,39 \text{ mm}^2$$

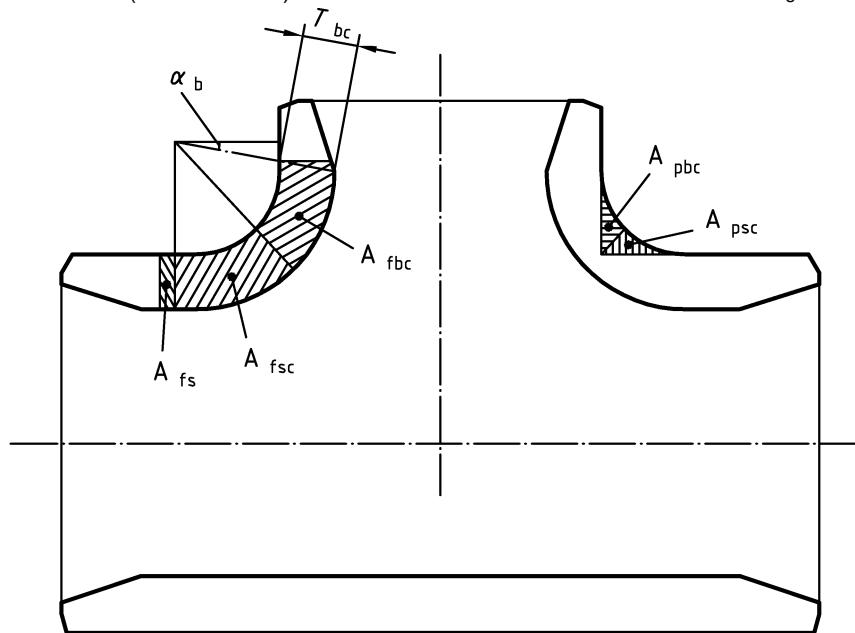
$$A_{pbc} = r_c^2 \cdot \left( \frac{1}{2} (1 - \sin(\alpha_b))^2 - \pi \cdot \frac{45^\circ - \alpha_b}{360^\circ} + \frac{1}{2} \sin(\alpha_b) (\cos(\alpha_b) - \sin(\alpha_b)) \right) = 956,31 \text{ mm}^2$$

$$A_p = \left( \frac{D_1 + l_s}{2} \right) \left( \frac{D}{2} + l_b \right) - l_s l_b + A_{psc} + A_{psb} - A_f = 167482,31 \text{ mm}^2$$

$$\frac{A_p}{A_f} = 76,31$$

$$\max\left(\frac{D-2T_{min}}{2T_{min}}, \frac{D_1-2T_{1min}}{2T_{1min}}\right) = 76,43$$

Inequation (8-5) is satisfied ( $76,31 \leq 76,43$ ) and therefore the assumed wall thicknesses  $T_s$  and  $T_b$  are acceptable.



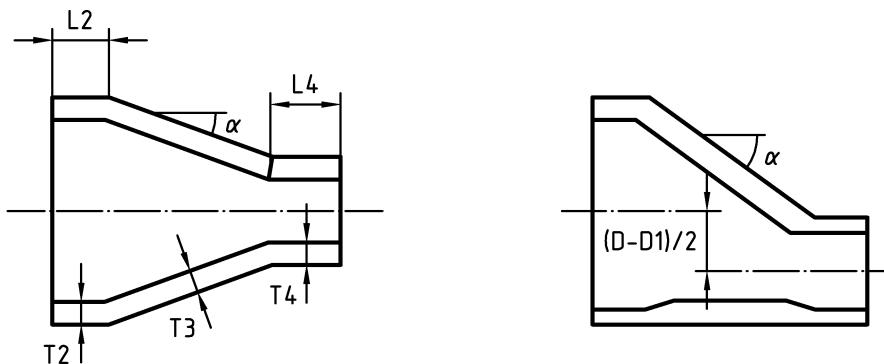
**Figure B.3 — Additional dimensions and areas used in the calculation  $A_p$  and  $A_f$  of a tee**

## B.6 Reducers

In general the wall thickness of the conical part of the reducer can be calculated easily.

Though, for small ratios of wall thickness to diameter additional reinforcement at the ends of the cone and the cylindrical parts are necessary. These reinforcements cannot be calculated directly, but have to be determined by iteration.

Wall thicknesses and other dimension of a reducer are illustrated in Figure B.4, both for concentric and eccentric type.



**Figure B.4 — Wall thicknesses and dimensions of reducers**

The wall thickness of a cone with the given half angle is calculated :

$$T_{co,min} = \frac{D}{\min\left(\frac{T_{min}}{D-T_{min}}, \frac{T1_{min}}{D1-T1_{min}}\right) + 1} \cdot \frac{1}{\cos(\alpha)} \quad (B.9)$$

The reinforced wall thickness at the large end of the reducer is calculated:

$$T_{j,min} = \beta \cdot (D - T_{j,min}) \cdot \min\left(\frac{T_{min}}{D - T_{min}}, \frac{T1_{min}}{D1 - T1_{min}}\right) \quad (B.10)$$

with

$$\beta = \frac{1}{3} \sqrt{\frac{D - T_{j,min}}{T_{j,min}}} \cdot \frac{\tan(\alpha)}{1 + \frac{1}{\sqrt{\cos(\alpha)}}} - 0,15 \quad (B.11)$$

NOTE      Formulas (B.11) and (B.10) cannot be evaluated directly but have to be solved by iteration.

The wall thickness of the conical part of a reducer shall be:

$$T_{3,min} = \max(T_{co,min}, T_{j,min}) \quad (B.12)$$

The wall thickness of the cylindrical part at the large end of the reducer shall be:

$$T_{2,min} = \max(T_{min}, T_{j,min}) \quad (B.13)$$

If the wall thickness at the cylindrical part at the large end of the reducer has to be reinforced, a minimal length of this part shall be assured:

$$L_{2,min} = \begin{cases} 1.4 \cdot \sqrt{(D - T_{j,min}) \cdot T_{j,min}} & \text{if } T_{j,min} > T_{min} \\ 0 & \text{otherwise} \end{cases} \quad (B.14)$$

The wall thickness of the cylindrical part at the small end of the reducer shall be determined using the following formulas:

$$s = \frac{T_{3\min}}{T_{4\min}} \quad (B.15)$$

$$\tau = \begin{cases} s \cdot \sqrt{\frac{s}{\cos(\alpha)}} + \sqrt{\frac{1+s^2}{2}} & \text{if } s < 1 \\ 1 + \sqrt{s \cdot \left( \frac{1+s^2}{2 \cdot \cos(\alpha)} \right)} & \text{if } s \geq 1 \end{cases} \quad (B.16)$$

$$\beta_H = 0,4 \cdot \sqrt{\frac{D_1 - T_{4\min}}{T_{4\min}}} \cdot \frac{\tan(\alpha)}{\tau} + 0,5 \quad (B.17)$$

If

$$\min\left(\frac{T_{\min}}{D - T_{\min}}, \frac{T_{1\min}}{D_1 - T_{1\min}}\right) \leq \frac{T_{4\min}}{(D_1 - T_{4\min}) \cdot \beta_H} \quad (B.18)$$

and

$$T_{4\min} \geq T_{1\min} \quad (B.19)$$

$T_{4\min}$  is acceptable. If not, the calculation shall be repeated with a increased value of  $T_{4\min}$ . In order to satisfy (B.18) it is also allowed to increase value of  $T_{3\min}$ .

If the wall thickness at the cylindrical part at the small end of the reducer has to be reinforced, a minimal length of this part shall be assured :

$$L_{4\min} = \begin{cases} \sqrt{(D_1 - T_{4\min}) \cdot T_{4\min}} & \text{if } T_{4\min} > T_{1\min} \\ 0 & \text{otherwise} \end{cases} \quad (B.20)$$

NOTE Formula (B.9) to (B.18) are only applicable for semi angle  $\alpha$  less equal 60° and ratios of D to  $T_{\min}$  less equal 1000.

NOTE Formula (B.9) is derived from (8.6.4-2) and (6.1-3) from EN 13480-3.

Formula (B.10) is derived from (6.4.4-3) and (6.1-3) from EN 13480-3.

Formula (B.11) is given in EN 13480-3 as (6.4.4-4) in EN 13480-3.

Formula (B.14) is based on (6.4.4-1) and Figure 6.4.4-1 of EN 13480-3.

Formulas (B.15) to (B.17) are given in EN 13445-3 as (7.6-22) to (7.6-25).

Formula (B.18) is derived from (7.6-26) from EN 13445-3 and (6.1-3) from EN 13480-3.

Formula (B.20) is given in EN 13445-3 as (7.6-9).

Example:

Wall thicknesses of a concentric reducer 813 x 5,6 - 508 x 4,0 with an half angle  $\alpha = 20^\circ$ .

$$(8-1) : \quad T_{\min} = 5,6 \text{ mm} - 0,35 \text{ mm} = 5,25 \text{ mm}$$

$$T_{1\min} = 4,0 \text{ mm} * (100 - 12,5) / 100 = 3,50 \text{ mm}$$

$$(8-9) : \quad T_{co,min} = 5,59 \text{ mm}$$

Initial assumption :  $T_{j,\min} = 5,59 \text{ mm}$

- (B.11), (B.10):  $\beta = 0,57, T_{j,\min} = 2,99 \text{ mm}$
- $\beta = 0,83, T_{j,\min} = 4,37 \text{ mm}$
- $\beta = 0,66, T_{j,\min} = 3,47 \text{ mm}$
- $\beta = 0,76, T_{j,\min} = 4,00 \text{ mm}$
- $\beta = 0,70, T_{j,\min} = 3,68 \text{ mm}$
- $\beta = 0,74, T_{j,\min} = 3,89 \text{ mm}$
- $\beta = 0,71, T_{j,\min} = 3,73 \text{ mm}$
- $\beta = 0,73, T_{j,\min} = 3,84 \text{ mm}$
- $\beta = 0,72, T_{j,\min} = 3,79 \text{ mm}$
- $\beta = 0,72, T_{j,\min} = 3,79 \text{ mm}$

$$(8-12): T_{3\min} = 5,59 \text{ mm}$$

$$(8-13): T_{2\min} = 5,25 \text{ mm}$$

$$(8-14): L_{2\min} = 0 \text{ mm}$$

Initial assumption:  $T_{4\min} = 3,50 \text{ mm}$

- (B.15) to (B.17):  $s = 1,60, \tau = 2,74, \beta_H = 1,14,$
- checking (B.18):  $0,00650 \text{ is not less equal } 0,00608$

next assumption:  $T_{4\min} = 3,70 \text{ mm}$

- (B.15) to (B.17):  $s = 1,51, \tau = 2,62, \beta_H = 1,15,$
- checking (B.18):  $0,00650 \text{ is not less equal } 0,00637$

next assumption:  $T_{4\min} = 3,80 \text{ mm}$

- (B.15) to (B.17):  $s = 1,47, \tau = 2,57, \beta_H = 1,15,$
- checking (B.18):  $0,00650 \text{ is less equal } 0,00655$

$T_{4\min} = 3,80 \text{ mm is acceptable.}$

$$(8-20): L_{4\min} = 43,77 \text{ mm}$$

$$(8-2): \begin{aligned} T_2 &= 5,25 \text{ mm} + 0,35 \text{ mm} = 5,60 \text{ mm} \\ T_3 &= 5,59 \text{ mm} + 0,35 \text{ mm} = 5,94 \text{ mm} \\ T_4 &= 3,80 \text{ mm} * 100 / (100 - 12,5) = 4,34 \text{ mm} \end{aligned}$$

## **Annex C** (informative)

### **Wall thickness tables**

#### **C.1 General**

This annex lists wall thicknesses at the body of the fitting of elbows, tees and reducers for 6 wall thickness series.

These wall thicknesses are calculated using the procedures given in annex B and tolerances listed in table 9. For the definition of symbols see section B.1 and the figures in annex B.

Fittings with nominal dimensions not listed in the tables of this annex or with other tolerances than given in table 9 may be designed in accordance with annex B.

#### **C.2 Elbows**

Table C.1 shows the wall thickness at the intrados of elbows of type 1 D, 1,5 D and 2,5 D whose bending radii are given annex A. The wall thickness at the extrados of the elbows shall be the same as at the welding ends.

