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Guidance on the selection of roller chain drives

Méthode de sélection des transmissions par chaîne à rouleaux

Reference number
ISO 10823:1996(E)

Foreword

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

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10823 was prepared by Technical Committee ISO/TC 100, *Chains and chain wheels for power transmission and conveyors*

Annex A of this International Standard is for information only.

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Guidance on the selection of roller chain drives

1 Scope

This International Standard gives guidance on the selection of chain drives, composed of a roller chain and sprockets conforming to ISO 606, for industrial applications.

The selection procedures and the chain ratings described in this International Standard provide for roller chain drives operating under specified conditions, as defined in 9.1, 9.2, 10.1 and 10.2, with a life expectancy of approximately 15 000 h.

Due to the wide variations in loading characteristics, environmental conditions and achieved maintenance, the supplier of the chains and sprockets should be consulted to ensure that the performance of the product will meet the requirements specified by the user and by this International Standard.

2 Normative reference

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

ISO 606:1994, *Short-pitch transmission precision roller chains and chain wheels.*

3 Symbols

The symbols and units used in this International Standard are given in table 1.

Table 1 — Symbols and units

Symbol	Designation	Unit
a	Maximum centre distance	mm
a_0	Approximate centre distance	mm
f_1	Application factor to allow for the operating conditions (see table 2)	—
f_2	Factor for number of teeth on drive sprocket (see figure 3)	—
f_3	Factor for calculation of the number of links with different numbers of teeth (see table 5)	—
f_4	Factor for the calculation of the centre distance with different numbers of teeth (see table 6)	—
i	Drive ratio	—
M	Torque	N·m
n_1	Input speed	r/min
n_2	Output speed	r/min
p	Chain pitch	mm
P	Input power	kW
P_c	Corrected power	kW
v	Chain speed	m/s
X	Number of links in chain	—
X_0	Calculated number of links in chain	—
z_1	Number of teeth on drive sprocket	—
z_2	Number of teeth on driven sprocket	—

4 Basic equations

4.1 Input power

The power to be transmitted is the input (P), in kilowatts, to the drive sprocket. If input torque is the known requirement, then P can be derived from the following equation:

$$P = \frac{M \times n_1}{9\,550} \quad \text{... (1)}$$

4.2 Corrected power

To allow for the characteristics of the drive system and the type of load to be transmitted, the input power (P) is multiplied by factors to obtain the corrected power P_c.

$$P_c = P \times f_1 \times f_2 \quad \text{... (2)}$$

5 Drive design specifications

The following design features should be specified before the chain and sprockets are selected:

a) power to be transmitted;

b) type of driver and driven machinery;

c) speed and sizes of the driver and driven shafts;

d) centre distance and layout of the shafts;

e) environmental conditions.

NOTE 1 Shaft sizes and unusually long or short centre distances and/or a complex layout may influence the drive selection.

6 Sprocket selection

Determine the number of teeth on the sprockets by the following procedure:

a) select the desired number of teeth for the drive sprocket;

b) determine the number of teeth for the driven sprocket from the drive ratio i, using the equation

$$i = z_2/z_1 \quad \text{... (3)}$$

Sprockets having a minimum of 17 teeth and a maximum of 114 teeth should be selected.

If the drive chain operates at high speed or if it is subjected to impulse loads, the drive sprocket should have at least 25 teeth and the teeth should be hardened.

7 Chain calculations and selection

7.1 Normal operating conditions and drive capacities for chains

Typical capacity charts for chain drives operating under the following conditions are given in figures 1 and 2:

a) a chain drive with two sprockets on parallel horizontal shafts;

b) a drive sprocket with 25 teeth;

c) a simplex chain without cranked link;

d) a chain length of 120 links (for shorter chain length, the life will be proportionally reduced);

e) a speed reduction ratio up to 3:1;

f) an expected life of 15 000 h;

g) an operating temperature between − 5 °C and + 70 °C;

h) sprockets correctly aligned and chain maintained in correct adjustment (see clause 10);

