EUROVENT 2/3 - 1996

SHEET METAL AIR DUCTS

STANDARD FOR DIMENSIONS

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FOREWORD

The present document gives recommendations on dimensions of ducts with circular and rectangular cross sections. The previous edition published in 1993 based on various national, manufacturers or contractor standards was used as a basic document for the preparation of the European Standards in the CEN/TC 156. The relevant European Standards :

- pr EN 1505 : Sheet metal air ducts and fittings with rectangular cross section
- pr EN 1506 : Sheet metal air ducts and fittings with circular cross section

are expected to be published in 1997.

This second edition of the EUROVENT 2/3 is in full accordance with these European Standards.

In addition to the standardised dimensions the fundamental factors affecting the choice of dimension steps and a number of diagrams intended to facilitate the use of standardised duct dimensions in practical design work are presented.

Dimensions of fittings are given in the EUROVENT 2/4.

CONTENTS

1. DEFINITIONS

1.1 - NOMINAL SIZE

The nominal size is the reference dimension used for the purpose of designation, calculation and application of ducts.

For practical purposes the nominal size is given in mm.

For ducts with circular cross-section the nominal size d is the internal diameter of the duct.

For ducts with rectangular cross-section the nominal size is the internal dimension of the duct.

There are two dimensions a and b :

a = the long side of the duct
b = the short side of the duct

1.2 - EFFECTIVE LENGTH L

Length by which the duct contributes to the length of the air distribution system.

1.3- CROSS-SECTIONAL AREA A_c

For ducts with circular cross-section the cross-sectional area A_c is equal to :

$A_c = \frac{\pi d^2}{4} . 10^{-6}$ (m^2)

For ducts with rectangular cross-section the cross-sectional area A_c is equal to :

$A_c = ab . 10^{-6}$ (m^2)

1.4 - DUCT SURFACE AREA A_i

Duct surface area Ai is the product of the internal perimeter and the duct length.
For ducts with circular cross-section the duct surface area per meter length is :
$A_i = \pi d . 10^{-3}$ ($m^{2)}$

For ducts with rectangular cross-section the duct surface area per meter length is :

$A_i = 2\,(a+b)\,.\,10^{-3}\ m^2$

1.5 - ASPECT RATIO FOR DUCTS WITH RECTANGULAR CROSS-SECTION k

The aspect ratio k is the ratio between the sides a and b :

$$k = \frac{a}{b}$$

1.6 - HYDRAULIC DIAMETER d_h

The hydraulic diameter d_h for a duct is that diameter of a circular duct which will cause the same pressure drop at equal air velocity *.

If the friction coefficients for the ducts are equal then :

$$d_h = \frac{4(\text{cross–sectional area})}{(\text{international perimeter})}$$

For ducts with circular cross-section the hydraulic diameter d_h is equal to the nominal size d of the duct.

For ducts with rectangular cross section the hydraulic diameter d_h is :

$$d_h = \frac{2\,ab}{a+b}\ (\text{mm})$$

1.7 - EQUIVALENT DIAMETER d_e

The equivalent diameter d_e for a duct is that diameter of a circular duct, which will cause the same pressure drop at equal air flow and at equal friction coefficients.

** Air velocity v (in m/s) is given by $v = q/A_c$ where q is the volume air flow rate (in m^3/s) and A_c is the cross-sectional area (in m^2)*

For ducts with circular cross-section the equivalent diameter d_e is equal to the nominal size d of the duct.

For ducts with rectangular cross-section and with an aspect ratio of $\frac{a}{b} \leq 4$.

the equivalent diameter d_e is :

$$d_e = 2b \left[\frac{\pi^{2-n}(1+\frac{a}{b})^{1+n}}{(\frac{a}{b})} \right]^{\frac{1}{n-5}} \text{ mm}$$

where $n \approx \frac{1}{1.05 \log Re - 0.45}$ **

1.8 - TOLERANCE

The tolerance is the difference between the upper and lower limits of size for a given nominal dimension (see figure 1).

1.9 - CLEARANCE (for duct connections)

Clearance is the actual dimensional difference between size of a female connector or duct and of a male connector (see fig. 1).