**Table C.1 — Wall thickness at the intrados of elbows**

| D      | T   | 1                |     |      | 2    |     |                  | 3   |      |      | 4    |                  |      | 5    |      |      | 6                |      |      |      |      |                  |      |      |      |  |  |
|--------|-----|------------------|-----|------|------|-----|------------------|-----|------|------|------|------------------|------|------|------|------|------------------|------|------|------|------|------------------|------|------|------|--|--|
|        |     | T <sub>int</sub> | 1D  | 1,5D | 2,5D | T   | T <sub>int</sub> | 1D  | 1,5D | 2,5D | T    | T <sub>int</sub> | 1D   | 1,5D | 2,5D | T    | T <sub>int</sub> | 1D   | 1,5D | 2,5D | T    | T <sub>int</sub> | 1D   | 1,5D | 2,5D |  |  |
| 21,3   | 1,6 | -                | 2,1 | 1,9  | -    | -   | -                | -   | -    | -    | 2,0  | -                | 2,6  | 2,3  | 3,2  | -    | 4,1              | 3,7  | 4,0  | -    | 5,1  | 4,6              |      |      |      |  |  |
| 26,9   | 1,6 | -                | 2,3 | 1,9  | -    | -   | -                | -   | -    | -    | 2,0  | -                | 2,8  | 2,3  | 3,2  | -    | 4,4              | 3,7  | 4,0  | -    | 5,5  | 4,6              |      |      |      |  |  |
| 33,7   | 1,6 | -                | 2,3 | 1,9  | 2,0  | -   | 2,8              | 2,3 | -    | -    | 2,3  | -                | 3,2  | 2,7  | 3,2  | -    | 4,4              | 3,7  | 4,5  | -    | 6,1  | 5,2              |      |      |      |  |  |
| 42,4   | 1,6 | -                | 2,3 | 1,9  | 2,0  | -   | 2,8              | 2,3 | -    | -    | 2,6  | -                | 3,6  | 3,0  | 3,6  | -    | 4,9              | 4,2  | 5,0  | -    | 6,8  | 5,7              |      |      |      |  |  |
| 48,3   | 1,6 | -                | 2,2 | 1,9  | 2,0  | -   | 2,8              | 2,3 | -    | -    | 2,6  | -                | 3,5  | 3,0  | 3,6  | -    | 4,9              | 4,2  | 5,0  | -    | 6,7  | 5,7              |      |      |      |  |  |
| 60,3   | 1,6 | 2,7              | 2,2 | 1,9  | 2,0  | 3,4 | 2,7              | 2,3 | 2,3  | 3,9  | 3,1  | 2,7              | 2,9  | 4,8  | 3,9  | 4,0  | 6,5              | 5,3  | 4,6  | 5,6  | 8,9  | 7,3              | 6,4  |      |      |  |  |
| 76,1   | 1,6 | 2,8              | 2,2 | 1,9  | 2,3  | 4,0 | 3,1              | 2,7 | 2,6  | 4,5  | 3,5  | 3,0              | 2,9  | 5,0  | 3,9  | 3,3  | 5,0              | 8,3  | 6,6  | 5,7  | 7,1  | 11,5             | 9,3  | 8,1  |      |  |  |
| 88,9   | 2,0 | 3,4              | 2,7 | 2,3  | 2,3  | 3,9 | 3,1              | 2,7 | 2,9  | 4,8  | 3,8  | 3,3              | 3,2  | 5,3  | 4,2  | 3,7  | 5,6              | 9,1  | 7,3  | 6,4  | 8,0  | 12,7             | 10,4 | 9,1  |      |  |  |
| 114,3  | 2,0 | 3,3              | 2,6 | 2,3  | 2,6  | 4,2 | 3,4              | 3,0 | 2,9  | 4,7  | 3,8  | 3,3              | 3,6  | 5,8  | 4,7  | 4,1  | 6,3              | 9,9  | 8,2  | 7,2  | 8,8  | 13,7             | 11,3 | 10,0 |      |  |  |
| 139,7  | 2,0 | 3,2              | 2,6 | 2,3  | 2,6  | 4,2 | 3,4              | 3,0 | 3,2  | 5,1  | 4,2  | 3,7              | 4,0  | 6,4  | 5,2  | 4,6  | 6,3              | 9,9  | 8,1  | 7,2  | 10,0 | 15,4             | 12,8 | 11,4 |      |  |  |
| 168,3  | 2,0 | 3,3              | 2,6 | 2,3  | 2,6  | 4,2 | 3,4              | 3,0 | 3,2  | 5,2  | 4,2  | 3,7              | 4,5  | 7,2  | 5,8  | 5,2  | 7,1              | 11,2 | 9,1  | 8,1  | 11,0 | 17,1             | 14,1 | 12,5 |      |  |  |
| 219,1  | 2,0 | 3,2              | 2,6 | 2,3  | 2,6  | 4,1 | 3,4              | 3,0 | 3,6  | 5,7  | 4,6  | 4,1              | 6,3  | 9,8  | 8,1  | 7,2  | 8,0              | 12,4 | 10,2 | 9,1  | 12,5 | 19,1             | 15,9 | 14,2 |      |  |  |
| 273,0  | 2,0 | 3,2              | 2,6 | 2,3  | 3,6  | 5,7 | 4,6              | 4,1 | 4,0  | 6,3  | 5,2  | 4,6              | 6,3  | 9,9  | 8,1  | 7,2  | 10,0             | 15,5 | 12,8 | 11,4 | -    | -                | -    | -    |      |  |  |
| 323,9  | 2,6 | 4,1              | 3,4 | 3,0  | 4,0  | 6,3 | 5,1              | 4,6 | 4,5  | 7,0  | 5,8  | 5,1              | 7,1  | 11,0 | 9,1  | 8,1  | 10,0             | 15,4 | 12,7 | 11,4 | -    | -                | -    | -    |      |  |  |
| 355,6  | 2,6 | 3,9              | 3,3 | 3,0  | 4,0  | 6,0 | 5,0              | 4,6 | 5,0  | 7,5  | 6,3  | 5,7              | 8,0  | 11,9 | 10,0 | 9,1  | 11,0             | 16,3 | 13,7 | 12,5 | -    | -                | -    | -    |      |  |  |
| 406,4  | 2,6 | 3,9              | 3,3 | 3,0  | 4,0  | 6,0 | 5,0              | 4,6 | 5,0  | 7,5  | 6,3  | 5,7              | 8,8  | 13,1 | 11,0 | 10,0 | 12,5             | 18,5 | 15,6 | 14,2 | -    | -                | -    | -    |      |  |  |
| 457,0  | 3,2 | 4,8              | 4,0 | 3,7  | 4,0  | 6,0 | 5,0              | 4,6 | 5,0  | 7,5  | 6,3  | 5,7              | 10,0 | 14,9 | 12,5 | 11,3 | -                | -    | -    | -    | -    | -                | -    |      |      |  |  |
| 508,0  | 3,2 | 4,8              | 4,0 | 3,7  | 5,0  | 7,5 | 6,3              | 5,7 | 5,6  | 8,4  | 7,0  | 6,4              | 11,0 | 16,4 | 13,8 | 12,4 | -                | -    | -    | -    | -    | -                | -    |      |      |  |  |
| 610,0  | 3,2 | 4,8              | 4,0 | 3,6  | 5,6  | 8,4 | 7,0              | 6,3 | 6,3  | 9,4  | 7,9  | 7,1              | 12,5 | 18,6 | 15,6 | 14,1 | -                | -    | -    | -    | -    | -                | -    |      |      |  |  |
| 711,0  | 4,0 | -                | 5,0 | 4,5  | 5,6  | -   | 7,0              | 6,3 | 7,1  | -    | 8,8  | 8,0              | 12,5 | -    | 15,5 | 14,0 | -                | -    | -    | -    | -    | -                | -    |      |      |  |  |
| 813,0  | 4,0 | -                | 5,0 | 4,5  | 5,6  | -   | 7,0              | 6,3 | 8,0  | -    | 9,9  | 9,0              | 12,5 | -    | 15,5 | 14,0 | -                | -    | -    | -    | -    | -                | -    |      |      |  |  |
| 914,0  | 4,0 | -                | 5,0 | 4,5  | 6,3  | -   | 7,8              | 7,1 | 8,8  | -    | 11,1 | 9,9              | 12,5 | -    | 15,5 | 14,0 | -                | -    | -    | -    | -    | -                | -    |      |      |  |  |
| 1016,0 | 4,0 | -                | 5,0 | 4,5  | 6,3  | -   | 7,8              | 7,1 | 10,0 | -    | 12,6 | 11,4             | 12,5 | -    | 15,5 | 14,0 | -                | -    | -    | -    | -    | -                | -    |      |      |  |  |

### C.3 Tees

Table C.2 shows the wall thickness at the body of equal tees and reducing tees. These data is applicable if one of the following two conditions apply :

- 1) The reinforcement is interior ( $D_s = D$ ,  $D_b = D_1$ ) and  
the crotch radius is less equal to 3/4 of the height of the branch ( $r_c \leq 0.75 * (G - D/2)$ ) and  
the wall thickness at the crotch zone is at least the mean of the wall thicknesses of run and branch  
 $(T_{c,min} \geq (T_{s,min} + T_{b,min}) / 2)$  and  
dimensions F and G are as listed in annex A.
- 2) The reinforcement is at maximum half to the external ( $D_c \leq D + (T_s - T)$ ,  $D_b \leq D_1 + (T_b - T_1)$ ) and  
the crotch radius is less equal to 1/2 of the height of the branch ( $r_c \leq 0.5 * (G - D/2)$ ) and  
the wall thickness at the crotch zone is at least the mean of the wall thicknesses of run and branch  
 $(T_{c,min} \geq (T_{s,min} + T_{b,min}) / 2)$  and  
dimensions F and G are as listed in annex A.

In all other cases the wall thicknesses may be calculated in accordance with annex B.

Smaller wall thicknesses than listed in Table C.2 are acceptable provided that they are calculated in accordance with annex B, e.g. for smaller crotch radii or other ratios of the wall thicknesses of run to branch.

Table C.2 — Wall thickness of tees

| D     | D1    | 1   |     |                |                | 2   |     |                |                | 3   |     |                |                | 4   |     |                |                | 5   |     |                |                | 6    |      |                |                |
|-------|-------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|------|------|----------------|----------------|
|       |       | T   | T1  | T <sub>s</sub> | T <sub>b</sub> | T   | T1  | T <sub>s</sub> | T <sub>b</sub> | T   | T1  | T <sub>s</sub> | T <sub>b</sub> | T   | T1  | T <sub>s</sub> | T <sub>b</sub> | T   | T1  | T <sub>s</sub> | T <sub>b</sub> | T    | T1   | T <sub>s</sub> | T <sub>b</sub> |
| 21,3  | 21,3  | 1,6 | 1,6 | 4,0            | 3,0            | -   | -   | -              | -              | -   | -   | -              | -              | 2,0 | 2,0 | 4,6            | 3,6            | 3,2 | 3,2 | 5,8            | 5,8            | 4,0  | 4,0  | 7,1            | 7,1            |
| 26,9  | 26,9  | 1,6 | 1,6 | 4,1            | 3,1            | -   | -   | -              | -              | -   | -   | -              | -              | 2,0 | 2,0 | 4,8            | 3,6            | 3,2 | 3,2 | 6,3            | 5,6            | 4,0  | 4,0  | 7,9            | 7,0            |
|       | 21,3  | 1,6 | 1,6 | 3,8            | 2,9            | -   | -   | -              | -              | -   | -   | -              | -              | 2,0 | 2,0 | 4,4            | 3,3            | 3,2 | 3,2 | 6,2            | 4,6            | 4,0  | 4,0  | 7,2            | 5,4            |
| 33,7  | 33,7  | 1,6 | 1,6 | 4,6            | 3,4            | 2,0 | 2,0 | 5,3            | 4,0            | -   | -   | -              | -              | 2,3 | 2,3 | 5,8            | 4,4            | 3,2 | 3,2 | 7,3            | 5,5            | 4,5  | 4,5  | 9,6            | 7,2            |
|       | 26,9  | 1,6 | 1,6 | 4,3            | 3,2            | -   | -   | -              | -              | -   | -   | -              | -              | 2,3 | 2,0 | 5,4            | 4,1            | 3,2 | 3,2 | 6,8            | 5,1            | 4,5  | 4,0  | 8,6            | 6,5            |
|       | 21,3  | 1,6 | 1,6 | 4,1            | 3,1            | -   | -   | -              | -              | -   | -   | -              | -              | 2,3 | 2,0 | 5,1            | 3,9            | 3,2 | 3,2 | 6,4            | 4,8            | 4,5  | 4,0  | 8,1            | 6,1            |
| 42,4  | 42,4  | 1,6 | 1,6 | 5,0            | 3,7            | 2,0 | 2,0 | 5,7            | 4,3            | -   | -   | -              | -              | 2,6 | 2,6 | 6,8            | 5,1            | 3,6 | 3,6 | 8,5            | 6,4            | 5,0  | 5,0  | 10,7           | 8,1            |
|       | 33,7  | 1,6 | 1,6 | 4,7            | 3,5            | 2,0 | 2,0 | 5,4            | 4,0            | -   | -   | -              | -              | 2,6 | 2,3 | 6,4            | 4,8            | 3,6 | 3,2 | 7,9            | 5,9            | 5,0  | 4,5  | 9,9            | 7,5            |
|       | 26,9  | 1,6 | 1,6 | 4,5            | 3,4            | -   | -   | -              | -              | -   | -   | -              | -              | 2,6 | 2,0 | 6,0            | 4,5            | 3,6 | 3,2 | 7,5            | 5,6            | 5,0  | 4,0  | 9,3            | 7,0            |
|       | 21,3  | 1,6 | 1,6 | 4,3            | 3,3            | -   | -   | -              | -              | -   | -   | -              | -              | 2,6 | 2,0 | 5,8            | 4,4            | 3,6 | 3,2 | 7,1            | 5,4            | 5,0  | 4,0  | 8,9            | 6,7            |
|       | 48,3  | 1,6 | 1,6 | 5,4            | 4,1            | 2,0 | 2,0 | 6,2            | 4,7            | -   | -   | -              | -              | 2,6 | 2,6 | 7,3            | 5,5            | 3,6 | 3,6 | 9,1            | 6,8            | 5,0  | 5,0  | 11,4           | 8,6            |
| 48,3  | 42,4  | 1,6 | 1,6 | 5,2            | 3,9            | 2,0 | 2,0 | 6,0            | 4,5            | -   | -   | -              | -              | 2,6 | 2,6 | 7,1            | 5,3            | 3,6 | 3,6 | 8,7            | 6,6            | 5,0  | 5,0  | 10,9           | 8,2            |
|       | 33,7  | 1,6 | 1,6 | 5,0            | 3,8            | 2,0 | 2,0 | 5,7            | 4,3            | -   | -   | -              | -              | 2,6 | 2,3 | 6,7            | 5,0            | 3,6 | 3,2 | 8,2            | 6,2            | 5,0  | 4,5  | 10,2           | 7,7            |
|       | 26,9  | 1,6 | 1,6 | 4,9            | 3,7            | -   | -   | -              | -              | -   | -   | -              | -              | 2,6 | 2,0 | 6,4            | 4,8            | 3,6 | 3,2 | 7,9            | 5,9            | 5,0  | 4,0  | 9,7            | 7,3            |
|       | 33,7  | 1,6 | 1,6 | 3,8            | 2,8            | 2,0 | 2,0 | 4,4            | 3,3            | -   | -   | -              | -              | 2,9 | 2,3 | 5,6            | 4,2            | 4,0 | 3,2 | 7,1            | 5,3            | 5,6  | 4,5  | 9,0            | 6,8            |
| 60,3  | 60,3  | 1,6 | 1,6 | 5,4            | 4,0            | 2,0 | 2,0 | 6,2            | 4,6            | 2,3 | 2,3 | 6,8            | 5,1            | 2,9 | 2,9 | 7,9            | 5,9            | 4,0 | 4,0 | 9,8            | 7,4            | 5,6  | 5,6  | 12,4           | 9,3            |
|       | 48,3  | 1,6 | 1,6 | 4,8            | 3,6            | 2,0 | 2,0 | 5,5            | 4,1            | -   | -   | -              | -              | 2,9 | 2,6 | 7,0            | 5,3            | 4,0 | 3,6 | 8,7            | 6,6            | 5,6  | 5,0  | 11,1           | 8,3            |
|       | 42,4  | 1,6 | 1,6 | 4,4            | 3,3            | 2,0 | 2,0 | 5,1            | 3,8            | -   | -   | -              | -              | 2,9 | 2,6 | 6,5            | 4,9            | 4,0 | 3,6 | 8,1            | 6,1            | 5,6  | 5,0  | 10,3           | 7,7            |
|       | 33,7  | 1,6 | 1,6 | 3,8            | 2,8            | 2,0 | 2,0 | 4,4            | 3,3            | -   | -   | -              | -              | 2,9 | 2,3 | 5,6            | 4,2            | 4,0 | 3,2 | 7,1            | 5,3            | 5,6  | 4,5  | 9,0            | 6,8            |
| 76,1  | 76,1  | 1,6 | 1,6 | 5,6            | 4,2            | 2,3 | 2,3 | 7,0            | 5,3            | 2,6 | 2,6 | 7,6            | 5,7            | 2,9 | 2,9 | 8,2            | 6,1            | 5,0 | 5,0 | 11,9           | 8,9            | 7,1  | 7,1  | 16,0           | 12,0           |
|       | 60,3  | 1,6 | 1,6 | 4,8            | 3,6            | 2,3 | 2,0 | 6,1            | 4,6            | 2,6 | 2,3 | 6,6            | 5,0            | 2,9 | 2,9 | 7,1            | 5,4            | 5,0 | 4,0 | 10,4           | 7,8            | 7,1  | 5,6  | 13,3           | 10,0           |
|       | 48,3  | 1,6 | 1,6 | 4,4            | 3,3            | 2,3 | 2,0 | 5,5            | 4,2            | -   | -   | -              | -              | 2,9 | 2,6 | 6,5            | 4,9            | 5,0 | 3,6 | 9,4            | 7,1            | 7,1  | 5,0  | 12,1           | 9,1            |
|       | 42,4  | 1,6 | 1,6 | 4,1            | 3,1            | 2,3 | 2,0 | 5,1            | 3,9            | -   | -   | -              | -              | 2,9 | 2,6 | 6,0            | 4,5            | 5,0 | 3,6 | 8,8            | 6,6            | 7,1  | 5,0  | 11,4           | 8,5            |
| 88,9  | 88,9  | 2,0 | 2,0 | 6,6            | 5,0            | 2,3 | 2,3 | 7,2            | 5,4            | 2,9 | 2,9 | 8,4            | 6,3            | 3,2 | 3,2 | 9,0            | 6,7            | 5,6 | 5,6 | 13,2           | 9,9            | 8,0  | 8,0  | 18,3           | 13,7           |
|       | 76,1  | 2,0 | 1,6 | 5,8            | 4,4            | 2,3 | 2,3 | 6,7            | 5,0            | 2,9 | 2,6 | 7,8            | 5,8            | 3,2 | 2,9 | 8,3            | 6,2            | 5,6 | 5,0 | 12,2           | 9,2            | 8,0  | 7,1  | 15,8           | 11,8           |
|       | 60,3  | 2,0 | 1,6 | 5,3            | 4,0            | 2,3 | 2,0 | 5,8            | 4,4            | 2,9 | 2,3 | 6,8            | 5,1            | 3,2 | 2,9 | 7,2            | 5,4            | 5,6 | 4,0 | 10,7           | 8,0            | 8,0  | 5,6  | 13,9           | 10,4           |
|       | 48,3  | 2,0 | 1,6 | 4,8            | 3,6            | 2,3 | 2,0 | 5,3            | 4,0            | -   | -   | -              | -              | 3,2 | 2,6 | 6,6            | 4,9            | 5,6 | 3,6 | 9,8            | 7,3            | 8,0  | 5,0  | 12,7           | 9,5            |
| 114,3 | 114,3 | 2,0 | 2,0 | 6,9            | 5,2            | 2,6 | 2,6 | 8,2            | 6,2            | 2,9 | 2,9 | 8,8            | 6,6            | 3,6 | 3,6 | 10,2           | 7,7            | 6,3 | 6,3 | 15,3           | 11,5           | 8,8  | 8,8  | 21,0           | 15,8           |
|       | 88,9  | 2,0 | 2,0 | 6,0            | 4,5            | 2,6 | 2,3 | 7,2            | 5,4            | 2,9 | 2,9 | 7,7            | 5,8            | 3,6 | 3,2 | 8,9            | 6,7            | 6,3 | 5,6 | 13,1           | 9,9            | 8,8  | 8,0  | 16,7           | 12,6           |
|       | 76,1  | 2,0 | 1,6 | 5,6            | 4,2            | 2,6 | 2,3 | 6,6            | 5,0            | 2,9 | 2,6 | 7,1            | 5,4            | 3,6 | 2,9 | 8,3            | 6,2            | 6,3 | 5,0 | 12,2           | 9,2            | 8,8  | 7,1  | 15,6           | 11,7           |
|       | 60,3  | 2,0 | 1,6 | 4,9            | 3,7            | 2,6 | 2,0 | 5,9            | 4,4            | 2,9 | 2,3 | 6,3            | 4,8            | 3,6 | 2,9 | 7,3            | 5,5            | 6,3 | 4,0 | 10,9           | 8,2            | 8,8  | 5,6  | 14,0           | 10,5           |
| 139,7 | 139,7 | 2,0 | 2,0 | 7,2            | 5,4            | 2,6 | 2,6 | 8,6            | 6,4            | 3,2 | 3,2 | 9,8            | 7,4            | 4,0 | 4,0 | 11,4           | 8,6            | 6,3 | 6,3 | 15,8           | 11,8           | 10,0 | 10,0 | 24,8           | 18,6           |
|       | 114,3 | 2,0 | 2,0 | 6,4            | 4,8            | 2,6 | 2,6 | 7,6            | 5,7            | 3,2 | 2,9 | 8,8            | 6,6            | 4,0 | 3,6 | 10,2           | 7,7            | 6,3 | 6,3 | 14,0           | 10,5           | 10,0 | 8,8  | 19,6           | 14,7           |
| 139,7 | 88,9  | 2,0 | 2,0 | 5,7            | 4,3            | 2,6 | 2,3 | 6,8            | 5,1            | 3,2 | 2,9 | 7,8            | 5,8            | 4,0 | 3,2 | 9,0            | 6,8            | 6,3 | 5,6 | 12,4           | 9,3            | 10,0 | 8,0  | 17,4           | 13,1           |
|       | 76,1  | 2,0 | 1,6 | 5,3            | 4,0            | 2,6 | 2,3 | 6,3            | 4,7            | 3,2 | 2,6 | 7,2            | 5,4            | 4,0 | 2,9 | 8,4            | 6,3            | 6,3 | 5,0 | 11,6           | 8,7            | 10,0 | 7,1  | 16,3           | 12,2           |
| 168,3 | 168,3 | 2,0 | 2,0 | 7,5            | 5,6            | 2,6 | 2,6 | 8,8            | 6,6            | 3,2 | 3,2 | 10,1           | 7,6            | 4,5 | 4,5 | 12,8           | 9,6            | 7,1 | 7,1 | 18,2           | 13,7           | 11,0 | 11,0 | 28,8           | 21,6           |
|       | 139,7 | 2,0 | 2,0 | 6,8            | 5,1            | 2,6 | 2,6 | 8,0            | 6,0            | 3,2 | 3,2 | 9,2            | 6,9            | 4,5 | 4,0 | 11,6           | 8,7            | 7,1 | 6,3 | 15,9           | 12,0           | 11,0 | 10,0 | 21,9           | 16,4           |
|       | 114,3 | 2,0 | 2,0 | 6,0            | 4,5            | 2,6 | 2,6 | 7,2            | 5,4            | 3,2 | 2,9 | 8,2            | 6,2            | 4,5 | 3,6 | 10,4           | 7,8            | 7,1 | 6,3 | 14,4           | 10,8           | 11,0 | 8,8  | 19,8           | 14,8           |
|       | 88,9  | 2,0 | 2,0 | 5,4            | 4,0            | 2,6 | 2,3 | 6,4            | 4,8            | 3,2 | 2,9 | 7,3            | 5,5            | 4,5 | 3,2 | 9,3            | 7,0            | 7,1 | 5,6 | 12,8           | 9,6            | 11,0 | 8,0  | 17,7           | 13,3           |
| 219,1 | 219,1 | 2,0 | 2,0 | 7,9            | 5,9            | 2,6 | 2,6 | 9,3            | 7,0            | 3,6 | 3,6 | 11,6           | 8,7            | 6,3 | 6,3 | 17,2           | 12,9           | 8,0 | 8,0 | 21,3           | 16,0           | 12,5 | 12,5 | 34,8           | 26,1           |
|       | 168,3 | 2,0 | 2,0 | 6,9            | 5,2            | 2,6 | 2,6 | 8,1            | 6,1            | 3,6 | 3,2 | 10,1           | 7,6            | 6,3 | 4,5 | 14,1           | 10,6           | 8,0 | 7,1 | 17,6           | 13,2           | 12,5 | 11,0 | 24,3           | 18,3           |
|       | 139,7 | 2,0 | 2,0 | 6,2            | 4,7            | 2,6 | 2,6 | 7,4            | 5,6            | 3,6 | 3,2 | 9,2            | 6,9            | 6,3 | 4,0 | 13,5           | 10,1           | 8,0 | 6,3 | 16,1           | 12,1           | 12,5 | 10,0 | 22,3           | 16,7           |
|       | 114,3 | 2,0 | 2,0 | 5,6            | 4,2            | 2,6 | 2,6 | 6,7            | 5,0            | 3,6 | 2,9 | 8,3            | 6,3            | 6,3 | 3,6 | 12,3           | 9,3            | 8,0 | 6,3 | 14,7           | 11,0           | 12,5 | 8,8  | 20,4           | 15,3           |