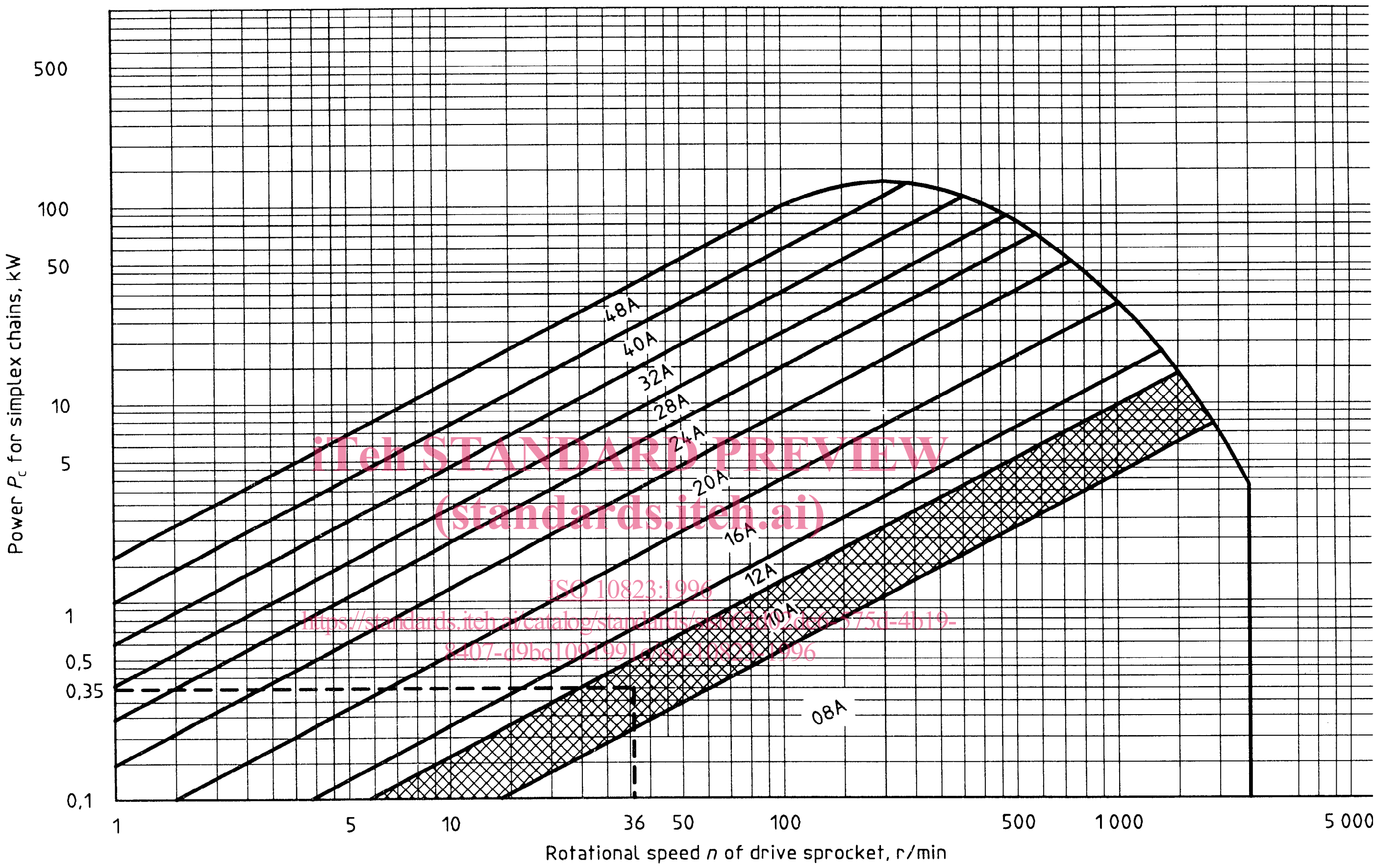
i) uniform operation without overload, shocks or frequent starts;

j) clean and adequate lubrication (see clause 9).

Figures 1 and 2 indicate the size of chain that is suitable for the chain drive as a function of the corrected power (P_c) and of the drive sprocket rotational speed.

