

---

---

**Internal combustion engines — Piston  
rings —**

**Part 4:  
Half keystone rings made of steel**

*Moteurs à combustion interne — Segments de piston —  
Partie 4: Segments semi-trapézoïdaux en acier*

STANDARDSISO.COM : Click to view the full PDF of ISO 6624-4:2003



**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

STANDARDSISO.COM : Click to view the full PDF of ISO 6624-4:2003

© ISO 2003

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## Contents

Page

Foreword .....	iv
Introduction .....	v
1 Scope .....	1
2 Normative references .....	1
3 Overview .....	1
4 Ring types and designation examples .....	1
4.1 Type HK — Straight faced half keystone ring 7° .....	1
4.2 Type HKB — Barrel faced half keystone ring 7° .....	2
5 Common features .....	4
5.1 Type HK and HKB — Half keystone ring .....	4
5.2 Type HK and HKB rings — Outside and inside rounded edges .....	5
5.3 Type HK and HKB rings (fully faced and inlaid) — Plating/coating thickness .....	6
5.4 Type HK and HKB rings — Nitrided case depth .....	7
6 Force factors .....	8
7 Dimensions .....	8
Bibliography .....	18

## 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6624-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

ISO 6624 consists of the following parts, under the general title *Internal combustion engines — Piston rings*:

- *Part 1: Keystone rings made of cast iron*
- *Part 2: Half keystone rings made of cast iron*
- *Part 3: Keystone rings made of steel*
- *Part 4: Half keystone rings made of steel*

## Introduction

ISO 6624 is one of a number of series of International Standards dealing with piston rings for reciprocating internal combustion engines. Others are ISO 6621<sup>[2], [3], [4], [5]</sup>, ISO 6622<sup>[6], [7]</sup>, ISO 6623<sup>[8]</sup>, ISO 6625<sup>[9]</sup>, ISO 6626<sup>[10], [11]</sup> and ISO 6627<sup>[12]</sup>.

The common features and dimensional tables presented in this part of ISO 6624 constitute a broad range of variables and, in selecting a particular ring type, the designer shall bear in mind the conditions under which it will be required to operate.

It is also essential that the designer refer to the specifications and requirements of ISO 6621-3<sup>[4]</sup> and ISO 6621-4 before completing selection.

STANDARDSISO.COM : Click to view the full PDF of ISO 6624-4:2003



# Internal combustion engines — Piston rings —

## Part 4: Half keystone rings made of steel

### 1 Scope

This part of ISO 6624 specifies the essential dimensional features of half keystone rings made of steel, types HK and HKB, having diameters of from 38 mm up to and including 160 mm, used in reciprocating internal combustion piston engines.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6621-4, *Internal combustion engines — Piston rings — Part 4: General specifications*

### 3 Overview

The half keystone ring types are specified in Table 1 and Figures 1 and 2. Their common features and the dimensions of those features are specified in Tables 2 to 5 and Figures 3 to 8. Table 6 gives the force factors for the different ring types, while Table 7 gives the dimensions and forces of half keystone rings.