"to be continued "

Table C.2 (end)

| D     | D1    | 1   |     |                |                | 2   |     |                |                | 3    |      |                |                | 4    |      |                |                | 5    |      |                |                | 6 |    |                |                |
|-------|-------|-----|-----|----------------|----------------|-----|-----|----------------|----------------|------|------|----------------|----------------|------|------|----------------|----------------|------|------|----------------|----------------|---|----|----------------|----------------|
|       |       | T   | T1  | T <sub>s</sub> | T <sub>b</sub> | T   | T1  | T <sub>s</sub> | T <sub>b</sub> | T    | T1   | T <sub>s</sub> | T <sub>b</sub> | T    | T1   | T <sub>s</sub> | T <sub>b</sub> | T    | T1   | T <sub>s</sub> | T <sub>b</sub> | T | T1 | T <sub>s</sub> | T <sub>b</sub> |
| 273   | 273   | 2,0 | 2,0 | 8,4            | 6,3            | 3,6 | 3,6 | 12,2           | 9,2            | 4,0  | 4,0  | 13,1           | 9,9            | 6,3  | 6,3  | 17,9           | 13,5           | 10,0 | 10,0 | 27,7           | 20,8           | - | -  | -              | -              |
|       | 219,1 | 2,0 | 2,0 | 7,3            | 5,5            | 3,6 | 2,6 | 10,0           | 7,5            | 4,0  | 3,6  | 11,5           | 8,7            | 6,3  | 6,3  | 15,8           | 11,9           | 10,0 | 8,0  | 21,9           | 16,5           | - | -  | -              | -              |
|       | 168,3 | 2,0 | 2,0 | 6,4            | 4,8            | 3,6 | 2,6 | 9,4            | 7,1            | 4,0  | 3,2  | 10,1           | 7,6            | 6,3  | 4,5  | 13,9           | 10,4           | 10,0 | 7,1  | 19,4           | 14,6           | - | -  | -              | -              |
|       | 139,7 | 2,0 | 2,0 | 5,9            | 4,5            | 3,6 | 2,6 | 8,7            | 6,6            | 4,0  | 3,2  | 9,4            | 7,1            | 6,3  | 4,0  | 12,9           | 9,7            | 10,0 | 6,3  | 18,0           | 13,5           | - | -  | -              | -              |
| 323,9 | 323,9 | 2,6 | 2,6 | 10,4           | 7,8            | 4,0 | 4,0 | 13,8           | 10,4           | 4,5  | 4,5  | 14,9           | 11,2           | 7,1  | 7,1  | 20,4           | 15,3           | 10,0 | 10,0 | 27,7           | 20,8           | - | -  | -              | -              |
|       | 273   | 2,6 | 2,0 | 8,8            | 6,6            | 4,0 | 3,6 | 12,4           | 9,3            | 4,5  | 4,0  | 13,5           | 10,1           | 7,1  | 6,3  | 18,4           | 13,8           | 10,0 | 10,0 | 23,5           | 17,7           | - | -  | -              | -              |
|       | 219,1 | 2,6 | 2,0 | 8,3            | 6,2            | 4,0 | 2,6 | 10,7           | 8,1            | 4,5  | 3,6  | 11,9           | 9,0            | 7,1  | 6,3  | 16,4           | 12,3           | 10,0 | 8,0  | 21,0           | 15,8           | - | -  | -              | -              |
|       | 168,3 | 2,6 | 2,0 | 7,2            | 5,4            | 4,0 | 2,6 | 9,7            | 7,3            | 4,5  | 3,2  | 10,5           | 7,9            | 7,1  | 4,5  | 14,5           | 10,9           | 10,0 | 7,1  | 18,6           | 13,9           | - | -  | -              | -              |
| 355,6 | 355,6 | 2,6 | 2,6 | 10,8           | 8,1            | 4,0 | 4,0 | 14,2           | 10,7           | 5,0  | 5,0  | 16,5           | 12,4           | 8,0  | 8,0  | 22,9           | 17,2           | 11,0 | 11,0 | 30,5           | 22,9           | - | -  | -              | -              |
|       | 323,9 | 2,6 | 2,6 | 10,1           | 7,6            | 4,0 | 4,0 | 13,4           | 10,1           | 5,0  | 4,5  | 15,4           | 11,6           | 8,0  | 7,1  | 21,1           | 15,9           | 11,0 | 10,0 | 27,0           | 20,2           | - | -  | -              | -              |
|       | 273   | 2,6 | 2,0 | 9,1            | 6,8            | 4,0 | 3,6 | 12,1           | 9,1            | 5,0  | 4,0  | 14,1           | 10,6           | 8,0  | 6,3  | 19,5           | 14,7           | 11,0 | 10,0 | 24,5           | 18,4           | - | -  | -              | -              |
|       | 219,1 | 2,6 | 2,0 | 8,2            | 6,1            | 4,0 | 2,6 | 10,8           | 8,1            | 5,0  | 3,6  | 12,6           | 9,5            | 8,0  | 6,3  | 17,6           | 13,2           | 11,0 | 8,0  | 22,1           | 16,6           | - | -  | -              | -              |
| 406,4 | 406,4 | 2,6 | 2,6 | 10,9           | 8,2            | 4,0 | 4,0 | 14,4           | 10,8           | 5,0  | 5,0  | 16,7           | 12,6           | 8,8  | 8,8  | 26,0           | 19,5           | 12,5 | 12,5 | 37,7           | 28,3           | - | -  | -              | -              |
|       | 355,6 | 2,6 | 2,6 | 10,4           | 7,8            | 4,0 | 4,0 | 13,7           | 10,3           | 5,0  | 5,0  | 15,9           | 11,9           | 8,8  | 8,0  | 23,4           | 17,6           | 12,5 | 11,0 | 30,0           | 22,5           | - | -  | -              | -              |
|       | 323,9 | 2,6 | 2,6 | 9,7            | 7,3            | 4,0 | 4,0 | 12,9           | 9,7            | 5,0  | 4,5  | 14,9           | 11,2           | 8,8  | 7,1  | 22,1           | 16,6           | 12,5 | 10,0 | 28,4           | 21,3           | - | -  | -              | -              |
|       | 273   | 2,6 | 2,0 | 8,8            | 6,6            | 4,0 | 3,6 | 11,7           | 8,8            | 5,0  | 4,0  | 13,6           | 10,2           | 8,8  | 6,3  | 20,2           | 15,1           | 12,5 | 10,0 | 26,0           | 19,5           | - | -  | -              | -              |
| 457   | 457   | 2,6 | 2,6 | 11,4           | 8,5            | 4,0 | 4,0 | 15,0           | 11,3           | 5,0  | 5,0  | 17,4           | 13,1           | 8,8  | 8,8  | 26,4           | 19,8           | 12,5 | 12,5 | 37,2           | 27,9           | - | -  | -              | -              |
|       | 406,4 | 2,6 | 2,6 | 10,5           | 7,9            | 4,0 | 4,0 | 13,9           | 10,4           | 5,0  | 5,0  | 16,1           | 12,1           | 8,8  | 8,8  | 23,9           | 17,9           | 12,5 | 12,5 | 30,7           | 23,0           | - | -  | -              | -              |
|       | 355,6 | 2,6 | 2,6 | 10,0           | 7,5            | 4,0 | 4,0 | 13,2           | 9,9            | 5,0  | 5,0  | 15,3           | 11,5           | 8,8  | 8,0  | 22,6           | 16,9           | 12,5 | 11,0 | 29,0           | 21,7           | - | -  | -              | -              |
|       | 323,9 | 2,6 | 2,6 | 9,4            | 7,1            | 4,0 | 4,0 | 12,5           | 9,4            | 5,0  | 4,5  | 14,5           | 10,9           | 8,8  | 7,1  | 21,4           | 16,1           | 12,5 | 10,0 | 27,5           | 20,6           | - | -  | -              | -              |
| 508   | 508   | 3,2 | 3,2 | 13,4           | 10,1           | 5,0 | 5,0 | 18,0           | 13,5           | 5,6  | 5,6  | 19,4           | 14,6           | 11,0 | 11,0 | 32,6           | 24,4           | -    | -    | -              | -              | - | -  | -              | -              |
|       | 457   | 3,2 | 2,6 | 11,7           | 8,8            | 5,0 | 4,0 | 15,6           | 11,7           | 5,6  | 5,0  | 18,1           | 13,6           | 11,0 | 8,8  | 26,7           | 20,0           | -    | -    | -              | -              | - | -  | -              | -              |
|       | 406,4 | 3,2 | 2,6 | 11,6           | 8,7            | 5,0 | 4,0 | 15,7           | 11,8           | 5,6  | 5,0  | 16,9           | 12,7           | 11,0 | 8,8  | 27,1           | 20,4           | -    | -    | -              | -              | - | -  | -              | -              |
|       | 355,6 | 3,2 | 2,6 | 11,1           | 8,3            | 5,0 | 4,0 | 14,9           | 11,2           | 5,6  | 5,0  | 16,1           | 12,1           | 11,0 | 8,0  | 25,7           | 19,3           | -    | -    | -              | -              | - | -  | -              | -              |
| 610   | 610   | 3,2 | 3,2 | 13,7           | 10,3           | 5,6 | 5,6 | 19,8           | 14,9           | 6,3  | 6,3  | 21,5           | 16,1           | 12,5 | 12,5 | 41,4           | 31,1           | -    | -    | -              | -              | - | -  | -              | -              |
|       | 508   | 3,2 | 3,2 | 12,7           | 9,6            | 5,6 | 5,0 | 18,4           | 13,8           | 6,3  | 5,6  | 19,9           | 14,9           | 12,5 | 11,0 | 32,0           | 24,0           | -    | -    | -              | -              | - | -  | -              | -              |
|       | 457   | 3,2 | 2,6 | 11,9           | 8,9            | 5,6 | 4,0 | 16,7           | 12,5           | 6,3  | 5,0  | 18,6           | 14,0           | 12,5 | 8,8  | 28,8           | 21,6           | -    | -    | -              | -              | - | -  | -              | -              |
|       | 406,4 | 3,2 | 2,6 | 11,0           | 8,3            | 5,6 | 4,0 | 16,0           | 12,0           | 6,3  | 5,0  | 17,4           | 13,1           | 12,5 | 8,8  | 28,2           | 21,2           | -    | -    | -              | -              | - | -  | -              | -              |
| 711   | 711   | 4,0 | 4,0 | 15,9           | 12,1           | 5,6 | 5,6 | 20,1           | 15,2           | 7,1  | 7,1  | 23,6           | 17,9           | 12,5 | 12,5 | 37,1           | 28,0           | -    | -    | -              | -              | - | -  | -              | -              |
| 813   | 813   | 4,0 | 4,0 | 16,7           | 12,7           | 5,6 | 5,6 | 21,0           | 15,9           | 8,0  | 8,0  | 26,8           | 20,3           | 12,5 | 12,5 | 37,6           | 28,3           | -    | -    | -              | -              | - | -  | -              | -              |
| 914   | 914   | 4,0 | 4,0 | 17,5           | 13,2           | 6,3 | 6,3 | 23,7           | 17,9           | 8,8  | 8,8  | 29,8           | 22,5           | 12,5 | 12,5 | 37,9           | 28,6           | -    | -    | -              | -              | - | -  | -              | -              |
| 1016  | 1016  | 4,0 | 4,0 | 18,2           | 13,8           | 6,3 | 6,3 | 24,6           | 18,6           | 10,0 | 10,0 | 33,7           | 25,4           | 12,5 | 12,5 | 39,0           | 29,4           | -    | -    | -              | -              | - | -  | -              | -              |