NOTE 2 P_c is calculated using equation (2).

The capacity rating charts given in figures 1 and 2 are representative of those published by chain manufacturers. Individual manufacturers may rate their chains differently. It is therefore recommended that the appropriate rating chart for the make of chain be consulted.

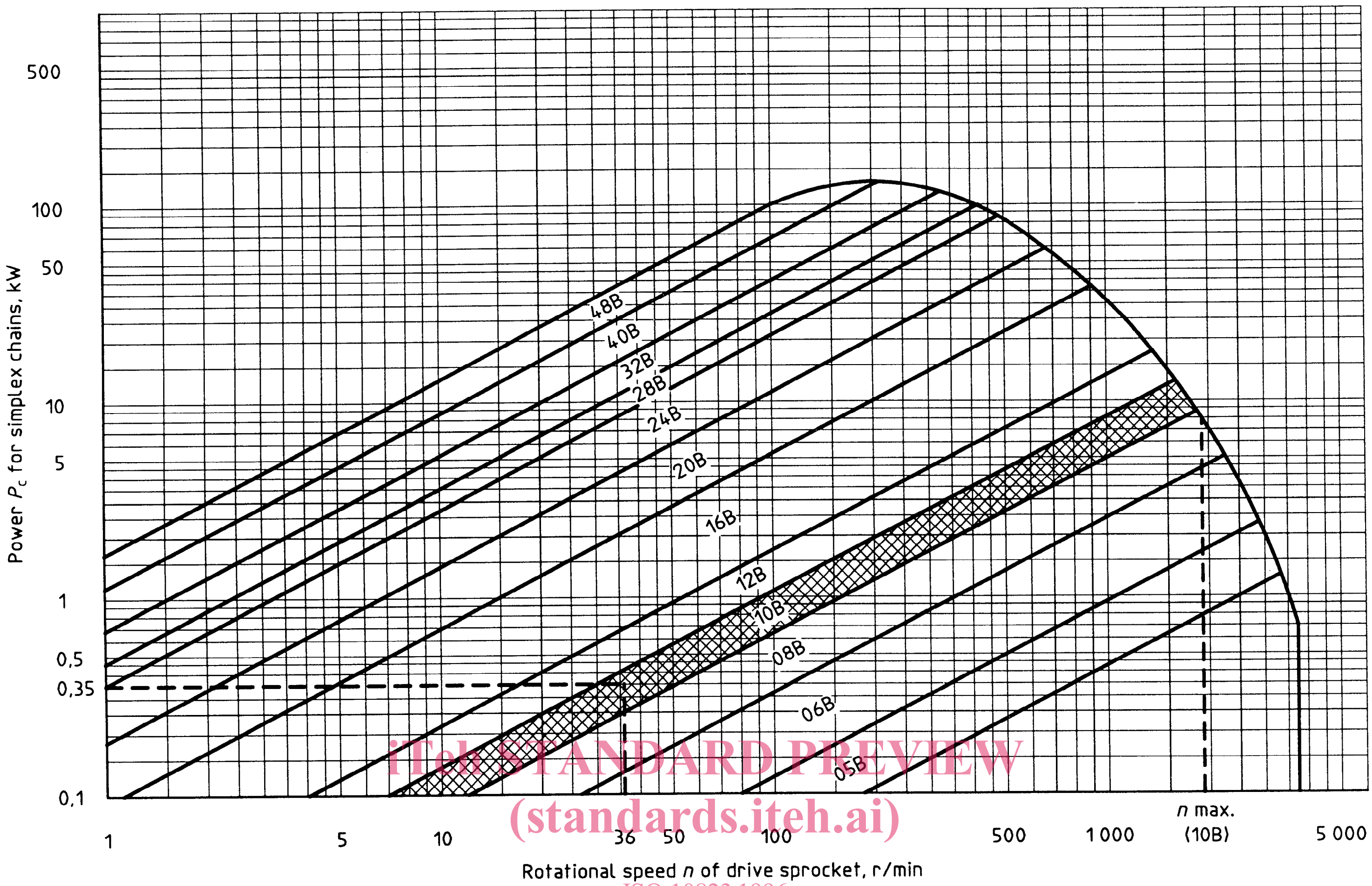


NOTES

1 The power ratings of duplex chain may be calculated by multiplying the value of P_c for simplex chain by the factor 1,75.