### 4 Ring types and designation examples

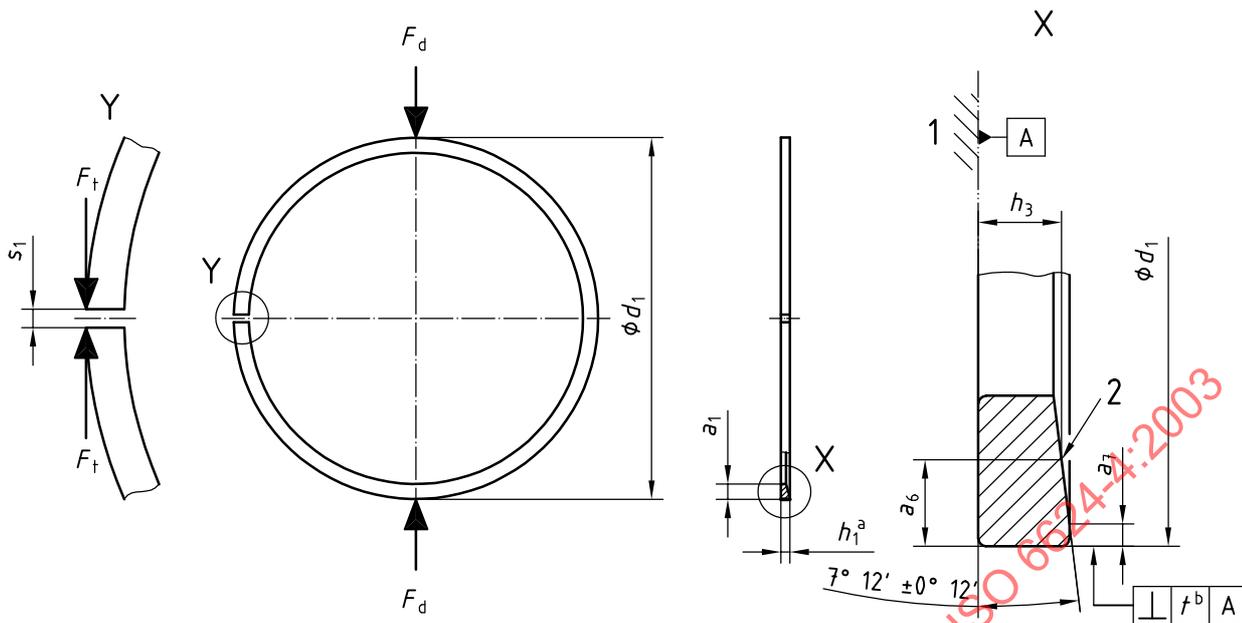
NOTE For the angle of half keystone rings, the same definition and measurement apply as for keystone rings (see ISO 6621-2).

#### 4.1 Type HK — Straight faced half keystone ring 7°

##### 4.1.1 General features

See Table 6 for dimensions and forces.

$h_3$  values are calculated based on  $h_1 + 0,05$  mm.



**Key**

- 1 reference plane
- 2 mark
- a Nominal.
- b  $t = 0,006 \times h_1$ .

**Figure 1 — Type HK**

**4.1.2 Designation**

**EXAMPLE** Designation of a piston ring complying with the requirements of ISO 6624-4, being a 7° half keystone ring made of steel with a straight faced peripheral surface (HK), of nominal diameter  $d_1 = 60$  mm (60), of nominal ring width  $h_1 = 1,2$  mm (1,2), made of CrSi alloyed steel subclass 62 (MC62), and having a chromium plated peripheral surface with a minimum thickness of 0,1 mm (CR2):