## C.4 Reducers

Tables C.3 to C.8 show the wall thicknesses of concentric and eccentric reducers. The data is valid for reducers with semi angles  $\alpha$  less equal than the maximum semi angle  $\alpha_{\max}$  listed in the tables. For larger semi angles wall thicknesses may be calculated in accordance with annex B,

For small ratios of wall thickness to diameter reinforcement at the ends of the cone and the cylindrical parts are necessary, In these cases the applicable minimal lengths of the cylindrical sections of the reducer are listed in the tables too.

Smaller wall thicknesses than listed in Tables C.3 to C.8 are acceptable provided that they are calculated in accordance with annex B. e.g. for smaller semi angles  $\alpha$ .

**Table C.3 — Wall thickness of reducers – Wall thickness serie 1**

| D     | D1    | T   | T1  | Concentric      |                   |     |     |     |                   | Eccentric       |                   |     |     |     |                   |
|-------|-------|-----|-----|-----------------|-------------------|-----|-----|-----|-------------------|-----------------|-------------------|-----|-----|-----|-------------------|
|       |       |     |     | $\alpha_{\max}$ | L2 <sub>min</sub> | T2  | T3  | T4  | L4 <sub>min</sub> | $\alpha_{\max}$ | L2 <sub>min</sub> | T2  | T3  | T4  | L4 <sub>min</sub> |
| 26,9  | 21,3  | 1,6 | 1,6 | 8 °             | -                 | 1,6 | 1,7 | 1,6 | -                 | 15 °            | -                 | 1,6 | 1,7 | 1,6 | -                 |
| 33,7  | 26,9  | 1,6 | 1,6 | 7 °             | -                 | 1,6 | 1,7 | 1,6 | -                 | 13 °            | -                 | 1,6 | 1,7 | 1,6 | -                 |
|       | 21,3  | 1,6 | 1,6 | 12 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 24 °            | -                 | 1,6 | 1,8 | 1,6 | -                 |
| 42,4  | 33,7  | 1,6 | 1,6 | 9 °             | -                 | 1,6 | 1,7 | 1,6 | -                 | 16 °            | -                 | 1,6 | 1,7 | 1,6 | -                 |
|       | 26,9  | 1,6 | 1,6 | 15 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 30 °            | -                 | 1,6 | 1,9 | 1,6 | -                 |
|       | 21,3  | 1,6 | 1,6 | 19 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 42 °            | -                 | 1,6 | 2,2 | 1,6 | -                 |
| 48,3  | 42,4  | 1,6 | 1,6 | 6 °             | -                 | 1,6 | 1,7 | 1,6 | -                 | 8 °             | -                 | 1,6 | 1,7 | 1,6 | -                 |
|       | 33,7  | 1,6 | 1,6 | 10 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 19 °            | -                 | 1,6 | 1,7 | 1,6 | -                 |
|       | 26,9  | 1,6 | 1,6 | 16 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 28 °            | -                 | 1,6 | 1,9 | 1,6 | -                 |
| 60,3  | 48,3  | 1,6 | 1,6 | 7 °             | -                 | 1,6 | 1,7 | 1,6 | -                 | 13 °            | -                 | 1,6 | 1,7 | 1,6 | -                 |
|       | 42,4  | 1,6 | 1,6 | 11 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 20 °            | -                 | 1,6 | 1,8 | 1,6 | -                 |
|       | 33,7  | 1,6 | 1,6 | 16 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 29 °            | -                 | 1,6 | 1,9 | 1,6 | -                 |
| 76,1  | 60,3  | 1,6 | 1,6 | 9 °             | -                 | 1,6 | 1,7 | 1,6 | -                 | 15 °            | -                 | 1,6 | 1,7 | 1,6 | -                 |
|       | 48,3  | 1,6 | 1,6 | 15 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 27 °            | -                 | 1,6 | 1,8 | 1,6 | -                 |
|       | 42,4  | 1,6 | 1,6 | 18 °            | -                 | 1,6 | 1,7 | 1,6 | -                 | 34 °            | -                 | 1,6 | 2,0 | 1,6 | -                 |
| 88,9  | 76,1  | 2,0 | 1,6 | 7 °             | -                 | 2,0 | 1,9 | 1,6 | -                 | 13 °            | -                 | 2,0 | 2,0 | 1,6 | -                 |
|       | 60,3  | 2,0 | 1,6 | 16 °            | -                 | 2,0 | 2,1 | 1,6 | -                 | 30 °            | -                 | 2,0 | 2,4 | 1,6 | -                 |
|       | 48,3  | 2,0 | 1,6 | 22 °            | -                 | 2,0 | 2,2 | 1,6 | -                 | 44 °            | -                 | 2,0 | 2,8 | 1,6 | -                 |
| 114,3 | 88,9  | 2,0 | 2,0 | 13 °            | -                 | 2,0 | 2,1 | 2,0 | -                 | 24 °            | -                 | 2,0 | 2,2 | 2,0 | -                 |
|       | 76,1  | 2,0 | 1,6 | 18 °            | -                 | 2,0 | 2,2 | 1,6 | -                 | 37 °            | -                 | 2,0 | 2,6 | 1,8 | 10,6              |
|       | 60,3  | 2,0 | 1,6 | 26 °            | -                 | 2,0 | 2,3 | 1,6 | -                 | 51 °            | 21,4              | 2,4 | 3,2 | 1,6 | -                 |
| 139,7 | 114,3 | 2,0 | 2,0 | 10 °            | -                 | 2,0 | 2,1 | 2,0 | -                 | 18 °            | -                 | 2,0 | 2,2 | 2,0 | -                 |
|       | 88,9  | 2,0 | 2,0 | 20 °            | -                 | 2,0 | 2,2 | 2,0 | -                 | 35 °            | -                 | 2,0 | 2,5 | 2,0 | -                 |
|       | 76,1  | 2,0 | 1,6 | 25 °            | -                 | 2,0 | 2,3 | 1,6 | -                 | 43 °            | 22,6              | 2,2 | 2,8 | 1,6 | -                 |
| 168,3 | 139,7 | 2,0 | 2,0 | 9 °             | -                 | 2,0 | 2,1 | 2,0 | -                 | 18 °            | -                 | 2,0 | 2,2 | 2,0 | -                 |
|       | 114,3 | 2,0 | 2,0 | 19 °            | -                 | 2,0 | 2,2 | 2,0 | -                 | 34 °            | -                 | 2,0 | 2,5 | 2,0 | -                 |
|       | 88,9  | 2,0 | 2,0 | 27 °            | -                 | 2,0 | 2,3 | 2,0 | -                 | 48 °            | 27,1              | 2,6 | 3,0 | 2,0 | -                 |
| 219,1 | 168,3 | 2,0 | 2,0 | 18 °            | -                 | 2,0 | 2,2 | 2,0 | -                 | 31 °            | -                 | 2,0 | 2,4 | 2,4 | 18,6              |
|       | 139,7 | 2,0 | 2,0 | 27 °            | -                 | 2,0 | 2,3 | 2,0 | -                 | 45 °            | 31,4              | 2,7 | 2,9 | 2,4 | 16,8              |
|       | 114,3 | 2,0 | 2,0 | 33 °            | 27,4              | 2,1 | 2,4 | 2,0 | -                 | 55 °            | 34,8              | 3,3 | 3,5 | 2,0 | -                 |

" to be continued"

**Table C.3 (end)**

| D      | D1    | T   | T1  | Concentric      |                   |     |     |     | Eccentric         |                 |                   |     |     |     |                   |
|--------|-------|-----|-----|-----------------|-------------------|-----|-----|-----|-------------------|-----------------|-------------------|-----|-----|-----|-------------------|
|        |       |     |     | $\alpha_{\max}$ | L2 <sub>min</sub> | T2  | T3  | T4  | L4 <sub>min</sub> | $\alpha_{\max}$ | L2 <sub>min</sub> | T2  | T3  | T4  | L4 <sub>min</sub> |
| 273,0  | 219,1 | 2,0 | 2,0 | 16 °            | -                 | 2,0 | 2,1 | 2,0 | -                 | 28 °            | -                 | 2,0 | 2,5 | 2,5 | 21,6              |
|        | 168,3 | 2,0 | 2,0 | 30 °            | 30,6              | 2,1 | 2,4 | 2,0 | -                 | 48 °            | 37,6              | 3,1 | 3,1 | 2,6 | 19,1              |
|        | 139,7 | 2,0 | 2,0 | 36 °            | 33,0              | 2,4 | 2,5 | 2,0 | -                 | 55 °            | 40,4              | 3,6 | 3,6 | 2,0 | -                 |
| 323,9  | 273,0 | 2,6 | 2,0 | 12 °            | -                 | 2,6 | 2,5 | 2,0 | -                 | 23 °            | -                 | 2,6 | 2,8 | 2,8 | 25,6              |
|        | 219,1 | 2,6 | 2,0 | 24 °            | -                 | 2,6 | 2,9 | 2,3 | 20,9              | 44 °            | 44,1              | 3,6 | 3,7 | 3,5 | 25,5              |
|        | 168,3 | 2,6 | 2,0 | 35 °            | 39,8              | 2,9 | 3,2 | 2,0 | -                 | 55 °            | 49,4              | 4,5 | 4,6 | 2,6 | 19,3              |
| 355,6  | 323,9 | 2,6 | 2,6 | 6 °             | -                 | 2,6 | 2,7 | 2,6 | -                 | 8 °             | -                 | 2,6 | 2,7 | 2,6 | -                 |
|        | 273,0 | 2,6 | 2,0 | 14 °            | -                 | 2,6 | 2,7 | 2,1 | 22,0              | 25 °            | -                 | 2,6 | 2,9 | 2,9 | 26,1              |
| 355,6  | 219,1 | 2,6 | 2,0 | 22 °            | -                 | 2,6 | 2,9 | 2,0 | -                 | 37 °            | 43,5              | 3,2 | 3,3 | 2,8 | 22,9              |
| 406,4  | 355,6 | 2,6 | 2,6 | 8 °             | -                 | 2,6 | 2,7 | 2,6 | -                 | 15 °            | -                 | 2,6 | 2,7 | 2,7 | 28,5              |
|        | 323,9 | 2,6 | 2,6 | 13 °            | -                 | 2,6 | 2,7 | 2,6 | -                 | 24 °            | -                 | 2,6 | 3,1 | 3,1 | 29,2              |
|        | 273,0 | 2,6 | 2,0 | 21 °            | -                 | 2,6 | 2,8 | 2,3 | 23,1              | 36 °            | 47,0              | 3,2 | 3,3 | 3,3 | 27,6              |
| 457,0  | 406,4 | 3,2 | 2,6 | 7 °             | -                 | 3,2 | 3,0 | 2,6 | -                 | 11 °            | -                 | 3,2 | 3,0 | 2,6 | -                 |
|        | 355,6 | 3,2 | 2,6 | 14 °            | -                 | 3,2 | 3,3 | 2,6 | -                 | 24 °            | -                 | 3,2 | 3,6 | 3,6 | 33,1              |
|        | 323,9 | 3,2 | 2,6 | 18 °            | -                 | 3,2 | 3,4 | 2,7 | 27,2              | 31 °            | 51,1              | 3,4 | 3,8 | 3,8 | 32,3              |
| 508,0  | 457,0 | 3,2 | 3,2 | 4 °             | -                 | 3,2 | 3,3 | 3,2 | -                 | 8 °             | -                 | 3,2 | 3,3 | 3,2 | -                 |
|        | 406,4 | 3,2 | 2,6 | 10 °            | -                 | 3,2 | 3,3 | 2,6 | -                 | 18 °            | -                 | 3,2 | 3,4 | 3,2 | 33,7              |
|        | 355,6 | 3,2 | 2,6 | 17 °            | -                 | 3,2 | 3,4 | 2,6 | -                 | 27 °            | -                 | 3,2 | 3,6 | 3,5 | 32,7              |
| 610,0  | 508,0 | 3,2 | 3,2 | 10 °            | -                 | 3,2 | 3,3 | 3,2 | -                 | 17 °            | -                 | 3,2 | 3,5 | 3,5 | 38,9              |
|        | 457,0 | 3,2 | 3,2 | 15 °            | -                 | 3,2 | 3,4 | 3,2 | -                 | 27 °            | 58,9              | 3,4 | 4,0 | 4,0 | 39,5              |
|        | 406,4 | 3,2 | 2,6 | 21 °            | -                 | 3,2 | 3,5 | 3,0 | 32,1              | 35 °            | 65,5              | 4,2 | 4,2 | 4,1 | 37,8              |
| 711,0  | 610,0 | 4,0 | 3,2 | 10 °            | -                 | 4,0 | 3,7 | 3,2 | -                 | 19 °            | -                 | 4,0 | 4,2 | 4,4 | 48,0              |
|        | 508,0 | 4,0 | 3,2 | 15 °            | -                 | 4,0 | 4,2 | 3,3 | 38,1              | 34 °            | 78,1              | 4,8 | 5,1 | 5,5 | 48,9              |
|        | 457,0 | 4,0 | 3,2 | 20 °            | -                 | 4,0 | 4,3 | 3,4 | 36,6              | 40 °            | 83,8              | 5,5 | 5,5 | 5,3 | 45,7              |
| 813,0  | 711,0 | 4,0 | 4,0 | 10 °            | -                 | 4,0 | 4,1 | 4,0 | -                 | 19 °            | -                 | 4,0 | 4,8 | 4,8 | 55,5              |
|        | 610,0 | 4,0 | 3,2 | 15 °            | -                 | 4,0 | 4,2 | 3,7 | 44,1              | 34 °            | 85,6              | 5,0 | 5,6 | 5,9 | 55,9              |
|        | 508,0 | 4,0 | 3,2 | 20 °            | -                 | 4,0 | 4,3 | 3,4 | 38,7              | 45 °            | 96,8              | 6,3 | 6,3 | 5,6 | 49,6              |
| 914,0  | 813,0 | 4,0 | 4,0 | 10 °            | -                 | 4,0 | 4,1 | 4,0 | -                 | 19 °            | -                 | 4,0 | 5,0 | 5,0 | 60,7              |
|        | 711,0 | 4,0 | 4,0 | 15 °            | -                 | 4,0 | 4,2 | 4,0 | -                 | 34 °            | 92,7              | 5,2 | 5,9 | 5,9 | 62,5              |
|        | 610,0 | 4,0 | 3,2 | 20 °            | -                 | 4,0 | 4,3 | 3,9 | 45,3              | 45 °            | 104,9             | 6,6 | 6,6 | 6,4 | 58,0              |
| 1016,0 | 914,0 | 4,0 | 4,0 | 10 °            | -                 | 4,0 | 4,1 | 4,0 | -                 | 19 °            | -                 | 4,0 | 5,1 | 5,1 | 65,6              |
|        | 813,0 | 4,0 | 4,0 | 15 °            | -                 | 4,0 | 4,2 | 4,1 | 55,0              | 34 °            | 99,6              | 5,4 | 6,3 | 6,3 | 68,8              |
|        | 711,0 | 4,0 | 4,0 | 20 °            | -                 | 4,0 | 4,3 | 4,1 | 51,5              | 45 °            | 112,7             | 6,8 | 6,8 | 6,5 | 65,8              |