2 The power ratings of triplex chain may be calculated by multiplying the value of P_c for simplex chain by the factor 2,5.

Figure 1 — Typical capacity chart for selection of type A chains conforming to ISO 606



NOTES

1 The power ratings of duplex chain may be calculated by multiplying the value of P_c for simplex chain by the factor 1,75.

2 The power ratings of triplex chain may be calculated by multiplying the value of P_c for simplex chain by the factor 2,5.

Figure 2 — Typical capacity chart for selection of type B chains conforming to ISO 606

7.2 Correction for other operating conditions for chains

7.2.1 Power correction

If the characteristics of the chain drive and its operating conditions are different from those described in 7.1, the power to be transmitted should be corrected by using equation (2).

The derivations of factors f_1 and f_2 are given in 7.2.2 and 7.2.3.

7.2.2 Application factor f_1

Factor f_1 takes into account dynamic overloads depending on the chain drive operating conditions and resulting, in particular, from the nature of the driver and driven elements. The value of factor f_1 can be selected directly or by analogy using table 2 in conjunction with the definitions given in tables 3 and 4.

Table 2 — Application factor f_1

Characteristics of driven machine (see table 4)	**Characteristics of driver machine** (see table 3)		
	Smooth running	Slight shocks	Moderate shocks
Smooth running	1	1,1	1,3
Moderate shocks	1,4	1,5	1,7
Heavy shocks	1,8	1,9	2,1

Table 3 — Definitions of characteristics of driver machines

Smooth running	Electric motors Steam and gas turbines Internal combustion engines with hydraulic coupling
Slight shocks	Internal combustion engines with six cylinders or more with mechanical coupling Electric motors subjected to frequent starts (more than two per day)
Moderate shocks	Internal combustion engines with less than six cylinders with mechanical coupling

7.2.3 Factor f_2

Factor f_2 takes account of the number of teeth on the drive sprocket. Its value may be determined from the graph given in figure 3.

Table 4 — Definitions of characteristics of driven machines

Smooth running	Centrifugal pumps and compressors Printing machines, uniformly loaded belt conveyors Paper calendars, escalators Liquid agitators and mixers Rotary driers, fans
Moderate shocks	Pumps and compressors with three or more cylinders Concrete mixing machines Non-uniformly loaded conveyors Solid agitators and mixers
Heavy shocks	Planers, excavators, roll and ball mills Rubber processing machines, presses, shears Pumps and compressors with one or two cylinders Oil drilling rigs