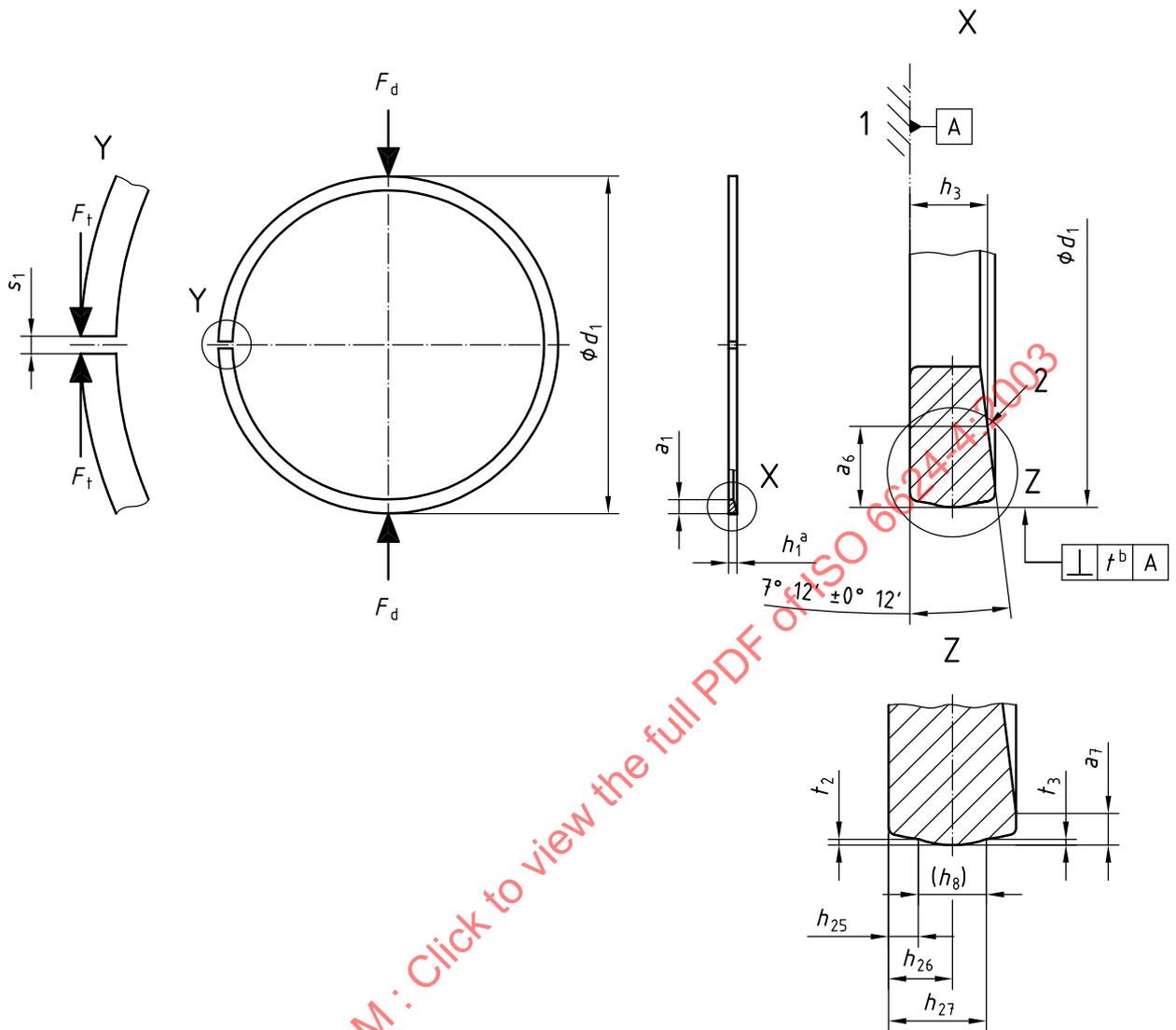
**Piston ring ISO 6624-4 HK - 60 × 1,2 - MC62/CR2**

**4.2 Type HKB — Barrel faced half keystone ring 7°**

**4.2.1 General features**

See Table 6 for dimensions and forces.

$h_3$  values are calculated based on  $h_1 + 0,05$  mm.



**Key**

1 reference plane

2 mark

a Nominal.

b  $t = 0,006 \times h_1$

Figure 2 — Type HKB

**Table 1 — Gauge width ( $h_8$ ) and barrel dimensions for symmetrical barrel faced compression rings**

Dimensions in millimetres

$h_1$	$h_{25}$	$h_{26}$	$h_{26}$ tol.	$h_{27}$	$t_2, t_3$	$h_8^a$
1,2	0,30	0,60	$\pm 0,20$	0,90	0,003...0,012	0,60
1,5	0,35	0,75	$\pm 0,25$	1,15	0,003...0,015	0,80
1,75	0,35	0,85	$\pm 0,30$	1,35		1,00
2,0	0,40	1,00	$\pm 0,30$	1,60		1,20
2,5	0,45	1,25	$\pm 0,40$	2,05		1,60
3,0	0,50	1,50	$\pm 0,50$	2,50	0,005...0,020	2,00
3,5	0,55	1,75	$\pm 0,50$	2,95		2,40

<sup>a</sup> Gauge width ( $h_8$ ) only informative; may be used only if agreed between manufacturer and client.