**Table C.4 — Wall thickness of reducers – Wall thickness serie 2**

| D      | D1    | T   | T1  | concentric      |                   |     |     |     | eccentric         |                 |                   |     |     |     |                   |
|--------|-------|-----|-----|-----------------|-------------------|-----|-----|-----|-------------------|-----------------|-------------------|-----|-----|-----|-------------------|
|        |       |     |     | $\alpha_{\max}$ | L2 <sub>min</sub> | T2  | T3  | T4  | L4 <sub>min</sub> | $\alpha_{\max}$ | L2 <sub>min</sub> | T2  | T3  | T4  | L4 <sub>min</sub> |
| 42,4   | 33,7  | 2,0 | 2,0 | 9 °             | -                 | 2,0 | 2,1 | 2,0 | -                 | 16 °            | -                 | 2,0 | 2,1 | 2,0 | -                 |
| 48,3   | 42,4  | 2,0 | 2,0 | 6 °             | -                 | 2,0 | 2,1 | 2,0 | -                 | 8 °             | -                 | 2,0 | 2,1 | 2,0 | -                 |
|        | 33,7  | 2,0 | 2,0 | 10 °            | -                 | 2,0 | 2,1 | 2,0 | -                 | 19 °            | -                 | 2,0 | 2,2 | 2,0 | -                 |
| 60,3   | 48,3  | 2,0 | 2,0 | 7 °             | -                 | 2,0 | 2,1 | 2,0 | -                 | 13 °            | -                 | 2,0 | 2,1 | 2,0 | -                 |
|        | 42,4  | 2,0 | 2,0 | 11 °            | -                 | 2,0 | 2,1 | 2,0 | -                 | 20 °            | -                 | 2,0 | 2,2 | 2,0 | -                 |
|        | 33,7  | 2,0 | 2,0 | 16 °            | -                 | 2,0 | 2,1 | 2,0 | -                 | 29 °            | -                 | 2,0 | 2,3 | 2,0 | -                 |
| 76,1   | 60,3  | 2,3 | 2,0 | 9 °             | -                 | 2,3 | 2,4 | 2,0 | -                 | 15 °            | -                 | 2,3 | 2,4 | 2,0 | -                 |
|        | 48,3  | 2,3 | 2,0 | 15 °            | -                 | 2,3 | 2,4 | 2,0 | -                 | 27 °            | -                 | 2,3 | 2,6 | 2,0 | -                 |
|        | 42,4  | 2,3 | 2,0 | 18 °            | -                 | 2,3 | 2,5 | 2,0 | -                 | 34 °            | -                 | 2,3 | 2,8 | 2,0 | -                 |
| 88,9   | 76,1  | 2,3 | 2,3 | 7 °             | -                 | 2,3 | 2,4 | 2,3 | -                 | 13 °            | -                 | 2,3 | 2,4 | 2,3 | -                 |
|        | 60,3  | 2,3 | 2,0 | 16 °            | -                 | 2,3 | 2,4 | 2,0 | -                 | 30 °            | -                 | 2,3 | 2,7 | 2,0 | -                 |
|        | 48,3  | 2,3 | 2,0 | 22 °            | -                 | 2,3 | 2,5 | 2,0 | -                 | 44 °            | -                 | 2,3 | 3,2 | 2,0 | -                 |
| 114,3  | 88,9  | 2,6 | 2,3 | 13 °            | -                 | 2,6 | 2,7 | 2,3 | -                 | 24 °            | -                 | 2,6 | 2,9 | 2,3 | -                 |
|        | 76,1  | 2,6 | 2,3 | 18 °            | -                 | 2,6 | 2,8 | 2,3 | -                 | 37 °            | -                 | 2,6 | 3,3 | 2,3 | -                 |
|        | 60,3  | 2,6 | 2,0 | 26 °            | -                 | 2,6 | 2,9 | 2,0 | -                 | 51 °            | 23,2              | 2,9 | 4,2 | 2,0 | -                 |
| 139,7  | 114,3 | 2,6 | 2,6 | 10 °            | -                 | 2,6 | 2,7 | 2,6 | -                 | 18 °            | -                 | 2,6 | 2,8 | 2,6 | -                 |
|        | 88,9  | 2,6 | 2,3 | 20 °            | -                 | 2,6 | 2,8 | 2,3 | -                 | 35 °            | -                 | 2,6 | 3,2 | 2,3 | -                 |
|        | 76,1  | 2,6 | 2,3 | 25 °            | -                 | 2,6 | 2,9 | 2,3 | -                 | 43 °            | -                 | 2,6 | 3,6 | 2,3 | -                 |
| 168,3  | 139,7 | 2,6 | 2,6 | 9 °             | -                 | 2,6 | 2,7 | 2,6 | -                 | 18 °            | -                 | 2,6 | 2,8 | 2,6 | -                 |
|        | 114,3 | 2,6 | 2,6 | 19 °            | -                 | 2,6 | 2,8 | 2,6 | -                 | 34 °            | -                 | 2,6 | 3,2 | 2,6 | -                 |
|        | 88,9  | 2,6 | 2,3 | 27 °            | -                 | 2,6 | 3,0 | 2,3 | -                 | 48 °            | 29,4              | 3,1 | 3,9 | 2,3 | -                 |
| 219,1  | 168,3 | 2,6 | 2,6 | 18 °            | -                 | 2,6 | 2,8 | 2,6 | -                 | 31 °            | -                 | 2,6 | 3,1 | 2,9 | 20,2              |
| 219,1  | 139,7 | 2,6 | 2,6 | 27 °            | -                 | 2,6 | 3,0 | 2,6 | -                 | 45 °            | 34,1              | 3,2 | 3,7 | 2,8 | 18,1              |
|        | 114,3 | 2,6 | 2,6 | 33 °            | -                 | 2,6 | 3,2 | 2,6 | -                 | 55 °            | 37,8              | 3,9 | 4,6 | 2,6 | -                 |
| 273,0  | 219,1 | 3,6 | 2,6 | 16 °            | -                 | 3,6 | 3,4 | 2,6 | -                 | 28 °            | -                 | 3,6 | 3,7 | 3,5 | 25,7              |
|        | 168,3 | 3,6 | 2,6 | 30 °            | -                 | 3,6 | 4,2 | 2,7 | 19,7              | 48 °            | 45,3              | 4,5 | 5,4 | 3,6 | 22,7              |
|        | 139,7 | 3,6 | 2,6 | 36 °            | -                 | 3,6 | 4,5 | 2,6 | -                 | 55 °            | 48,7              | 5,2 | 6,3 | 2,7 | 17,8              |
| 323,9  | 273,0 | 4,0 | 3,6 | 12 °            | -                 | 4,0 | 4,1 | 3,6 | -                 | 23 °            | -                 | 4,0 | 4,4 | 4,1 | 30,9              |
|        | 219,1 | 4,0 | 2,6 | 24 °            | -                 | 4,0 | 4,3 | 3,0 | 23,8              | 44 °            | 49,9              | 4,6 | 5,4 | 4,4 | 28,6              |
|        | 168,3 | 4,0 | 2,6 | 35 °            | -                 | 4,0 | 4,9 | 2,6 | -                 | 55 °            | 56,6              | 5,9 | 7,0 | 3,2 | 21,3              |
| 355,6  | 323,9 | 4,0 | 4,0 | 6 °             | -                 | 4,0 | 4,1 | 4,0 | -                 | 8 °             | -                 | 4,0 | 4,1 | 4,0 | -                 |
|        | 273,0 | 4,0 | 3,6 | 14 °            | -                 | 4,0 | 4,2 | 3,6 | -                 | 25 °            | -                 | 4,0 | 4,5 | 3,9 | 30,2              |
|        | 219,1 | 4,0 | 2,6 | 22 °            | -                 | 4,0 | 4,4 | 2,7 | 22,3              | 37 °            | 49,8              | 4,1 | 5,1 | 3,6 | 26,1              |
| 406,4  | 355,6 | 4,0 | 4,0 | 8 °             | -                 | 4,0 | 4,1 | 4,0 | -                 | 15 °            | -                 | 4,0 | 4,2 | 4,0 | -                 |
|        | 323,9 | 4,0 | 4,0 | 13 °            | -                 | 4,0 | 4,2 | 4,0 | -                 | 24 °            | -                 | 4,0 | 4,4 | 4,2 | 34,0              |
|        | 273,0 | 4,0 | 3,6 | 21 °            | -                 | 4,0 | 4,3 | 3,6 | -                 | 36 °            | 53,9              | 4,3 | 5,0 | 4,3 | 31,5              |
| 457,0  | 406,4 | 4,0 | 4,0 | 7 °             | -                 | 4,0 | 4,1 | 4,0 | -                 | 11 °            | -                 | 4,0 | 4,1 | 4,0 | -                 |
|        | 355,6 | 4,0 | 4,0 | 14 °            | -                 | 4,0 | 4,2 | 4,0 | -                 | 24 °            | -                 | 4,0 | 4,4 | 4,2 | 35,8              |
|        | 323,9 | 4,0 | 4,0 | 18 °            | -                 | 4,0 | 4,3 | 4,0 | -                 | 31 °            | -                 | 4,0 | 4,7 | 4,3 | 34,7              |
| 508,0  | 457,0 | 5,0 | 4,0 | 4 °             | -                 | 5,0 | 4,5 | 4,0 | -                 | 8 °             | -                 | 5,0 | 4,5 | 4,0 | -                 |
|        | 406,4 | 5,0 | 4,0 | 10 °            | -                 | 5,0 | 5,1 | 4,0 | -                 | 18 °            | -                 | 5,0 | 5,3 | 4,4 | 39,3              |
|        | 355,6 | 5,0 | 4,0 | 17 °            | -                 | 5,0 | 5,3 | 4,0 | -                 | 27 °            | -                 | 5,0 | 5,7 | 4,7 | 37,8              |
| 610,0  | 508,0 | 5,6 | 5,0 | 10 °            | -                 | 5,6 | 5,7 | 5,0 | -                 | 17 °            | -                 | 5,6 | 5,9 | 5,2 | 47,5              |
|        | 457,0 | 5,6 | 4,0 | 15 °            | -                 | 5,6 | 5,6 | 4,0 | -                 | 27 °            | -                 | 5,6 | 6,0 | 5,7 | 47,3              |
|        | 406,4 | 5,6 | 4,0 | 21 °            | -                 | 5,6 | 6,0 | 4,3 | 38,7              | 35 °            | 78,2              | 5,9 | 6,9 | 5,9 | 45,4              |
| 711,0  | 610,0 | 5,6 | 5,6 | 10 °            | -                 | 5,6 | 5,7 | 5,6 | -                 | 19 °            | -                 | 5,6 | 6,0 | 6,3 | 57,4              |
|        | 508,0 | 5,6 | 5,0 | 15 °            | -                 | 5,6 | 5,8 | 5,0 | -                 | 34 °            | 87,7              | 6,0 | 6,7 | 7,1 | 55,5              |
|        | 457,0 | 5,6 | 4,0 | 20 °            | -                 | 5,6 | 6,0 | 4,4 | 41,4              | 40 °            | 94,0              | 6,8 | 7,3 | 6,8 | 51,6              |
| 813,0  | 711,0 | 5,6 | 5,6 | 10 °            | -                 | 5,6 | 5,7 | 5,6 | -                 | 19 °            | -                 | 5,6 | 6,1 | 6,1 | 63,7              |
|        | 610,0 | 5,6 | 5,6 | 15 °            | -                 | 5,6 | 5,8 | 5,6 | -                 | 34 °            | 96,1              | 6,2 | 7,1 | 7,7 | 63,8              |
|        | 508,0 | 5,6 | 5,0 | 20 °            | -                 | 5,6 | 6,0 | 5,0 | -                 | 45 °            | 108,8             | 7,9 | 7,9 | 7,4 | 56,9              |
| 914,0  | 813,0 | 6,3 | 5,6 | 10 °            | -                 | 6,3 | 6,4 | 5,6 | -                 | 19 °            | -                 | 6,3 | 7,0 | 7,0 | 72,8              |
|        | 711,0 | 6,3 | 5,6 | 15 °            | -                 | 6,3 | 6,6 | 5,6 | -                 | 34 °            | 108,3             | 7,0 | 8,3 | 8,3 | 74,6              |
|        | 610,0 | 6,3 | 5,6 | 20 °            | -                 | 6,3 | 6,7 | 5,6 | -                 | 45 °            | 122,6             | 8,9 | 8,9 | 9,2 | 69,6              |
| 1016,0 | 914,0 | 6,3 | 6,3 | 10 °            | -                 | 6,3 | 6,4 | 6,3 | -                 | 19 °            | -                 | 6,3 | 7,2 | 7,2 | 78,9              |
|        | 813,0 | 6,3 | 5,6 | 15 °            | -                 | 6,3 | 6,6 | 5,7 | 65,2              | 34 °            | 116,4             | 7,2 | 8,8 | 8,8 | 82,0              |
|        | 711,0 | 6,3 | 5,6 | 20 °            | -                 | 6,3 | 6,7 | 5,6 | -                 | 45 °            | 131,7             | 9,2 | 9,2 | 9,2 | 78,7              |