2. STANDARDISATION OF DUCT DIMENSIONS

To facilitate an industrialised building process building components have to be dimensionally standardised.

As a basis for this standardisation ISO recommendations R 1789, R 1790, R 1791, R 1040 (1+2) and R 1006 are being used. In R 1006 the basic module M (=100 mm) is recommended as the international standard.

** Reynolds'number $Re = v. D_h/v$

where v = the kinematic viscosity (m^2/s)

d_h = the hydraulic diameter (m)

v = the mean air velocity (m/s)

Many components of an air duct system (such as air terminal devices and heat exchangers) are directly connected to the building structure and are adapted to the bacis module of M, consequently so also are duct dimensions.

In this standard the basic module M has been used for ducts with rectangular cross-section, although for some installations such as mounting over false ceilings the step 0,5 M has been introduced for duct dimensions smaller than 300 mm.

Spaces and holes in structural work are also given dimensions in increments of M.

For ducts of circular cross-section the module 11 has been used for spaces and holes in structural work. The recommended nominal diameters d have because of common usage been chosen from the Renard series R 10 with a base of 100 mm. The additional sizes have mostly been chosen from the Renard series R 20.

3. BASIS OF THE STANDARD

3.1 - STANDARD FOR DIMENSIONING OF DUCTS WITH CIRCULAR CROSS-SECTION

The standard for dimensioning of ducts with circular cross-section has been established in accordance with existing European standard pr EN 1506

The standard for recommended sizes is based on the Renard series R 10 which has a ratio between consecutive diameters of 1,25.

The additional sizes except size 150 and 300 are based on R 20, which has a ratio between consecutive diameters of 1,125.

Basic size for the series is d = M(100 mm). The nominal diameter is within the range of $63 \leq d \leq 1{,}250$ mm *

i.e. at values of A_c within a range of 0,0031 m^2 to 1,2300 m^2.

3.2 - STANDARD FOR DIMENSIONING OF DUCTS WITH RECTANGULAR CROSS-SECTION

The standard for dimensioning of ducts with rectangular cross-section has been established in accordance with the European standard pr EN 1505.

The standard for dimensioning of ducts with rectangular cross-section is applicable for ducts with nominal sizes within the range of :

$200 \leq a \leq 2{,}000$ mm **
$100 \leq b \leq 1{,}200$ mm **
and an aspect ratio of $k \leq 4$,

i.e. at values of A_c within a range of 0,02 m^2 to 2,40 m^2. **

By considering the different ways of installating duct systems and the requirement for a reasonable number of duct sizes, the standard has been based on the following :

3.2.1 - For each value of cross-sectional area A_c within the range of 0.88 A_c to 1.12 A_c at least three different duct aspect ratios shall exist *** (see fig. 4)

For small ducts where A_c < 0,04 m2, the number of ducts has been reduced because in this case circular ducts are more often used.

* Sizes of ducts with larger dimensions than given above should preferably be based on R 20

** Sizes for ducts with larger dimensions than given above should preferably be based on multiples of M.

*** A decrease of 12% of the cross-sectional area in a fitting will by a corresponding increase of the air velocity cause an increase of approximately 3 dB in sound pressure level.

3.2.2 - For each height b, at least four cross-sectional areas Ac shall exist (see fig. 5)

In table 4 the number of long sides (a) and the relationship between the largest and smallest cross-sectional areas for a given short side (b) according to the standard are shown.

4. STANDARDISED DIMENSIONS AND DATA

4.1 - STANDARDISED DIMENSIONS AND DATA FOR DUCTS WITH CIRCULAR CROSS-SECTION

Nominal diameter d, cross-sectional area A_c and duct surface area A_i are given in table 1 and figure 2. *

4.2 - STANDARDISED DIMENSIONS AND DATA FOR DUCTS WITH RECTANGULAR CROSS-SECTION

Duct dimensions a and b, cross-sectional area A_c and duct surface area A_i are given in table 3 and figure 6. **

Hydraulic diameters d_h for the ducts (included in the standard) are given in figure 9.
Equivalent diameters d_e for the ducts are given in figure 10.

* Should smaller steps be needed the following intermediate nominal dimensions shall be used : 71, 90, 112, 140, 180, 224 and 280 mm.

