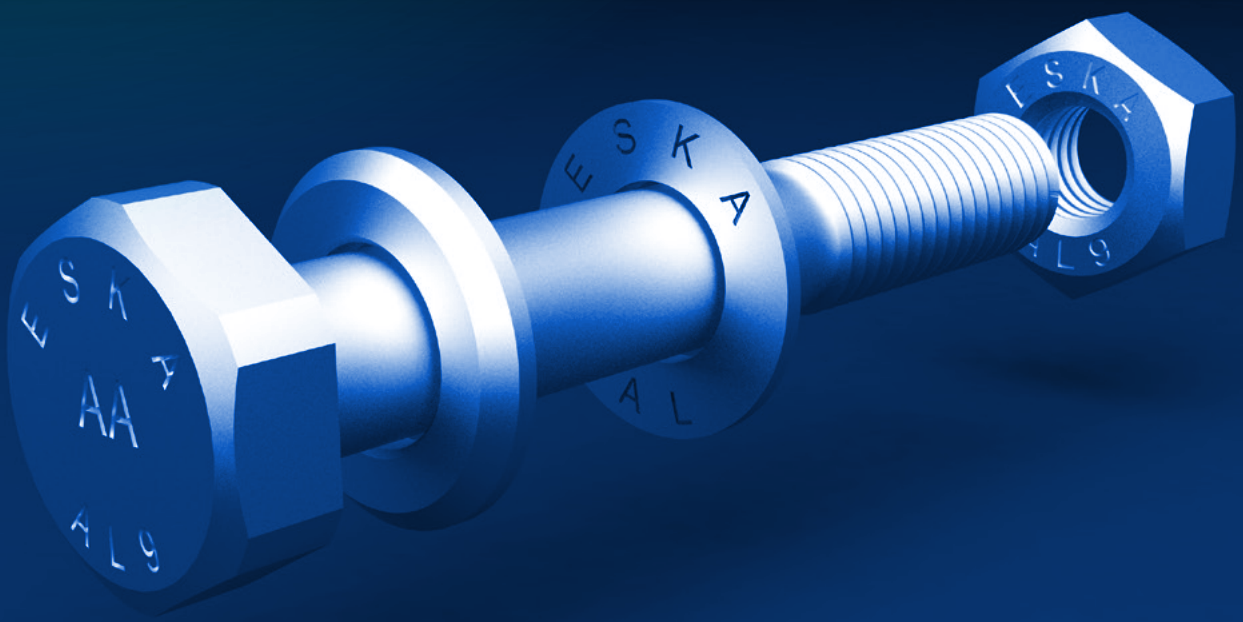
ESKA®
perFORMING in perfection

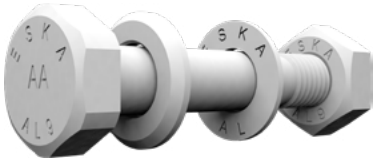
ESKA® - HA-SCHRAUBEN-GARNITUREN®

made of high-strength aluminium for preloadable aluminium constructions and structures with higher corrosion protection and reduced weight



Technical Data Sheet

Description/Fields of application



HA-SCHRAUBENGARNITUREN® from ESKA® are made of a high-strength aluminium alloy for preloaded joints to connect aluminium constructions and structures in aluminium building industry.

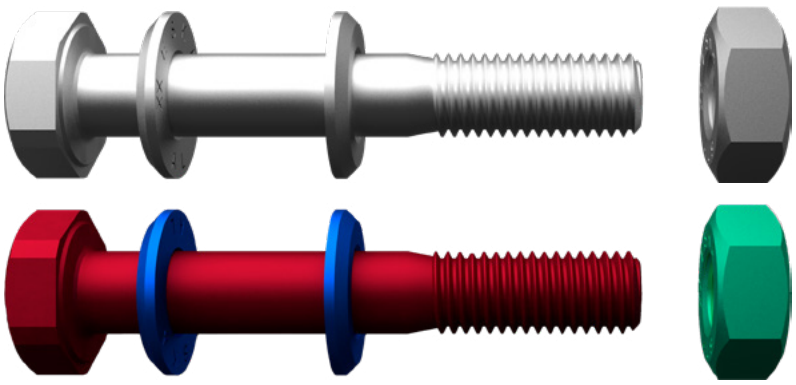
The HA-SCHRAUBENGARNITUREN® from ESKA® are suitable for all industrial applications in which light-metal components have to be tightened safely under the aspects of weight saving, constant preload force, and corrosion optimisation. Thus, light-weight construction concepts can be implemented in a persistent, safe, and visually appealing manner.