**4.2.2 Designation**

**EXAMPLE** Designation of a piston ring complying with the requirements of ISO 6624-4, being a half keystone ring made of steel with a barrel faced peripheral surface (HKB), of nominal diameter  $d_r = 60$  mm (60), of nominal ring width  $h_1 = 1,5$  mm (1,5), made of martensitic steel 11%Cr (min.) subclass 65 (MC65), and nitrided on the peripheral surface and side faces (NT) to a depth of 0,050 mm min. on the peripheral surface (050), with an associated side face depth of 0,015 mm min.:

**Piston ring ISO 6624-4 HKB - 60x1,5 - MC65/NT050**

**5 Common features**

**5.1 Type HK and HKB — Half keystone rings**

**5.1.1 Nitrided rings**



**Key**

1 mark

**Figure 3 — Nitrided rings**

5.1.2 Chromium plated or spray coated rings

5.1.2.1 Fully faced



Key

1 mark

Figure 4 — Fully faced rings

5.1.2.2 Inlaid (not recommended for chromium plated rings)



Key

1 mark

Figure 5 — Inlaid rings

5.2 Type HK and HKB rings — Outside and inside rounded edges

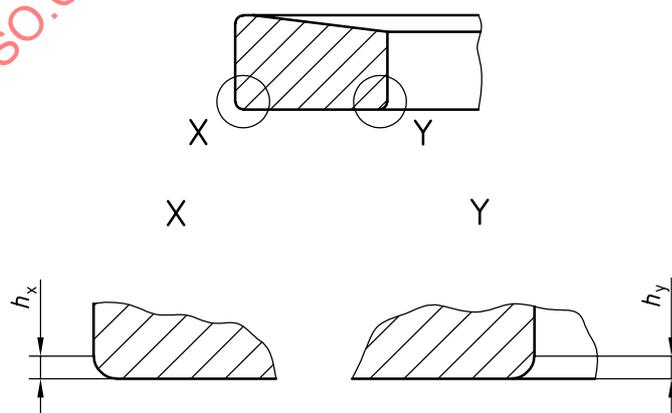


Figure 6 — Outside and inside rounded edges

**Table 2 —  $h_x$  and  $h_y$  dimensions**

Dimensions in millimetres

$h_1$	$h_x$ max.	$h_y$ max.
1,2	0,25	0,3
1,5	0,3	0,35
1,75		
2,0	0,3	0,4
2,5		
3,0		
3,5		

**5.3 Type HK and HKB rings (fully faced and inlaid) — Plating/coating thickness**



**Figure 7 — Plating/coating thickness**

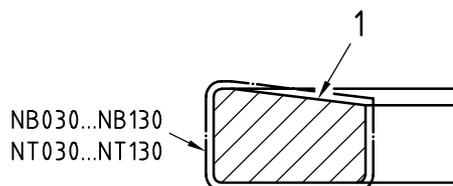
**Table 3 — Plating/coating thickness**

Dimensions in millimetres

Chromium plating code	Spray coating code	Thickness min.
CRF	—	0,005
CR1	SC1	0,05
CR2	SC2	0,10
CR3 <sup>a</sup>	SC3 <sup>a</sup>	0,15
CR4 <sup>a</sup>	SC4 <sup>a</sup>	0,20

<sup>a</sup> Not recommended for rings  $h_1 \leq 1,5$ .

## 5.4 Type HK and HKB rings — Nitrided case depth



## Key

1 mark

Figure 8 — Nitrided case depth

Table 4 — Nitrided case depth of peripheral surface and bottom side face

Dimensions in millimetres

Code	Nitrided case depth min.	
	Peripheral surface	Bottom side face
NB030	0,03	0,010
NB050	0,05	0,015
NB070	0,07	0,020
NB090	0,09	0,020
NB110	0,11	0,030
NB130	0,13	0,030

NOTE Nitrided case depth on top side face and on inside surface not specified.

Table 5 — Nitrided case depth of peripheral surface and side faces

Dimensions in millimetres

Code	Nitrided case depth min.	
	Peripheral surface	Side faces
NT030	0,03	0,010
NT050	0,05	0,015
NT070	0,07	0,020
NT090	0,09	0,020
NT110	0,11	0,030
NT130	0,13	0,030

NOTE Nitrided case depth on inside surface not specified.

## 6 Force factors

The tangential and diametral forces given in Table 7 shall be corrected when additional features are being used.

For common features, multiplier correction factors given in Table 6 shall be used. The force correction factors for the ratio  $m/(d_1 - a_1)$ , as given in ISO 6621-4, shall be used.