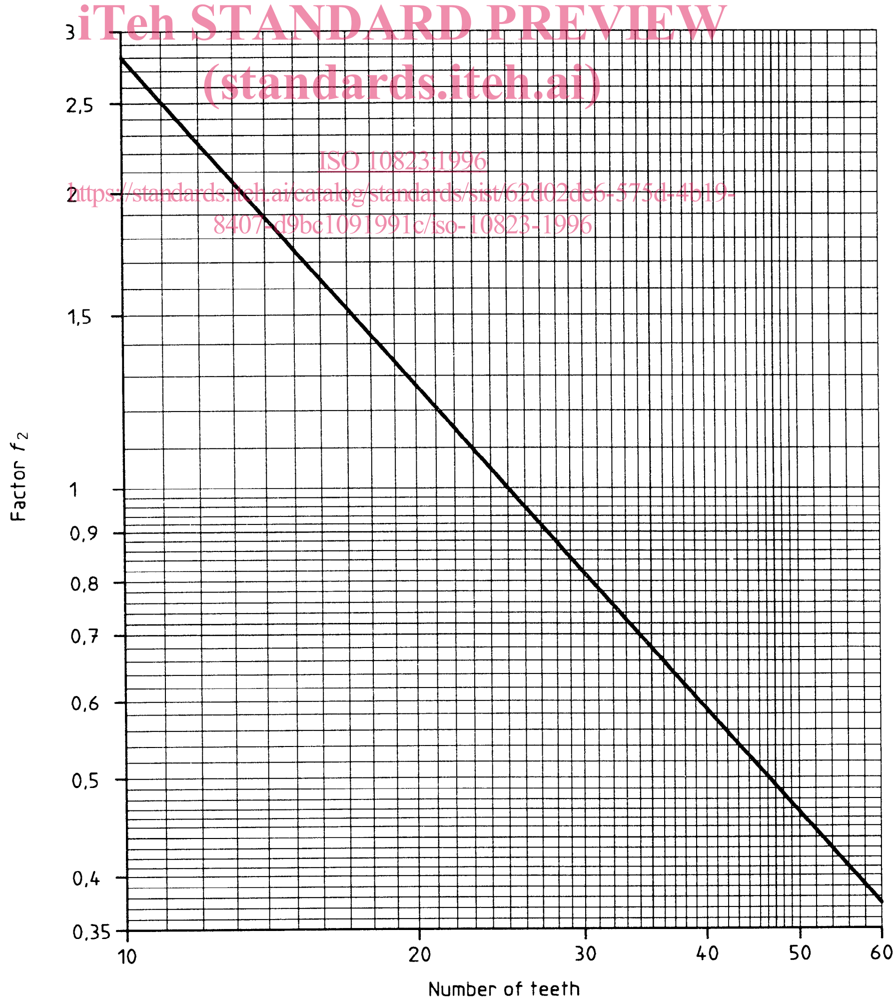


Figure 3 — Factor f_2 allowing for the number of teeth on the drive sprocket

7.3 Chain selection

From the chain capacity charts (see figures 1 and 2) select the smallest pitch of simplex chain to transmit the required power at the speed of the drive.

Where a more compact drive is necessary, a multiplex chain of smaller pitch should be considered, with a resultant reduction in the diameters of the sprockets.

7.4 Chain length

For a drive with two sprockets, having a known chain pitch (p) and approximate sprocket centre distance (a_0), calculate the number of chain links (X_0) using equations (4) and (5).

The calculated number of links (X_0) should be rounded up to a whole even number (X) to avoid the use of cranked links.

7.4.1 Sprockets with the same number of teeth

($z = z_1 = z_2$)

$$X_0 = 2\frac{a_0}{p} + z \quad \text{... (4)}$$

7.4.2 Sprockets with different numbers of teeth

$$X_0 = 2\frac{a_0}{p} + \frac{z_1 + z_2}{2} + \frac{f_3 \times p}{a_0} \quad \text{... (5)}$$

where factor $f_3 = \left(\frac{z_2 - z_1}{2\pi}\right)^2$

Calculated values for f_3 are given in table 5.

7.5 Chain speed

Calculate the chain speed using the following equation:

$$v = \frac{n_1 \times z_1 \times p}{60\,000} \quad \text{... (6)}$$

8 Maximum sprocket centre distance

For the number of chain links (X) derived in 7.4, determine the maximum distance between the centres of the sprockets (a) using equations (7) and (8).

Table 5 — Calculated values of factor f_3

$z_2 - z_1$	f_3	$z_2 - z_1$	f_3	$z_2 - z_1$	f_3	$z_2 - z_1$	f_3	$z_2 - z_1$	f_3
1	0,025 3	21	11,171	41	42,580	61	94,254	81	166,191
2	0,101 3	22	12,260	42	44,683	62	97,370	82	170,320
3	0,228 0	23	13,400	43	46,836	63	100,536	83	174,500
4	0,405 3	24	14,590	44	49,040	64	103,753	84	178,730
5	0,633 3	25	15,831	45	51,294	65	107,021	85	183,011
6	0,912	26	17,123	46	53,599	66	110,339	86	187,342
7	1,241	27	18,466	47	55,955	67	113,708	87	191,724
8	1,621	28	19,859	48	58,361	68	117,128	88	196,157
9	2,052	29	21,303	49	60,818	69	120,598	89	200,640
10	2,533	30	22,797	50	63,326	70	124,119	90	205,174
11	3,065	31	24,342	51	65,884	71	127,690	91	209,759
12	3,648	32	25,938	52	68,493	72	131,313	92	214,395
13	4,281	33	27,585	53	71,153	73	134,986	93	219,081
14	4,965	34	29,282	54	73,863	74	138,709	94	223,817
15	5,699	35	31,030	55	76,624	75	142,483	95	228,605
16	6,485	36	32,828	56	79,436	76	146,308	96	233,443
17	7,320	37	34,677	57	82,298	77	150,184	97	238,333
18	8,207	38	36,577	58	85,211	78	154,110	98	243,271
19	9,144	39	38,527	59	88,175	79	158,087	99	248,261
20	10,132	40	40,529	60	91,189	80	162,115	100	253,302