** In normal cases the dimensional steps given are sufficient. Should there be a need for smaller steps these should be half the steps given in this EUROVENT Recommendation with a minimum step of 100 mm.

5. SELECTION OF DUCTS

A choice of duct dimensions with respect to total costs may be made with the aid of figure 3 for ducts with circular cross-section and figure 8 for ducts with rectangular cross-section. Additional sizes should be avoided.

Considerations should be given to the « economic range of air velocities » in the ducts which will depend on installation costs and running costs.

6. TOLERANCES AND CLEARANCE

6.1 - TOLERANCES FOR DUCTS WITH CIRCULAR CROSS-SECTION

The accuracy of manufacture for ducts and fittings (spigots and sockets) with reference to the nominal diameter d is given in table 2.

For each duct dimension the tolerance zone for both the duct and fitting is equal except when $d \geq 800$ mm.

6.2 - CLEARANCE FOR DUCTS WITH CIRCULAR CROSS-SECTION

Minimum diametrical clearance is a constant of 0,7 mm.

6.3 - TOLERANCES FOR DUCTS WITH RECTANGULAR CROSS-SECTION

The tolerance is a constant of 0/-4 mm.

The tolerance of the length L of a straight duct is 0,005 L.

7. TABLES AND FIGURES

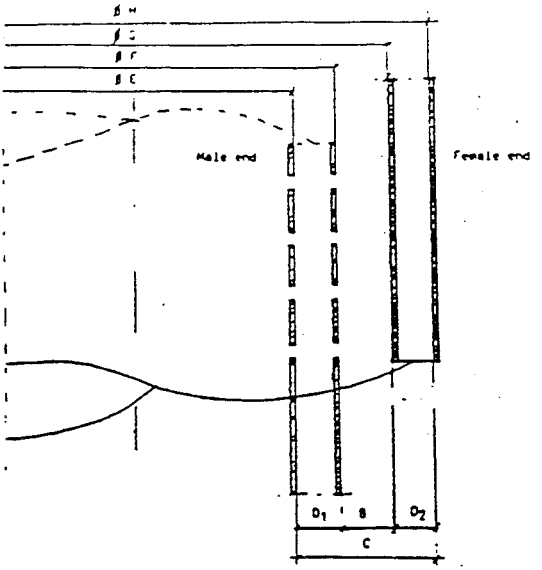
Table 1 Ducts with circular cross-section, standardised dimensions

Nominal diameter mm	Cross-sectional area m^2	Duct surface area m^2/mm
Recommended sizes		
63	$3{,}12 \cdot 10^{-3}$	0,197
80	$5{,}03 \cdot 10^{-3}$	0,251
100	$7{,}85 \cdot 10^{-3}$	0,314
125	$12{,}3 \cdot 10^{-3}$	0,393
160	$20{,}1 \cdot 10^{-3}$	0,502
200	$31{,}4 \cdot 10^{-3}$	0,628
250	$49{,}1 \cdot 10^{-3}$	0,785
315	$77{,}9 \cdot 10^{-3}$	0,990
400	0,126	1,26
500	0,196	1,57
630	0,312	1,98
800	0,503	2,51
1000	0,785	3,14
1250	1,23	3,93
Additional sizes		
150	$17{,}7 \cdot 10^{-3}$	0,421
300	$70{,}7 \cdot 10^{-3}$	0,943
355	$98{,}9 \cdot 10^{-3}$	1,11
450	0,159	1,41
560	0,246	1,76
710	0,396	2,23
900	0,636	2,83
1120	0,985	3,52

Table 2 - Ducts and fittings with circular cross section, tolerances and clearance