HA-SCHRAUBENGARNITUREN® from ESKA® vs. HV-bolt-set according to DIN EN 14399-1 after 1008 hours of salt spray test (screwed in aluminium)

Advantages

of HA-SCHRAUBENGARNITUREN® from ESKA®

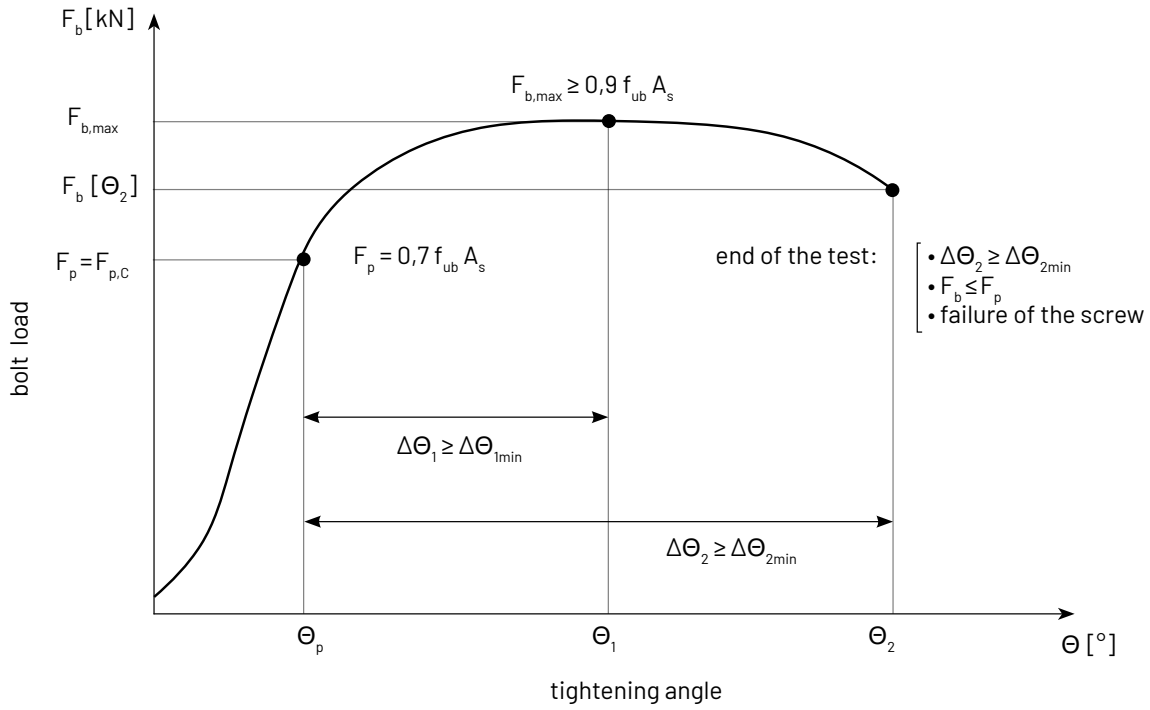
- Approx. 65 % weight saving as compared to steel bolts of same size
- No contact corrosion towards aluminium components
- No cold brittleness
- In general, to be used without additional coating
- Sustainable long-term durability can be obtained
- Minimum preload forces can be assured (in classes K1 and K2)
- Joints pursuant to DIN EN 1090-2 with adjusted characteristics
- Dimensions based on the systems HV and HR pursuant to DIN EN 14399
- More flexibility thanks to longer threads as compared to the HV system
- Assembly tools can be used further
- Visual upgrade of joint thanks to coloured anodic coats
- Similar relaxation behaviour in comparison to HV bolt sets