8.1 Two sprockets with the same number of teeth ($z = z_1 = z_2$)

$$a = p\left(\frac{X - z}{2}\right) \qquad \dots (7)$$

8.2 Two sprockets with different numbers of teeth

$$a = f_4 \times p\,[2X - (z_1 + z_2)] \qquad \dots (8)$$

The values of factor f_4 are given in table 6.

9 Lubrication

9.1 Methods of lubrication

The method of lubrication that should be used to ensure satisfactory control of wear in the chain drive is determined by the speed and capacity rating of the chain.

The lubrication ranges which define the minimum required methods of lubrication to be used are derived from the chart given in figure 4. The definitions of the lubrication ranges are as follows:

Range 1: Oil supply by means of oil can or brush, applied manually at frequent intervals.

Range 2: Drip-feed lubrication.

Range 3: Oil bath or disc lubrication.

Range 4: Forced-feed lubrication with filter and, if necessary, an oil cooler.

NOTE 3 An oil cooler may be necessary if the drive operates at high power and speeds in a confined space.

Table 6 — Calculated values of factor f_4

$\frac{X - z_1}{z_2 - z_1}$	f_4	$\frac{X - z_1}{z_2 - z_1}$	f_4	$\frac{X - z_1}{z_2 - z_1}$	f_4
13	0,249 91	2,00	0,244 21	1,33	0,229 68
12	0,249 90	1,95	0,243 80	1,32	0,229 12
11	0,249 88	1,90	0,243 33	1,31	0,228 54
10	0,249 86	1,85	0,242 81	1,30	0,227 93
9	0,249 83	1,80	0,242 22	1,29	0,227 29
8	0,249 78	1,75	0,241 56	1,28	0,226 62
7	0,249 70	1,70	0,240 81	1,27	0,225 93
6	0,249 58	1,68	0,240 48	1,26	0,225 20
5	0,249 37	1,66	0,240 13	1,25	0,224 43
4,8	0,249 31	1,64	0,239 77	1,24	0,223 61
4,6	0,249 25	1,62	0,239 38	1,23	0,222 75
4,4	0,249 17	1,60	0,238 97	1,22	0,221 85
4,2	0,249 07	1,58	0,238 54	1,21	0,220 90
4,0	0,248 96	1,56	0,238 07	1,20	0,219 90
3,8	0,248 83	1,54	0,237 58	1,19	0,218 84
3,6	0,248 68	1,52	0,237 05	1,18	0,217 71
3,4	0,248 49	1,50	0,236 48	1,17	0,216 52
3,2	0,248 25	1,48	0,235 88	1,16	0,215 26
3,0	0,247 95	1,46	0,235 24	1,15	0,213 90
2,9	0,247 78	1,44	0,234 55	1,14	0,212 45
2,8	0,247 58	1,42	0,233 81	1,13	0,210 90
2,7	0,247 35	1,40	0,233 01	1,12	0,209 23
2,6	0,247 08	1,39	0,232 59	1,11	0,207 44
2,5	0,246 78	1,38	0,232 15	1,10	0,205 49
2,4	0,246 43	1,37	0,231 70	1,09	0,203 36
2,3	0,246 02	1,36	0,231 23	1,08	0,201 04
2,2	0,245 52	1,35	0,230 73	1,07	0,198 48
2,1	0,244 93	1,34	0,230 22	1,06	0,195 64