**Table C.5 — Wall thickness of reducers – Wall thickness serie 3**

| D      | D1    | T    | T1  | concentric      |                   |      |      |     | eccentric         |                 |                   |      |      |      |                   |
|--------|-------|------|-----|-----------------|-------------------|------|------|-----|-------------------|-----------------|-------------------|------|------|------|-------------------|
|        |       |      |     | $\alpha_{\max}$ | L2 <sub>min</sub> | T2   | T3   | T4  | L4 <sub>min</sub> | $\alpha_{\max}$ | L2 <sub>min</sub> | T2   | T3   | T4   | L4 <sub>min</sub> |
| 76,1   | 60,3  | 2,6  | 2,3 | 9 °             | -                 | 2,6  | 2,7  | 2,3 | -                 | 15 °            | -                 | 2,6  | 2,7  | 2,3  | -                 |
| 88,9   | 76,1  | 2,9  | 2,6 | 7 °             | -                 | 2,9  | 3,0  | 2,6 | -                 | 13 °            | -                 | 2,9  | 3,0  | 2,6  | -                 |
|        | 60,3  | 2,9  | 2,3 | 16 °            | -                 | 2,9  | 3,1  | 2,3 | -                 | 30 °            | -                 | 2,9  | 3,4  | 2,3  | -                 |
| 114,3  | 88,9  | 2,9  | 2,9 | 13 °            | -                 | 2,9  | 3,0  | 2,9 | -                 | 24 °            | -                 | 2,9  | 3,2  | 2,9  | -                 |
|        | 76,1  | 2,9  | 2,6 | 18 °            | -                 | 2,9  | 3,1  | 2,6 | -                 | 37 °            | -                 | 2,9  | 3,7  | 2,6  | -                 |
|        | 60,3  | 2,9  | 2,3 | 26 °            | -                 | 2,9  | 3,3  | 2,3 | -                 | 51 °            | 24,0              | 3,1  | 4,7  | 2,3  | -                 |
| 139,7  | 114,3 | 3,2  | 2,9 | 10 °            | -                 | 3,2  | 3,3  | 2,9 | -                 | 18 °            | -                 | 3,2  | 3,4  | 2,9  | -                 |
|        | 88,9  | 3,2  | 2,9 | 20 °            | -                 | 3,2  | 3,5  | 2,9 | -                 | 35 °            | -                 | 3,2  | 4,0  | 2,9  | -                 |
|        | 76,1  | 3,2  | 2,6 | 25 °            | -                 | 3,2  | 3,6  | 2,6 | -                 | 43 °            | -                 | 3,2  | 4,4  | 2,6  | -                 |
| 168,3  | 139,7 | 3,2  | 3,2 | 9 °             | -                 | 3,2  | 3,3  | 3,2 | -                 | 18 °            | -                 | 3,2  | 3,4  | 3,2  | -                 |
|        | 114,3 | 3,2  | 2,9 | 19 °            | -                 | 3,2  | 3,4  | 2,9 | -                 | 34 °            | -                 | 3,2  | 3,9  | 2,9  | -                 |
|        | 88,9  | 3,2  | 2,9 | 27 °            | -                 | 3,2  | 3,6  | 2,9 | -                 | 48 °            | 31,3              | 3,5  | 4,8  | 2,9  | -                 |
| 219,1  | 168,3 | 3,6  | 3,2 | 18 °            | -                 | 3,6  | 3,8  | 3,2 | -                 | 31 °            | -                 | 3,6  | 4,2  | 3,5  | 22,5              |
|        | 139,7 | 3,6  | 3,2 | 27 °            | -                 | 3,6  | 4,1  | 3,2 | -                 | 45 °            | 37,8              | 3,9  | 5,1  | 3,3  | 19,9              |
|        | 114,3 | 3,6  | 2,9 | 33 °            | -                 | 3,6  | 4,3  | 2,9 | -                 | 55 °            | 41,9              | 4,8  | 6,3  | 2,9  | -                 |
| 273,0  | 219,1 | 4,0  | 3,6 | 16 °            | -                 | 4,0  | 4,2  | 3,6 | -                 | 28 °            | -                 | 4,0  | 4,6  | 4,1  | 27,6              |
|        | 168,3 | 4,0  | 3,2 | 30 °            | -                 | 4,0  | 4,7  | 3,2 | -                 | 48 °            | 46,8              | 4,8  | 6,0  | 3,8  | 23,3              |
|        | 139,7 | 4,0  | 3,2 | 36 °            | -                 | 4,0  | 5,0  | 3,2 | -                 | 55 °            | 50,3              | 5,5  | 7,0  | 3,2  | -                 |
| 323,9  | 273,0 | 4,5  | 4,0 | 12 °            | -                 | 4,5  | 4,7  | 4,0 | -                 | 23 °            | -                 | 4,5  | 4,9  | 4,4  | 32,2              |
|        | 219,1 | 4,5  | 3,6 | 24 °            | -                 | 4,5  | 5,0  | 3,6 | -                 | 44 °            | 52,4              | 5,0  | 6,3  | 4,8  | 30,0              |
|        | 168,3 | 4,5  | 3,2 | 35 °            | -                 | 4,5  | 5,5  | 3,2 | -                 | 55 °            | 58,7              | 6,4  | 7,9  | 3,3  | 21,9              |
| 355,6  | 323,9 | 5,0  | 4,5 | 6 °             | -                 | 5,0  | 5,0  | 4,5 | -                 | 8 °             | -                 | 5,0  | 5,0  | 4,5  | -                 |
|        | 273,0 | 5,0  | 4,0 | 14 °            | -                 | 5,0  | 5,2  | 4,0 | -                 | 25 °            | -                 | 5,0  | 5,6  | 4,5  | 32,5              |
|        | 219,1 | 5,0  | 3,6 | 22 °            | -                 | 5,0  | 5,4  | 3,6 | -                 | 37 °            | -                 | 5,0  | 6,3  | 4,2  | 27,9              |
| 406,4  | 355,6 | 5,0  | 5,0 | 8 °             | -                 | 5,0  | 5,1  | 5,0 | -                 | 15 °            | -                 | 5,0  | 5,2  | 5,0  | -                 |
|        | 323,9 | 5,0  | 4,5 | 13 °            | -                 | 5,0  | 5,2  | 4,5 | -                 | 24 °            | -                 | 5,0  | 5,5  | 4,8  | 36,7              |
|        | 273,0 | 5,0  | 4,0 | 21 °            | -                 | 5,0  | 5,4  | 4,0 | -                 | 36 °            | -                 | 5,0  | 6,2  | 4,9  | 33,8              |
| 457,0  | 406,4 | 5,0  | 5,0 | 7 °             | -                 | 5,0  | 5,1  | 5,0 | -                 | 11 °            | -                 | 5,0  | 5,1  | 5,0  | -                 |
|        | 355,6 | 5,0  | 5,0 | 14 °            | -                 | 5,0  | 5,2  | 5,0 | -                 | 24 °            | -                 | 5,0  | 5,5  | 5,0  | -                 |
|        | 323,9 | 5,0  | 4,5 | 18 °            | -                 | 5,0  | 5,3  | 4,5 | -                 | 31 °            | -                 | 5,0  | 5,9  | 5,0  | 37,3              |
| 508,0  | 457,0 | 5,6  | 5,0 | 4 °             | -                 | 5,6  | 5,6  | 5,0 | -                 | 8 °             | -                 | 5,6  | 5,7  | 5,0  | -                 |
|        | 406,4 | 5,6  | 5,0 | 10 °            | -                 | 5,6  | 5,7  | 5,0 | -                 | 18 °            | -                 | 5,6  | 5,9  | 5,0  | -                 |
|        | 355,6 | 5,6  | 5,0 | 17 °            | -                 | 5,6  | 5,9  | 5,0 | -                 | 27 °            | -                 | 5,6  | 6,3  | 5,0  | -                 |
| 610,0  | 508,0 | 6,3  | 5,6 | 10 °            | -                 | 6,3  | 6,4  | 5,6 | -                 | 17 °            | -                 | 6,3  | 6,6  | 5,6  | -                 |
|        | 457,0 | 6,3  | 5,0 | 15 °            | -                 | 6,3  | 6,6  | 5,0 | -                 | 27 °            | -                 | 6,3  | 7,1  | 6,4  | 50,0              |
|        | 406,4 | 6,3  | 5,0 | 21 °            | -                 | 6,3  | 6,8  | 5,0 | -                 | 35 °            | 81,1              | 6,4  | 7,7  | 6,4  | 47,1              |
| 711,0  | 610,0 | 7,1  | 6,3 | 10 °            | -                 | 7,1  | 6,9  | 6,3 | -                 | 19 °            | -                 | 7,1  | 7,2  | 7,2  | 61,6              |
|        | 508,0 | 7,1  | 5,6 | 15 °            | -                 | 7,1  | 7,4  | 5,6 | -                 | 34 °            | -                 | 7,1  | 8,5  | 8,3  | 60,1              |
|        | 457,0 | 7,1  | 5,0 | 20 °            | -                 | 7,1  | 7,6  | 5,2 | 45,1              | 40 °            | 101,8             | 7,9  | 9,2  | 7,9  | 55,7              |
| 813,0  | 711,0 | 8,0  | 7,1 | 10 °            | -                 | 8,0  | 8,2  | 7,1 | -                 | 19 °            | -                 | 8,0  | 8,5  | 8,0  | 73,0              |
|        | 610,0 | 8,0  | 6,3 | 15 °            | -                 | 8,0  | 8,0  | 6,3 | -                 | 34 °            | -                 | 8,0  | 9,3  | 9,8  | 71,7              |
|        | 508,0 | 8,0  | 5,6 | 20 °            | -                 | 8,0  | 8,5  | 5,6 | -                 | 45 °            | 122,5             | 9,9  | 11,4 | 9,3  | 63,5              |
| 914,0  | 813,0 | 8,8  | 8,0 | 10 °            | -                 | 8,8  | 9,0  | 8,0 | -                 | 19 °            | -                 | 8,8  | 9,3  | 9,0  | 83,2              |
|        | 711,0 | 8,8  | 7,1 | 15 °            | -                 | 8,8  | 9,1  | 7,1 | -                 | 34 °            | -                 | 8,8  | 10,8 | 10,8 | 84,7              |
|        | 610,0 | 8,8  | 6,3 | 20 °            | -                 | 8,8  | 9,2  | 6,8 | 59,6              | 45 °            | 136,0             | 11,0 | 12,2 | 11,2 | 76,7              |
| 1016,0 | 914,0 | 10,0 | 8,8 | 10 °            | -                 | 10,0 | 9,9  | 8,8 | -                 | 19 °            | -                 | 10,0 | 10,3 | 10,1 | 93,6              |
|        | 813,0 | 10,0 | 8,0 | 15 °            | -                 | 10,0 | 10,3 | 8,0 | -                 | 34 °            | -                 | 10,0 | 12,4 | 12,4 | 97,5              |
|        | 711,0 | 10,0 | 7,1 | 20 °            | -                 | 10,0 | 10,8 | 7,6 | 71,4              | 45 °            | 153,6             | 12,5 | 14,2 | 12,6 | 91,7              |