d	B	C	D_1	D_2	E	F	G	H
Recommended sizes in mm								
63	0,7	1,7	0,5	0,5	61,87	62,3	63,0	63,5
80	0,7	1,7	0,5	0,5	78,8	79,3	80,0	80,5
100	0,7	1,7	0,5	0,5	98,8	99,3	100,0	100,5
125	0,7	1,7	0,5	0,5	123,8	124,3	125,0	125,5
160	0,7	1,9	0,6	0,6	158,7	159,3	160,0	160,6
200	0,7	2,1	0,7	0,7	198,6	199,3	200,0	200,7
250	0,7	2,3	0,8	0,8	248,5	249,3	250,0	250,8
315	0,7	2,5	0,9	0,9	313,4	314,3	315,0	315,9
400	0,7	2,7	1,0	1,0	398,3	399,3	400,0	401,0
500	0,7	2,9	1,1	1,1	498,2	499,3	500,0	501,1
630	0,7	3,1	1,2	1,2	628,1	629,3	630,0	631,2
800	0,7	3,6	1,3	1,6	798,0	799,3	800,0	801,6
1000	0,7	4,1	1,4	2,0	997,9	999,3	1000,0	1002,0
1250	0,7	4,7	1,5	2,5	1247,8	1249,3	1250,0	1252,5
Additional sizes in mm								
150	0,7	1,9	0,6	0,6	148,7	149,3	150,0	150,6
300	0,7	2,5	0,9	0,9	298,4	299,3	300,0	300,9
355	0,7	2,7	1,0	1,0	353,3	354,3	355,0	356,0
450	0,7	2,9	1,1	1,1	448,2	449,3	450,0	451,1
560	0,7	3,1	1,2	1,2	558,1	559,3	560,0	561,2
710	0,7	3,5	1,3	1,6	708,0	709,0	710,0	711,5
900	0,7	4,1	1,4	2,0	897,9	899,3	900,0	902,0
1120	0,7	4,7	1,5	2,5	1117,8	1119,3	1120,0	1122,5

Figure 1 - Ducts and fittings with circular cross section, tolerances and clearance



d	Nominal diameter
B	Minimum diameteral clearance
C	Maximum diameteral clearance
D_1	Tolerance of the diameter of the male end
D_2	Tolerance of the diameter of the female end
E	Minimum diameter of the male end
F	Maximum diameter of the male end
G	Minimum diameter of the female end
H	Maximum diameter of the female end

Table 3 - Ducts with rectangular cross-section : standardised dimensions

Side lengths mm												
	100	150	200	250	300	400	500	600	800	1000	1200	
200	0,020 133 149 0,60	0,030 171 186 0,70	0,040 200 218 0,80									A_c d_h d_e A_i
250	0,025 143 165 0,70	0,038 188 206 0,80	0,050 222 241 0,90	0,063 250 273 1,00								A_c d_h d_e A_i
300	0,030 150 180 0,80	0,045 200 224 0,90	0,060 240 262 1,00	0,075 273 296 1,10	0,090 300 327 1,20							A_c d_h d_e A_i
400	0,040 160 205 1,00	0,060 218 255 1,10	0,080 267 299 1,20	0,10 308 337 1,30	0,12 343 373 1,40	0,16 400 436 1,60						A_c d_h d_e A_i
500		0,075 231 283 1,30	0,10 286 331 1,40	0,13 333 374 1,50	0,15 375 413 1,60	0,20 444 483 1,80	0,25 500 545 2,00					A_c d_h d_e A_i
600		0,090 240 307 1,50	0,12 300 359 1,60	0,15 353 406 1,70	0,18 400 448 1,80	0,24 480 524 2,00	0,30 545 592 2,20	0,36 600 654 2,40				A_c d_h d_e A_i
800			0,16 320 410 2,00	0,20 381 463 2,10	0,24 436 511 2,20	0,32 533 598 2,40	0,40 615 675 2,60	0,48 686 745 2,80	0,64 800 872 3,20			A_c d_h d_e A_i
1000				0,25 400 512 2,50	0,30 462 566 2,60	0,40 571 662 2,80	0,50 667 747 3,00	0,60 750 825 3,20	0,80 889 965 3,60	1,00 1000 1090 4,00		A_c d_h d_e A_i
1200					0,36 480 614 3,00	0,48 600 719 3,20	0,60 706 812 3,40	0,72 800 896 3,60	0,96 960 1049 4,00	1,20 1091 1184 4,40	1,44 1200 1308 4,80	A_c d_h d_e A_i
1400						0,56 622 771 3,60	0,70 737 871 3,80	0,84 840 962 4,00	1,12 1018 1125 4,40	1,40 1167 1270 4,80	1,68 1292 1403 5,20	A_c d_h d_e A_i
1600						0,64 640 819 4,00	0,80 762 925 4,20	0,96 873 1022 4,40	1,28 1067 1195 4,80	1,60 1231 1350 5,20	1,92 1371 1491 5,60	A_c d_h d_e A_i
1800							0,90 783 976 4,60	1,08 900 1078 4,80	1,44 1108 1261 5,20	1,80 1286 1424 5,60	2,16 1440 1573 6,00	A_c d_h d_e A_i
2000							1,00 800 1024 5,00	1,20 923 1131 5,20	1,60 1143 1323 5,60	2,00 1333 1494 6,00	2,40 1500 1650 6,40	A_c d_h d_e A_i