**Table 6 — Force correction factors for chromium plated, spray coated and nitrided HK and HKB rings**

$d_1$ mm	Factor							
	CRF	CR1	CR2/SC1	CR3	SC2	CR4/SC3	SC4	NB030...NB130 NT030...NT130
$38 \leq d_1 < 50$	1	0,80	0,71	—	0,63	—	—	1,03
$50 \leq d_1 < 75$	1	0,87	0,81	0,75	0,75	0,69	0,64	1,03
$75 \leq d_1 < 100$	1	0,91	0,86	0,82	0,82	0,78	0,74	1,03
$100 \leq d_1 < 125$	1	0,93	0,89	0,86	0,86	0,82	0,79	1,03
$125 \leq d_1 \leq 160$	1	0,94	0,91	0,89	0,89	0,86	0,83	1,03

## 7 Dimensions

See Table 7.

STANDARDSISO.COM : Click to view the full PDF of ISO 6624-4:2003

(blank page)

Table 7 — Dimensions of HK and HKB half keystone rings

Nominal diameter $d_1$	Radial wall thickness $a_1$	Nominal value of ring width $h_1$						$a_6$ Ref.	$a_7$	Method A						Method B															
		Column								Measured value $h_3^a$ For $h_1$ shown in column						$h_3$ (ref.) Column						Measured value $a_6$									
		1	2	3	4	5	6			1	2	3	4	5	6	Tolerance	1	2	3	4	5		6	Tolerance							
38	1,3							0,6		1,169															1,16						0,69
39																															
40																															
41	1,5																														
42																															
43																															
44																															
45								0,8		1,143															1,13						0,90
46																															
47	1,7																														
48																															
49									0,5 max.																						
50																															
51																															
52																															
53	1,9																														
54		$\pm 0,15$																													$0$ $-0,19$
55		Within a ring:																													
56		0,15 max.	1,2								1,118	1,418																			For phosphated PO surface: $+0,08$ $-0,19$
57																															
58																															
59	2,1																														
60								1,0																							
61																															
62																															
63																															
64	2,3																														
65									0,6 max.	1,116	1,416													1,10	1,40					1,09	
66																															
67																															
68																															
69																															
70	2,5																														
71																															
72																															
73									1,5	0,7 max.	1,053	1,353	1,603	1,853											1,04	1,34	1,59	1,84			1,60

Table 7 (continued)

Dimensions in millimetres

Closed gap		Tangential force						Diametral force						Nominal diameter		
$s_1$	Tolerance	$F_t$ N						$F_d$ N						$d_1$		
		For $h_1$ shown in column						For $h_1$ shown in column								
		1	2	3	4	5	6	1	2	3	4	5	6	Tolerance		
0,15	$\begin{matrix} +0,2 \\ 0 \end{matrix}$							7,0							38	
								8,1							39	
								8,1							40	
								8,1							41	
								8,1							42	
								8,1							43	
				—	—											44
																45
																46
																47
																48
																49
				4,2	5,3					9,0	11,4					50
				4,8	6,1					10,3	13,1					51
				4,8	6,1					10,3	13,1					52
				4,7	6,0					10,1	12,9					53
				4,7	6,0	—	—	—	—	10,1	12,9	—	—	—	—	54
				4,7	6,0					10,1	12,9					55
				4,6	5,9					9,9	12,7					56
				5,3	6,8					11,4	14,6					57
		5,2	6,7					11,2	14,4					58		
		5,2	6,6					11,2	14,2					59		
0,2	$\begin{matrix} +0,2 \\ 0 \end{matrix}$	5,1	6,5					11,0	14,0						60	
		5,0	6,4					10,8	13,8						61	
		5,7	7,3					12,3	15,7						62	
		5,6	7,2					12,0	15,5						63	
		5,6	7,2					12,0	15,5						64	
		5,5	7,1					11,8	15,3						65	
		5,5	7,0					11,8	15,1						66	
		5,4	6,9					11,6	14,8						67	
		6,2	7,9					13,3	17,0						68	
		6,1	7,8					13,1	16,8						69	
		6,0	7,7	9,2	10,6			12,9	16,6	19,8	22,8			70		
		6,0	7,7	9,1	10,5			12,9	16,6	19,6	22,5			71		
		5,9	7,6	9,0	10,4			12,7	16,3	19,4	22,3			72		
		5,8	7,5	8,9	10,2			12,5	16,1	19,1	22,0			73		