Product properties

Characteristic features			HA-bolts	HA-nuts	HA-washers
Tensile strength	R_m	[MPa]	≥ 410		
Yield strength at 0,2 %	$R_{p0,2}$	[MPa]	350 - 400		
Elongation at break of a prepared test sample in percent	A	[%]	≥ 7		
Vickers hardness	HV10		≥ 125	≥ 125	≥ 99
Brinell hardness	HBW		≥ 120	≥ 120	≥ 94
Chemical composition			EN AW-6056 (AlSi1MgCuMn)	EN AW-6056 (AlSi1MgCuMn)	EN AW-6082 (AlSi1MgMn)
Thread tolerance			6g	6H	
Heat treatment condition			T6	T6	T6

HA-SCHRAUBENGARNITUREN®		
Individual value of the highest bolt load in the tightening test	$F_{bi,max}$	$> 0,9\ f_{ub}A_s$
Individual angle difference between reaching $F_{p,C}$ and the end of the test	$\Delta\Theta_2$	$t < 2d$: $> 180°$ $2d \leq t < 6d$: $> 210°$ $6d \leq t \leq 10d$: $> 240°$
Individual value of k-factor	k_i	$0,105 \leq k \leq 0,140$
Target average value of k-faktor	k_m	~ 0,12
Shear strength coefficient	screw shank and thread in shear plane	$\alpha_V = 0,55$
max. application temperature		150 °C, momentary (<10 h) up to 180 °C



Picture 1 Criteria for suitability test acc. DIN EN 14399-2

Guaranteed preload & tightening parameters

torque-controlled tightening				
Dimension (diameter d in mm)	Tightening moment 1. tightening step $M_{A,HA,h}$ [Nm]	Tightening moment 2. tightening step 0,75 $M_{A,HA-DV}$ [Nm]	Tightening moment 3. tightening step $M_{A,HA-DV}$ [Nm]	Preload $F_{p,c-HA^*}$ [kN]
M8	5	8	11	9
M10	10	18	22	14
M12	15	25	35	21
M16	35	65	90	40
M20	60	125	170	60

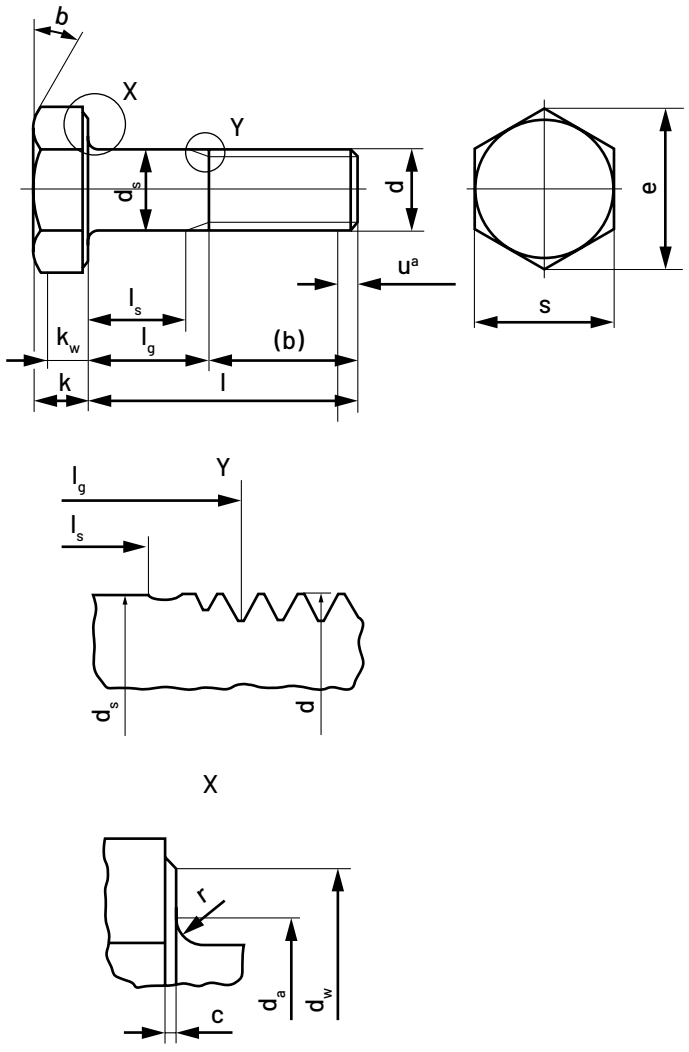
Combined preload procedure				
Dimension (diameter d in mm)	Tightening moment 1. tightening step $M_{A,HA,h}$ [Nm]	Tightening moment 2. tightening step 0,75 $M_{A,HA-DV}$ [Nm]	Prevailing angle $\Delta\Theta$[1] for t[2]	Preload $F_{p,c-HA}$ [kN]
M8	5	8	< 2d: 60° 2 - 6d: 90° 6 - 10d: 120°	11
M10	10	15		17
M12	15	25		24
M16	35	65		45
M20	60	120		70