Tableau C.6 — Wall thickness of reducers – Wall thickness serie 4

| D      | D1    | T    | T1   | concentric      |                    |      |      |      | eccentric          |                 |                    |      |      |      |                    |
|--------|-------|------|------|-----------------|--------------------|------|------|------|--------------------|-----------------|--------------------|------|------|------|--------------------|
|        |       |      |      | $\alpha_{\max}$ | L <sub>2_min</sub> | T2   | T3   | T4   | L <sub>4_min</sub> | $\alpha_{\max}$ | L <sub>2_min</sub> | T2   | T3   | T4   | L <sub>4_min</sub> |
| 26,9   | 21,3  | 2,0  | 2,0  | 8 °             | -                  | 2,0  | 2,1  | 2,0  | -                  | 15 °            | -                  | 2,0  | 2,1  | 2,0  | -                  |
| 33,7   | 26,9  | 2,3  | 2,0  | 7 °             | -                  | 2,3  | 2,4  | 2,0  | -                  | 13 °            | -                  | 2,3  | 2,4  | 2,0  | -                  |
|        | 21,3  | 2,3  | 2,0  | 12 °            | -                  | 2,3  | 2,4  | 2,0  | -                  | 24 °            | -                  | 2,3  | 2,6  | 2,0  | -                  |
| 42,4   | 33,7  | 2,6  | 2,3  | 9 °             | -                  | 2,6  | 2,7  | 2,3  | -                  | 16 °            | -                  | 2,6  | 2,8  | 2,3  | -                  |
|        | 26,9  | 2,6  | 2,0  | 15 °            | -                  | 2,6  | 2,7  | 2,0  | -                  | 30 °            | -                  | 2,6  | 3,1  | 2,0  | -                  |
|        | 21,3  | 2,6  | 2,0  | 19 °            | -                  | 2,6  | 2,8  | 2,0  | -                  | 42 °            | -                  | 2,6  | 3,5  | 2,0  | -                  |
|        | 42,4  | 2,6  | 2,6  | 6 °             | -                  | 2,6  | 2,7  | 2,6  | -                  | 8 °             | -                  | 2,6  | 2,7  | 2,6  | -                  |
| 48,3   | 33,7  | 2,6  | 2,3  | 10 °            | -                  | 2,6  | 2,7  | 2,3  | -                  | 19 °            | -                  | 2,6  | 2,8  | 2,3  | -                  |
|        | 26,9  | 2,6  | 2,0  | 16 °            | -                  | 2,6  | 2,8  | 2,0  | -                  | 28 °            | -                  | 2,6  | 3,0  | 2,0  | -                  |
|        | 48,3  | 2,9  | 2,6  | 7 °             | -                  | 2,9  | 3,0  | 2,6  | -                  | 13 °            | -                  | 2,9  | 3,0  | 2,6  | -                  |
| 60,3   | 42,4  | 2,9  | 2,6  | 11 °            | -                  | 2,9  | 3,0  | 2,6  | -                  | 20 °            | -                  | 2,9  | 3,1  | 2,6  | -                  |
|        | 33,7  | 2,9  | 2,3  | 16 °            | -                  | 2,9  | 3,1  | 2,3  | -                  | 29 °            | -                  | 2,9  | 3,4  | 2,3  | -                  |
| 76,1   | 60,3  | 2,9  | 2,9  | 9 °             | -                  | 2,9  | 3,0  | 2,9  | -                  | 15 °            | -                  | 2,9  | 3,1  | 2,9  | -                  |
|        | 48,3  | 2,9  | 2,6  | 15 °            | -                  | 2,9  | 3,1  | 2,6  | -                  | 27 °            | -                  | 2,9  | 3,3  | 2,6  | -                  |
|        | 42,4  | 2,9  | 2,6  | 18 °            | -                  | 2,9  | 3,1  | 2,6  | -                  | 34 °            | -                  | 2,9  | 3,5  | 2,6  | -                  |
| 88,9   | 76,1  | 3,2  | 2,9  | 7 °             | -                  | 3,2  | 3,3  | 2,9  | -                  | 13 °            | -                  | 3,2  | 3,3  | 2,9  | -                  |
|        | 60,3  | 3,2  | 2,9  | 16 °            | -                  | 3,2  | 3,4  | 2,9  | -                  | 30 °            | -                  | 3,2  | 3,7  | 2,9  | -                  |
|        | 48,3  | 3,2  | 2,6  | 22 °            | -                  | 3,2  | 3,5  | 2,6  | -                  | 44 °            | -                  | 3,2  | 4,5  | 2,6  | -                  |
| 114,3  | 88,9  | 3,6  | 3,2  | 13 °            | -                  | 3,6  | 3,7  | 3,2  | -                  | 24 °            | -                  | 3,6  | 4,0  | 3,2  | -                  |
|        | 76,1  | 3,6  | 2,9  | 18 °            | -                  | 3,6  | 3,8  | 2,9  | -                  | 37 °            | -                  | 3,6  | 4,6  | 2,9  | -                  |
|        | 60,3  | 3,6  | 2,9  | 26 °            | -                  | 3,6  | 4,1  | 2,9  | -                  | 51 °            | -                  | 3,6  | 5,8  | 2,9  | -                  |
| 139,7  | 114,3 | 4,0  | 3,6  | 10 °            | -                  | 4,0  | 4,1  | 3,6  | -                  | 18 °            | -                  | 4,0  | 4,3  | 3,6  | -                  |
|        | 88,9  | 4,0  | 3,2  | 20 °            | -                  | 4,0  | 4,3  | 3,2  | -                  | 35 °            | -                  | 4,0  | 4,9  | 3,2  | -                  |
|        | 76,1  | 4,0  | 2,9  | 25 °            | -                  | 4,0  | 4,5  | 2,9  | -                  | 43 °            | -                  | 4,0  | 5,5  | 2,9  | -                  |
| 168,3  | 139,7 | 4,5  | 4,0  | 9 °             | -                  | 4,5  | 4,6  | 4,0  | -                  | 18 °            | -                  | 4,5  | 4,8  | 4,0  | -                  |
|        | 114,3 | 4,5  | 3,6  | 19 °            | -                  | 4,5  | 4,8  | 3,6  | -                  | 34 °            | -                  | 4,5  | 5,5  | 3,6  | -                  |
|        | 88,9  | 4,5  | 3,2  | 27 °            | -                  | 4,5  | 5,1  | 3,2  | -                  | 48 °            | -                  | 4,5  | 6,8  | 3,2  | -                  |
| 219,1  | 168,3 | 6,3  | 4,5  | 18 °            | -                  | 6,3  | 6,2  | 4,5  | -                  | 31 °            | -                  | 6,3  | 6,9  | 4,9  | 26,5               |
|        | 139,7 | 6,3  | 4,0  | 27 °            | -                  | 6,3  | 7,1  | 4,0  | -                  | 45 °            | -                  | 6,3  | 8,9  | 4,7  | 23,4               |
|        | 114,3 | 6,3  | 3,6  | 33 °            | -                  | 6,3  | 7,6  | 3,6  | -                  | 55 °            | 49,9               | 6,8  | 11,0 | 3,6  | -                  |
| 273,0  | 219,1 | 6,3  | 6,3  | 16 °            | -                  | 6,3  | 6,6  | 6,3  | -                  | 28 °            | -                  | 6,3  | 7,2  | 6,3  | -                  |
|        | 168,3 | 6,3  | 4,5  | 30 °            | -                  | 6,3  | 7,3  | 4,5  | -                  | 48 °            | 54,0               | 6,4  | 9,5  | 4,9  | 26,5               |
|        | 139,7 | 6,3  | 4,0  | 36 °            | -                  | 6,3  | 7,8  | 4,0  | -                  | 55 °            | 58,0               | 7,4  | 11,0 | 4,0  | -                  |
| 323,9  | 273,0 | 7,1  | 6,3  | 12 °            | -                  | 7,1  | 7,3  | 6,3  | -                  | 23 °            | -                  | 7,1  | 7,8  | 6,3  | -                  |
|        | 219,1 | 7,1  | 6,3  | 24 °            | -                  | 7,1  | 7,8  | 6,3  | -                  | 44 °            | -                  | 7,1  | 9,9  | 6,3  | -                  |
|        | 168,3 | 7,1  | 4,5  | 35 °            | -                  | 7,1  | 8,7  | 4,5  | -                  | 55 °            | 67,7               | 8,5  | 12,4 | 4,5  | -                  |
| 355,6  | 323,9 | 8,0  | 7,1  | 6 °             | -                  | 8,0  | 7,9  | 7,1  | -                  | 8 °             | -                  | 8,0  | 7,9  | 7,1  | -                  |
|        | 273,0 | 8,0  | 6,3  | 14 °            | -                  | 8,0  | 8,3  | 6,3  | -                  | 25 °            | -                  | 8,0  | 8,9  | 6,3  | -                  |
|        | 219,1 | 8,0  | 6,3  | 22 °            | -                  | 8,0  | 8,7  | 6,3  | -                  | 37 °            | -                  | 8,0  | 10,1 | 6,3  | -                  |
| 406,4  | 355,6 | 8,8  | 8,0  | 8 °             | -                  | 8,8  | 8,9  | 8,0  | -                  | 15 °            | -                  | 8,8  | 9,2  | 8,0  | -                  |
|        | 323,9 | 8,8  | 7,1  | 13 °            | -                  | 8,8  | 9,1  | 7,1  | -                  | 24 °            | -                  | 8,8  | 9,7  | 7,2  | 44,6               |
|        | 273,0 | 8,8  | 6,3  | 21 °            | -                  | 8,8  | 9,5  | 6,3  | -                  | 36 °            | -                  | 8,8  | 10,9 | 7,0  | 40,4               |
| 457,0  | 406,4 | 10,0 | 8,8  | 7 °             | -                  | 10,0 | 10,0 | 8,8  | -                  | 11 °            | -                  | 10,0 | 10,1 | 8,8  | -                  |
|        | 355,6 | 10,0 | 8,0  | 14 °            | -                  | 10,0 | 10,4 | 8,0  | -                  | 24 °            | -                  | 10,0 | 11,0 | 8,0  | -                  |
|        | 323,9 | 10,0 | 7,1  | 18 °            | -                  | 10,0 | 10,6 | 7,1  | -                  | 31 °            | -                  | 10,0 | 11,7 | 7,9  | 46,8               |
| 508,0  | 457,0 | 11,0 | 10,0 | 4 °             | -                  | 11,0 | 11,1 | 10,0 | -                  | 8 °             | -                  | 11,0 | 11,2 | 10,0 | -                  |
|        | 406,4 | 11,0 | 8,8  | 10 °            | -                  | 11,0 | 11,2 | 8,8  | -                  | 18 °            | -                  | 11,0 | 11,6 | 8,8  | -                  |
|        | 355,6 | 11,0 | 8,0  | 17 °            | -                  | 11,0 | 11,6 | 8,0  | -                  | 27 °            | -                  | 11,0 | 12,4 | 8,0  | -                  |
| 610,0  | 508,0 | 12,5 | 11,0 | 10 °            | -                  | 12,5 | 12,7 | 11,0 | -                  | 17 °            | -                  | 12,5 | 13,1 | 11,0 | -                  |
|        | 457,0 | 12,5 | 10,0 | 15 °            | -                  | 12,5 | 13,0 | 10,0 | -                  | 27 °            | -                  | 12,5 | 14,1 | 10,1 | 62,9               |
|        | 406,4 | 12,5 | 8,8  | 21 °            | -                  | 12,5 | 13,4 | 8,8  | -                  | 35 °            | -                  | 12,5 | 15,3 | 9,8  | 58,4               |
| 711,0  | 610,0 | 12,5 | 12,5 | 10 °            | -                  | 12,5 | 12,7 | 12,5 | -                  | 19 °            | -                  | 12,5 | 13,2 | 12,5 | -                  |
|        | 508,0 | 12,5 | 11,0 | 15 °            | -                  | 12,5 | 13,0 | 11,0 | -                  | 34 °            | -                  | 12,5 | 15,0 | 12,0 | 72,3               |
|        | 457,0 | 12,5 | 10,0 | 20 °            | -                  | 12,5 | 13,3 | 10,0 | -                  | 40 °            | -                  | 12,5 | 16,2 | 11,2 | 66,2               |
| 813,0  | 711,0 | 12,5 | 12,5 | 10 °            | -                  | 12,5 | 12,7 | 12,5 | -                  | 19 °            | -                  | 12,5 | 13,2 | 12,5 | -                  |
|        | 610,0 | 12,5 | 12,5 | 15 °            | -                  | 12,5 | 13,0 | 12,5 | -                  | 34 °            | -                  | 12,5 | 15,0 | 13,5 | 84,0               |
|        | 508,0 | 12,5 | 11,0 | 20 °            | -                  | 12,5 | 13,3 | 11,0 | -                  | 45 °            | 141,2              | 13,2 | 17,5 | 12,0 | 72,3               |
| 914,0  | 813,0 | 12,5 | 12,5 | 10 °            | -                  | 12,5 | 12,7 | 12,5 | -                  | 19 °            | -                  | 12,5 | 13,2 | 12,5 | -                  |
|        | 711,0 | 12,5 | 12,5 | 15 °            | -                  | 12,5 | 13,0 | 12,5 | -                  | 34 °            | -                  | 12,5 | 15,0 | 13,4 | 94,9               |
|        | 610,0 | 12,5 | 12,5 | 20 °            | -                  | 12,5 | 13,3 | 12,5 | -                  | 45 °            | 153,0              | 13,8 | 17,5 | 14,0 | 85,6               |
| 1016,0 | 914,0 | 12,5 | 12,5 | 10 °            | -                  | 12,5 | 12,7 | 12,5 | -                  | 19 °            | -                  | 12,5 | 13,2 | 12,5 | -                  |
|        | 813,0 | 12,5 | 12,5 | 15 °            | -                  | 12,5 | 13,0 | 12,5 | -                  | 34 °            | -                  | 12,5 | 15,0 | 14,4 | 105,4              |
|        | 711,0 | 12,5 | 12,5 | 20 °            | -                  | 12,5 | 13,3 | 12,5 | -                  | 45 °            | 164,5              | 14,3 | 17,5 | 14,3 | 97,9               |