A_c = Cross-sectional area (m^2)
d_h = Hydraulic diameter (mm)
d_e = Equivalent diameter (mm)
A_i = Duct surface area (m^2)

Figure 2 - Ducts with circular cross-section : duct surface area A_i and cross-section A_c as a function of nominal diameter d.

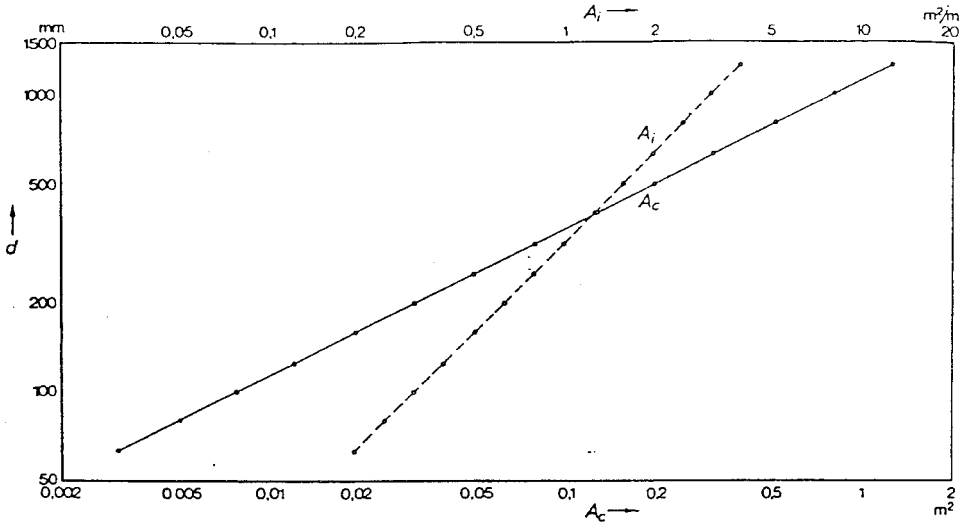


Figure 3 - Ducts with circular cross-section : air velocity $\bar{v}$ as a function of air flow rate q_{nom} and diameter d

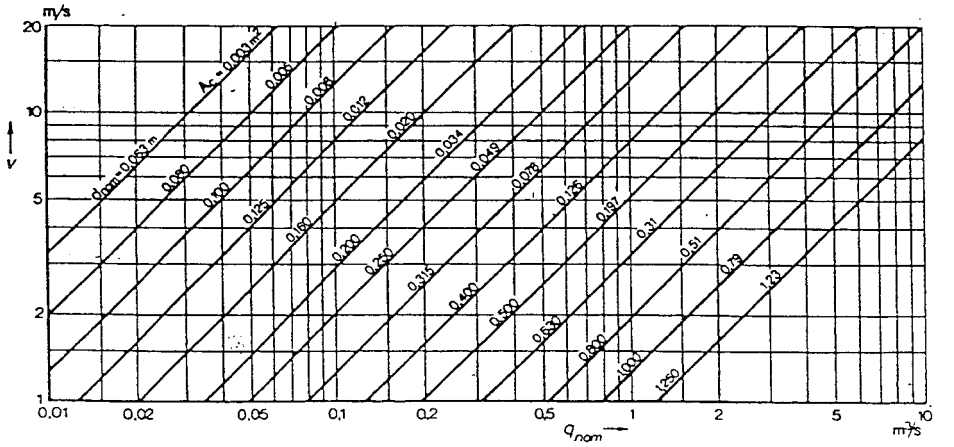


Figure 4 - Ducts with rectangular cross-section : number n of ducts with different aspect ratios as a function of A_c