Table 7 (continued)

Dimensions in millimetres

Closed gap		Tangential force						Diametral force						Nominal diameter		
$s_1$	Tolerance	$F_t$ N						$F_d$ N						$d_1$		
		For $h_1$ shown in column						For $h_1$ shown in column								
		1	2	3	4	5	6	1	2	3	4	5	6			
0,2	$\begin{matrix} +0,2 \\ 0 \end{matrix}$	6,6	8,5	10,1	11,7			14,2	18,3	21,7	25,1			74		
0,25		6,5	8,4	9,9	11,5			14,0	18,1	21,3	24,7			75		
		6,4	8,2	9,8	11,3			13,8	17,6	21,1	24,2			76		
		6,3	8,1	9,6	11,1			13,5	17,4	20,6	23,8			77		
		6,1	7,9	9,4	10,9			13,1	17,0	20,2	23,3			78		
		7,0	9,0	10,7	12,4			15,1	19,4	23,0	26,6			79		
		6,9	8,9	10,6	12,2			14,8	19,1	22,8	26,2			80		
		6,8	8,8	10,4	12,1			14,6	18,9	22,4	26,0			81		
		6,7	8,7	10,3	11,9			14,4	18,7	22,1	25,6			82		
		6,6	8,6	10,2	11,8			14,2	18,5	21,9	25,4			83		
		6,5	8,4	10,0	11,6		—	14,0	18,1	21,5	24,9		—	84		
		7,4	9,6	11,4	13,2			15,9	20,6	24,5	28,4			85		
		7,3	9,5	11,3	13,0			15,7	20,4	24,3	28,0			86		
		7,2	9,3	11,1	12,9			15,5	20,0	23,9	27,7			87		
		7,1	9,2	11,0	12,7			15,3	19,8	23,7	27,3			88		
		7,0	9,1	10,8	12,5			15,1	19,6	23,2	26,9			89		
		0,3	$\begin{matrix} +0,25 \\ 0 \end{matrix}$	9,0	10,6	12,3	15,7			19,2	22,8	26,4	33,8			± 30 % if $F_d < 21,5$ N
10,1	12,1			14,0	17,9			21,8	26,0	30,1	38,5			91		
10,0	11,9			13,8	17,6			21,4	25,6	29,7	37,8			± 20 % if $F_d \geq 21,5$ N	92	
9,8	11,6			13,5	17,2			21,0	24,9	29,0	37,0			93		
9,6	11,4			13,2	16,9			20,5	24,5	24,5	36,3			94		
9,3	11,1			12,9	16,5			20,1	23,9	27,7	35,5			95		
10,6	12,6			14,7	18,8			22,8	27,1	31,6	40,4			96		
10,4	12,5			14,5	18,5			22,5	26,9	31,2	39,9			97		
10,3	12,3			14,3	18,3			22,1	26,4	30,7	39,3			98		
10,2	12,1			14,1	18,0			21,8	26,0	30,3	38,7			99		
				17,7	13,9	17,7	21,6				38,1	29,8	38,1	46,4		100
				17,4	13,6	17,4	21,2				37,5	29,3	37,5	45,7		101
				19,8	15,5	19,8	24,2				42,7	33,3	42,7	52,0		102
				19,6	15,3	19,6	23,9				42,1	32,8	42,1	51,3		103
		19,3	15,1	19,3	23,5				41,5	32,4	41,5	50,5		104		
		19,0	14,8	19,0	23,1				40,8	31,9	40,8	49,8		105		
		18,7	14,6	18,7	22,8				40,2	31,4	40,2	49,0		106		
		18,4	14,3	18,4	22,4				39,5	30,8	39,5	48,1		107		
		20,9	16,3	20,9	25,5				44,9	35,0	44,9	54,8		108		
		20,5	15,9	20,5	25,0				44,0	34,3	44,0	53,7		109		