**Table C.7 —C. Wall thickness of reducers – Wall thickness serie 5**

| D     | D1    | T    | T1   | concentric      |                   |                |                |                | eccentric         |                 |                   |                |                |                |
|-------|-------|------|------|-----------------|-------------------|----------------|----------------|----------------|-------------------|-----------------|-------------------|----------------|----------------|----------------|
|       |       |      |      | $\alpha_{\max}$ | L <sub>2min</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> | L <sub>4min</sub> | $\alpha_{\max}$ | L <sub>2min</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> |
| 26,9  | 21,3  | 3,2  | 3,2  | 8°              | -                 | 3,2            | 3,3            | 3,2            | -                 | 15°             | -                 | 3,2            | 3,4            | 3,2            |
| 33,7  | 26,9  | 3,2  | 3,2  | 7°              | -                 | 3,2            | 3,3            | 3,2            | -                 | 13°             | -                 | 3,2            | 3,3            | 3,2            |
|       | 21,3  | 3,2  | 3,2  | 12°             | -                 | 3,2            | 3,3            | 3,2            | -                 | 24°             | -                 | 3,2            | 3,6            | 3,2            |
| 42,4  | 33,7  | 3,6  | 3,2  | 9°              | -                 | 3,6            | 3,7            | 3,2            | -                 | 16°             | -                 | 3,6            | 3,8            | 3,2            |
|       | 26,9  | 3,6  | 3,2  | 15°             | -                 | 3,6            | 3,8            | 3,2            | -                 | 30°             | -                 | 3,6            | 4,2            | 3,2            |
|       | 21,3  | 3,6  | 3,2  | 19°             | -                 | 3,6            | 3,9            | 3,2            | -                 | 42°             | -                 | 3,6            | 4,9            | 3,2            |
| 48,3  | 42,4  | 3,6  | 3,6  | 6°              | -                 | 3,6            | 3,7            | 3,6            | -                 | 8°              | -                 | 3,6            | 3,7            | 3,6            |
|       | 33,7  | 3,6  | 3,2  | 10°             | -                 | 3,6            | 3,7            | 3,2            | -                 | 19°             | -                 | 3,6            | 3,9            | 3,2            |
|       | 26,9  | 3,6  | 3,2  | 16°             | -                 | 3,6            | 3,8            | 3,2            | -                 | 28°             | -                 | 3,6            | 4,1            | 3,2            |
| 60,3  | 48,3  | 4,0  | 3,6  | 7°              | -                 | 4,0            | 4,1            | 3,6            | -                 | 13°             | -                 | 4,0            | 4,2            | 3,6            |
|       | 42,4  | 4,0  | 3,6  | 11°             | -                 | 4,0            | 4,1            | 3,6            | -                 | 20°             | -                 | 4,0            | 4,3            | 3,6            |
|       | 33,7  | 4,0  | 3,2  | 16°             | -                 | 4,0            | 4,2            | 3,2            | -                 | 29°             | -                 | 4,0            | 4,6            | 3,2            |
| 76,1  | 60,3  | 5,0  | 4,0  | 9°              | -                 | 5,0            | 5,1            | 4,0            | -                 | 15°             | -                 | 5,0            | 5,2            | 4,0            |
|       | 48,3  | 5,0  | 3,6  | 15°             | -                 | 5,0            | 5,2            | 3,6            | -                 | 27°             | -                 | 5,0            | 5,7            | 3,6            |
|       | 42,4  | 5,0  | 3,6  | 18°             | -                 | 5,0            | 5,3            | 3,6            | -                 | 34°             | -                 | 5,0            | 6,1            | 3,6            |
| 88,9  | 76,1  | 5,6  | 5,0  | 7°              | -                 | 5,6            | 5,7            | 5,0            | -                 | 13°             | -                 | 5,6            | 5,8            | 5,0            |
|       | 60,3  | 5,6  | 4,0  | 16°             | -                 | 5,6            | 5,9            | 4,0            | -                 | 30°             | -                 | 5,6            | 6,5            | 4,0            |
|       | 48,3  | 5,6  | 3,6  | 22°             | -                 | 5,6            | 6,1            | 3,6            | -                 | 44°             | -                 | 5,6            | 7,8            | 3,6            |
| 114,3 | 88,9  | 6,3  | 5,6  | 13°             | -                 | 6,3            | 6,5            | 5,6            | -                 | 24°             | -                 | 6,3            | 6,9            | 5,6            |
|       | 76,1  | 6,3  | 5,0  | 18°             | -                 | 6,3            | 6,7            | 5,0            | -                 | 37°             | -                 | 6,3            | 7,9            | 5,0            |
|       | 60,3  | 6,3  | 4,0  | 26°             | -                 | 6,3            | 7,1            | 4,0            | -                 | 51°             | -                 | 6,3            | 10,1           | 4,0            |
| 139,7 | 114,3 | 6,3  | 6,3  | 10°             | -                 | 6,3            | 6,4            | 6,3            | -                 | 18°             | -                 | 6,3            | 6,7            | 6,3            |
|       | 88,9  | 6,3  | 5,6  | 20°             | -                 | 6,3            | 6,8            | 5,6            | -                 | 35°             | -                 | 6,3            | 7,7            | 5,6            |
|       | 76,1  | 6,3  | 5,0  | 25°             | -                 | 6,3            | 7,0            | 5,0            | -                 | 43°             | -                 | 6,3            | 8,7            | 5,0            |
| 168,3 | 139,7 | 7,1  | 6,3  | 9°              | -                 | 7,1            | 7,2            | 6,3            | -                 | 18°             | -                 | 7,1            | 7,5            | 6,3            |
|       | 114,3 | 7,1  | 6,3  | 19°             | -                 | 7,1            | 7,6            | 6,3            | -                 | 34°             | -                 | 7,1            | 8,6            | 6,3            |
|       | 88,9  | 7,1  | 5,6  | 27°             | -                 | 7,1            | 8,0            | 5,6            | -                 | 48°             | -                 | 7,1            | 10,7           | 5,6            |
| 219,1 | 168,3 | 8,0  | 7,1  | 18°             | -                 | 8,0            | 8,5            | 7,1            | -                 | 31°             | -                 | 8,0            | 9,4            | 7,1            |
|       | 139,7 | 8,0  | 6,3  | 27°             | -                 | 8,0            | 9,0            | 6,3            | -                 | 45°             | -                 | 8,0            | 11,4           | 6,3            |
|       | 114,3 | 8,0  | 6,3  | 33°             | -                 | 8,0            | 9,6            | 6,3            | -                 | 55°             | -                 | 8,0            | 14,0           | 6,3            |
| 273,0 | 219,1 | 10,0 | 8,0  | 16°             | -                 | 10,0           | 10,4           | 8,0            | -                 | 28°             | -                 | 10,0           | 11,3           | 8,0            |
|       | 168,3 | 10,0 | 7,1  | 30°             | -                 | 10,0           | 11,6           | 7,1            | -                 | 48°             | -                 | 10,0           | 15,0           | 7,1            |
|       | 139,7 | 10,0 | 6,3  | 36°             | -                 | 10,0           | 12,4           | 6,3            | -                 | 55°             | -                 | 10,0           | 17,5           | 6,3            |
| 323,9 | 273,0 | 10,0 | 10,0 | 12°             | -                 | 10,0           | 10,3           | 10,0           | -                 | 23°             | -                 | 10,0           | 10,9           | 10,0           |
|       | 219,1 | 10,0 | 8,0  | 24°             | -                 | 10,0           | 11,0           | 8,0            | -                 | 44°             | -                 | 10,0           | 14,0           | 8,0            |
|       | 168,3 | 10,0 | 7,1  | 35°             | -                 | 10,0           | 12,3           | 7,1            | -                 | 55°             | 75,3              | 10,5           | 17,5           | 7,1            |
| 355,6 | 323,9 | 11,0 | 10,0 | 6°              | -                 | 11,0           | 11,1           | 10,0           | -                 | 8°              | -                 | 11,0           | 11,1           | 10,0           |
|       | 273,0 | 11,0 | 10,0 | 14°             | -                 | 11,0           | 11,4           | 10,0           | -                 | 25°             | -                 | 11,0           | 12,2           | 10,0           |
|       | 219,1 | 11,0 | 8,0  | 22°             | -                 | 11,0           | 11,9           | 8,0            | -                 | 37°             | -                 | 11,0           | 13,8           | 8,0            |
| 406,4 | 355,6 | 12,5 | 11,0 | 8°              | -                 | 12,5           | 12,7           | 11,0           | -                 | 15°             | -                 | 12,5           | 13,0           | 11,0           |
|       | 323,9 | 12,5 | 10,0 | 13°             | -                 | 12,5           | 12,9           | 10,0           | -                 | 24°             | -                 | 12,5           | 13,7           | 10,0           |
|       | 273,0 | 12,5 | 10,0 | 21°             | -                 | 12,5           | 13,4           | 10,0           | -                 | 36°             | -                 | 12,5           | 15,5           | 10,0           |

**Table C.8 — Wall thickness of reducers – Wall thickness serie 6**

| D     | D1    | T    | T1   | concentric      |                   |      |      |      |                   | eccentric       |                   |      |      |      |                   |
|-------|-------|------|------|-----------------|-------------------|------|------|------|-------------------|-----------------|-------------------|------|------|------|-------------------|
|       |       |      |      | $\alpha_{\max}$ | L2 <sub>min</sub> | T2   | T3   | T4   | L4 <sub>min</sub> | $\alpha_{\max}$ | L2 <sub>min</sub> | T2   | T3   | T4   | L4 <sub>min</sub> |
| 26,9  | 21,3  | 4,0  | 4,0  | 8 °             | -                 | 4,0  | 4,1  | 4,0  | -                 | 15 °            | -                 | 4,0  | 4,2  | 4,0  | -                 |
| 33,7  | 26,9  | 4,5  | 4,0  | 7 °             | -                 | 4,5  | 4,6  | 4,0  | -                 | 13 °            | -                 | 4,5  | 4,7  | 4,0  | -                 |
|       | 21,3  | 4,5  | 4,0  | 12 °            | -                 | 4,5  | 4,7  | 4,0  | -                 | 24 °            | -                 | 4,5  | 5,0  | 4,0  | -                 |
| 42,4  | 33,7  | 5,0  | 4,5  | 9 °             | -                 | 5,0  | 5,1  | 4,5  | -                 | 16 °            | -                 | 5,0  | 5,3  | 4,5  | -                 |
| 42,4  | 26,9  | 5,0  | 4,0  | 15 °            | -                 | 5,0  | 5,2  | 4,0  | -                 | 30 °            | -                 | 5,0  | 5,8  | 4,0  | -                 |
|       | 21,3  | 5,0  | 4,0  | 19 °            | -                 | 5,0  | 5,3  | 4,0  | -                 | 42 °            | -                 | 5,0  | 6,8  | 4,0  | -                 |
| 48,3  | 42,4  | 5,0  | 5,0  | 6 °             | -                 | 5,0  | 5,1  | 5,0  | -                 | 8 °             | -                 | 5,0  | 5,1  | 5,0  | -                 |
|       | 33,7  | 5,0  | 4,5  | 10 °            | -                 | 5,0  | 5,1  | 4,5  | -                 | 19 °            | -                 | 5,0  | 5,3  | 4,5  | -                 |
|       | 26,9  | 5,0  | 4,0  | 16 °            | -                 | 5,0  | 5,3  | 4,0  | -                 | 28 °            | -                 | 5,0  | 5,7  | 4,0  | -                 |
| 60,3  | 48,3  | 5,6  | 5,0  | 7 °             | -                 | 5,6  | 5,7  | 5,0  | -                 | 13 °            | -                 | 5,6  | 5,8  | 5,0  | -                 |
|       | 42,4  | 5,6  | 5,0  | 11 °            | -                 | 5,6  | 5,8  | 5,0  | -                 | 20 °            | -                 | 5,6  | 6,0  | 5,0  | -                 |
|       | 33,7  | 5,6  | 4,5  | 16 °            | -                 | 5,6  | 5,9  | 4,5  | -                 | 29 °            | -                 | 5,6  | 6,5  | 4,5  | -                 |
| 76,1  | 60,3  | 7,1  | 5,6  | 9 °             | -                 | 7,1  | 7,2  | 5,6  | -                 | 15 °            | -                 | 7,1  | 7,4  | 5,6  | -                 |
|       | 48,3  | 7,1  | 5,0  | 15 °            | -                 | 7,1  | 7,4  | 5,0  | -                 | 27 °            | -                 | 7,1  | 8,0  | 5,0  | -                 |
|       | 42,4  | 7,1  | 5,0  | 18 °            | -                 | 7,1  | 7,5  | 5,0  | -                 | 34 °            | -                 | 7,1  | 8,6  | 5,0  | -                 |
| 88,9  | 76,1  | 8,0  | 7,1  | 7 °             | -                 | 8,0  | 8,1  | 7,1  | -                 | 13 °            | -                 | 8,0  | 8,3  | 7,1  | -                 |
|       | 60,3  | 8,0  | 5,6  | 16 °            | -                 | 8,0  | 8,4  | 5,6  | -                 | 30 °            | -                 | 8,0  | 9,3  | 5,6  | -                 |
|       | 48,3  | 8,0  | 5,0  | 22 °            | -                 | 8,0  | 8,7  | 5,0  | -                 | 44 °            | -                 | 8,0  | 11,2 | 5,0  | -                 |
| 114,3 | 88,9  | 8,8  | 8,0  | 13 °            | -                 | 8,8  | 9,1  | 8,0  | -                 | 24 °            | -                 | 8,8  | 9,7  | 8,0  | -                 |
|       | 76,1  | 8,8  | 7,1  | 18 °            | -                 | 8,8  | 9,3  | 7,1  | -                 | 37 °            | -                 | 8,8  | 11,1 | 7,1  | -                 |
|       | 60,3  | 8,8  | 5,6  | 26 °            | -                 | 8,8  | 9,8  | 5,6  | -                 | 51 °            | -                 | 8,8  | 14,0 | 5,6  | -                 |
| 139,7 | 114,3 | 10,0 | 8,8  | 10 °            | -                 | 10,0 | 10,2 | 8,8  | -                 | 18 °            | -                 | 10,0 | 10,6 | 8,8  | -                 |
|       | 88,9  | 10,0 | 8,0  | 20 °            | -                 | 10,0 | 10,7 | 8,0  | -                 | 35 °            | -                 | 10,0 | 12,3 | 8,0  | -                 |
|       | 76,1  | 10,0 | 7,1  | 25 °            | -                 | 10,0 | 11,1 | 7,1  | -                 | 43 °            | -                 | 10,0 | 13,7 | 7,1  | -                 |
| 168,3 | 139,7 | 11,0 | 10,0 | 9 °             | -                 | 11,0 | 11,2 | 10,0 | -                 | 18 °            | -                 | 11,0 | 11,6 | 10,0 | -                 |
|       | 114,3 | 11,0 | 8,8  | 19 °            | -                 | 11,0 | 11,7 | 8,8  | -                 | 34 °            | -                 | 11,0 | 13,3 | 8,8  | -                 |
|       | 88,9  | 11,0 | 8,0  | 27 °            | -                 | 11,0 | 12,4 | 8,0  | -                 | 48 °            | -                 | 11,0 | 16,5 | 8,0  | -                 |
| 219,1 | 168,3 | 12,5 | 11,0 | 18 °            | -                 | 12,5 | 13,2 | 11,0 | -                 | 31 °            | -                 | 12,5 | 14,6 | 11,0 | -                 |
|       | 139,7 | 12,5 | 10,0 | 27 °            | -                 | 12,5 | 14,1 | 10,0 | -                 | 45 °            | -                 | 12,5 | 17,7 | 10,0 | -                 |
|       | 114,3 | 12,5 | 8,8  | 33 °            | -                 | 12,5 | 15,0 | 8,8  | -                 | 55 °            | -                 | 12,5 | 21,8 | 8,8  | -                 |

## Annex D

(informative)

### Commonly used inside diameters and wall thicknesses

**Table D.1 — commonly used diameters and wall thicknesses**

| ID     | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9    | 10   |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| 15,0   | 1,5 |     |     |     |     |     |     |     |      |      |
| 16,0   | 1,5 | 2,0 |     |     |     |     |     |     |      |      |
| 20,0   | 1,5 | 2,0 |     |     |     |     |     |     |      |      |
| 21,0   |     | 2,0 |     |     |     |     |     |     |      |      |
| 25,0   | 1,5 |     |     |     |     |     |     |     |      |      |
| 26,0   |     | 2,0 |     |     |     |     |     |     |      |      |
| 32,0   | 1,5 |     |     |     |     |     |     |     |      |      |
| 34,0   |     | 2,0 |     |     |     |     |     |     |      |      |
| 35,0   | 1,5 |     |     |     |     |     |     |     |      |      |
| 40,0   | 1,5 | 2,0 |     |     |     |     |     |     |      |      |
| 50,0   | 1,5 | 2,0 |     |     |     |     |     |     |      |      |
| 51,0   |     | 2,0 |     | 3,0 |     |     |     |     |      |      |
| 65,0   |     | 2,0 |     |     |     |     |     |     |      |      |
| 75,0   |     | 2,0 |     |     |     |     |     |     |      |      |
| 80,0   |     | 2,0 | 2,5 | 3,0 |     |     |     |     |      |      |
| 100,0  |     | 2,0 | 2,5 | 3,0 |     |     |     |     |      |      |
| 125,0  |     | 2,0 | 2,5 | 3,0 |     |     |     |     |      |      |
| 150,0  |     | 2,0 | 2,5 | 3,0 | 4,0 |     |     |     |      |      |
| 200,0  |     | 2,0 | 2,5 | 3,0 | 4,0 | 5,0 |     |     |      |      |
| 250,0  |     | 2,0 | 2,5 | 3,0 | 4,0 | 5,0 |     |     |      |      |
| 300,0  |     | 2,0 | 2,5 | 3,0 | 4,0 | 5,0 | 6,0 |     |      |      |
| 350,0  |     |     |     | 3,0 | 4,0 | 5,0 | 6,0 | 8,0 |      |      |
| 400,0  |     |     |     | 3,0 | 4,0 | 5,0 | 6,0 | 8,0 |      |      |
| 450,0  |     |     |     | 3,0 | 4,0 | 5,0 | 6,0 | 8,0 |      |      |
| 500,0  |     |     |     | 3,0 | 4,0 | 5,0 | 6,0 | 8,0 |      |      |
| 600,0  |     |     |     | 3,0 | 4,0 | 5,0 | 6,0 | 8,0 |      |      |
| 700,0  |     |     |     |     | 4,0 | 5,0 | 6,0 | 8,0 | 10,0 |      |
| 800,0  |     |     |     |     | 4,0 | 5,0 | 6,0 | 8,0 | 10,0 |      |
| 900,0  |     |     |     |     | 4,0 | 5,0 | 6,0 | 8,0 | 10,0 |      |
| 1000,0 |     |     |     |     |     | 5,0 | 6,0 | 8,0 | 10,0 | 12,0 |

## **Annex ZA** (informative)

### **Clauses of this European Standard addressing essential requirements or other provisions of EU Directives**

This European Standard has been prepared under a mandate given to CEN by the European Commission and supports essential requirements of EU Directive 97/23/EC.

**Warning      Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this European Standard.**

The clauses of this European Standard are likely to support the essential requirements of section 4 of annex 1, "Essential safety requirements" of the Pressure Equipment Directive 97/23/EC.

Compliance with this European Standard provides one means of conforming to the specific essential requirements of the Directive concerned.