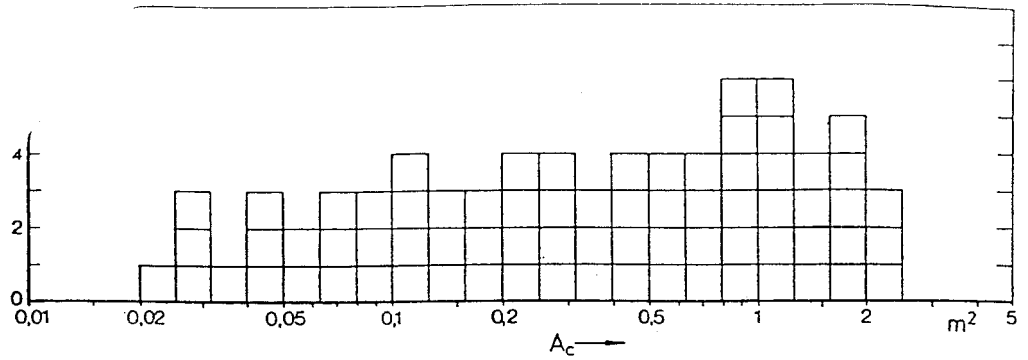


Figure 5 - Ducts with rectangular cross-section : relation between b and A_c for normalised values of a

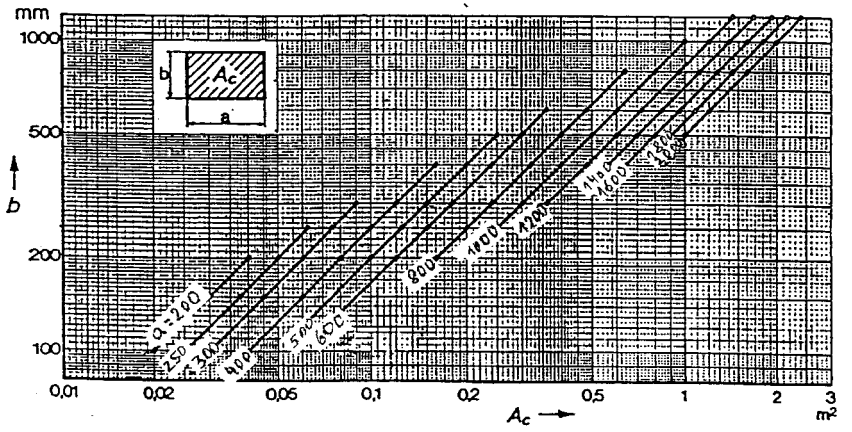


Figure 6 - Ducts with rectangular cross-section : cross-sectional area A_c as a function of the values of a and b

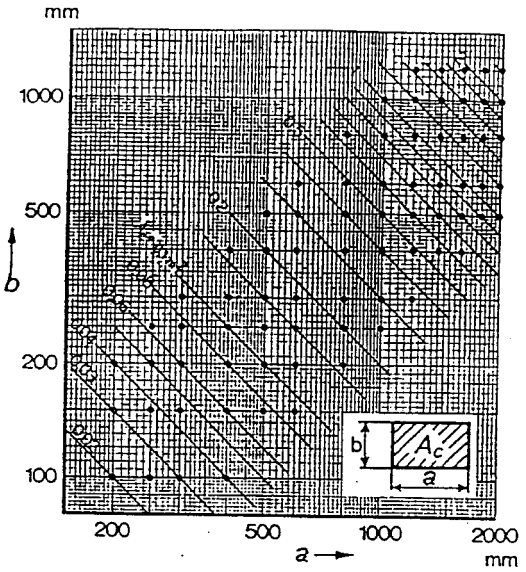


Figure 7 - Ducts with rectangular cross-section : air velocity $\bar{v}$ as a function of air flow q_{nom} and duct dimensions b x a.

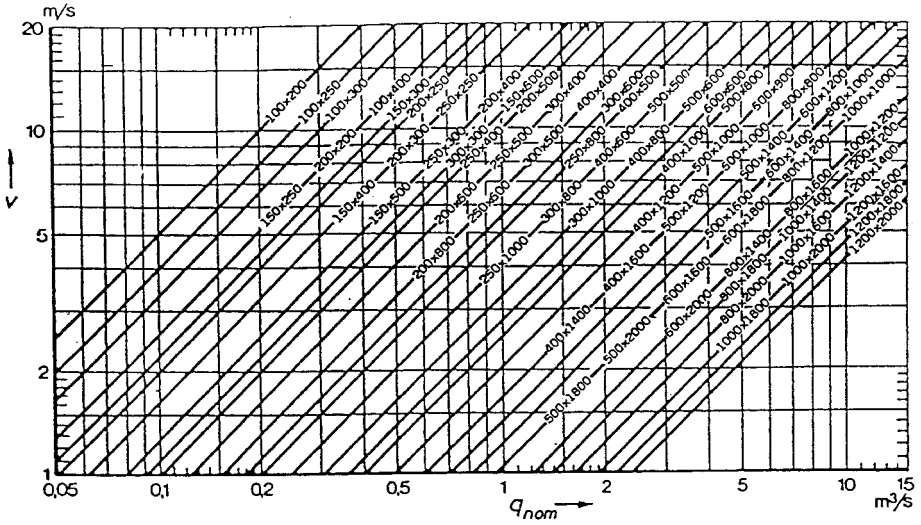


Table 4 - Ducts with rectangular cross-section : number of values possibles and ratio between the largest values of a

Value of b	Number of values possible of a	Ratio between the largest values of a
100	4	2
150	6	3
200	7	4
250	7	4
300	7	4
400	8	4
500	9	4
600	8	3 1/3
800	7	2 1/2
1000	6	2
1200	5	1 2/3

Figure 8 - Ducts with rectangular cross-section : hydraulic diameter d_h

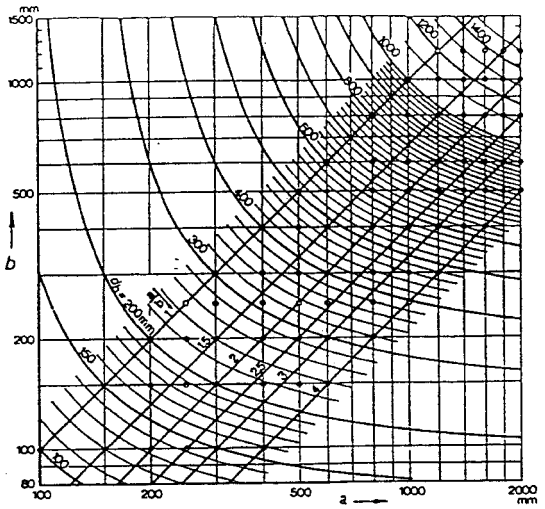
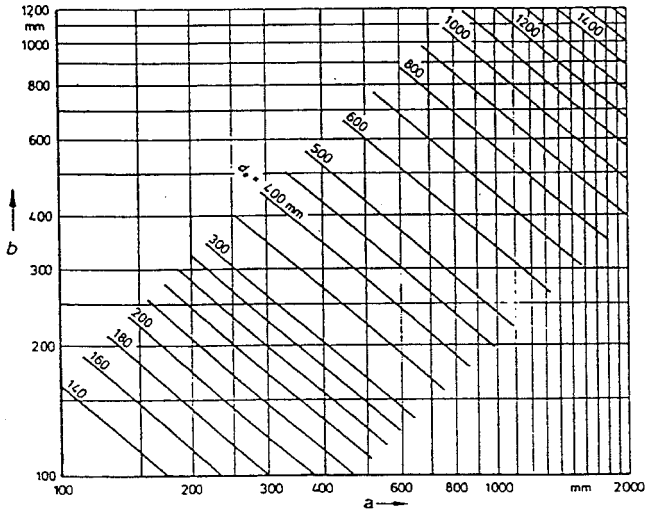


Figure 9 - Ducts with rectangular cross-section : equivalent diameter

$$d_e = 2b \left[\pi^{2-n} \frac{(1+\frac{a}{b})^{1+n}}{(\frac{a}{b})^3} \right]^{\frac{1}{n-5}} \qquad \text{where } n \approx \frac{1}{1{,}05 \log Re - 0{,}45}$$



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