[1] acc. DIN EN 1090-2 and DASt-024

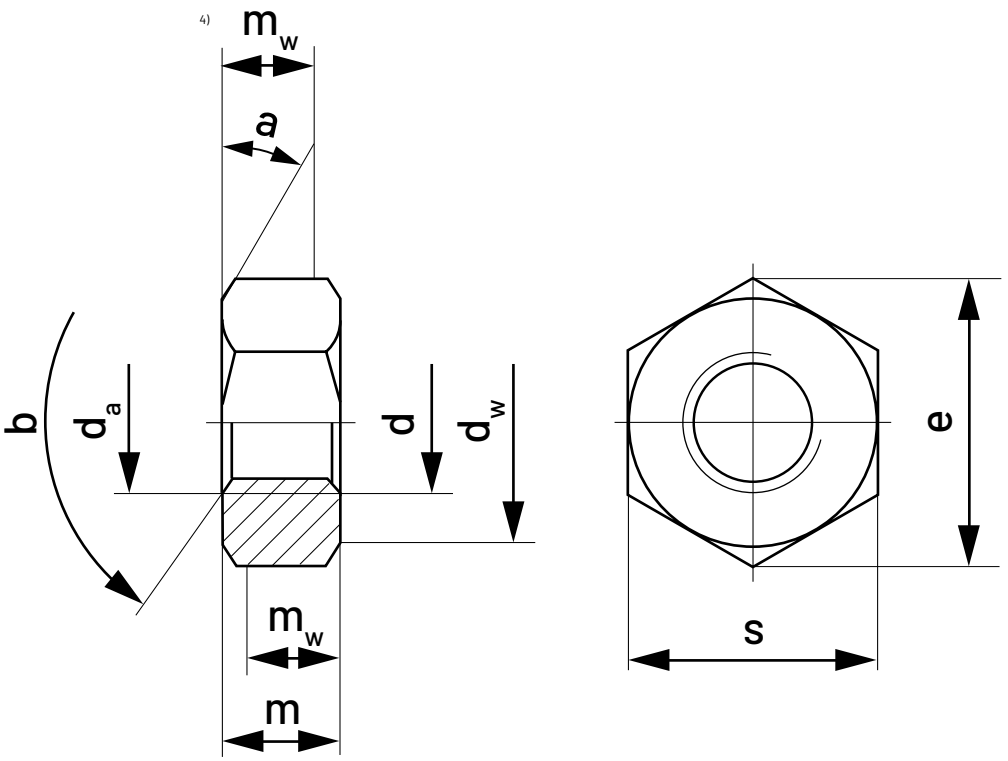
[2] t: total nominal thickness of the parts to be connected (incl. all filler plates and washers)

Dimensions of the bolts [3]						
d		M8 (6g)	M10(6g)	M12 (6g)	M16 (6g)	M20 (6g)
p		1,25	1,5	1,75	2	2,5
(b)		20	25	30	40	50
c	min.	0,2	0,2	0,4	0,4	0,4
	max	0,6	0,6	0,6	0,6	0,8
d_a	max.	10	12,4	15,2	19,2	24,0
d_s	nom.	8	10	12	16	20
	min.	7,9	9,9	11,9	15,9	19,9
	max.	8,1	10,1	12,1	16,1	20,1
d_w	min.	12,63	15,63	20,1	24,9	29,5
e	min.	15,52	18,91	23,91	29,56	35,03
k	nom.	5,3	6,4	8	10	13
	min.	5,15	6,22	7,82	9,82	12,785
	max.	5,45	6,58	8,18	10,18	13,215
k_w	min.	3,61	4,35	5,28	6,47	8,47
r	min.	0,8	1	1,2	1,2	1,5
s	max.	14	17	22	27	32
	min.	13,73	16,73	21,67	26,67	31,38

3)

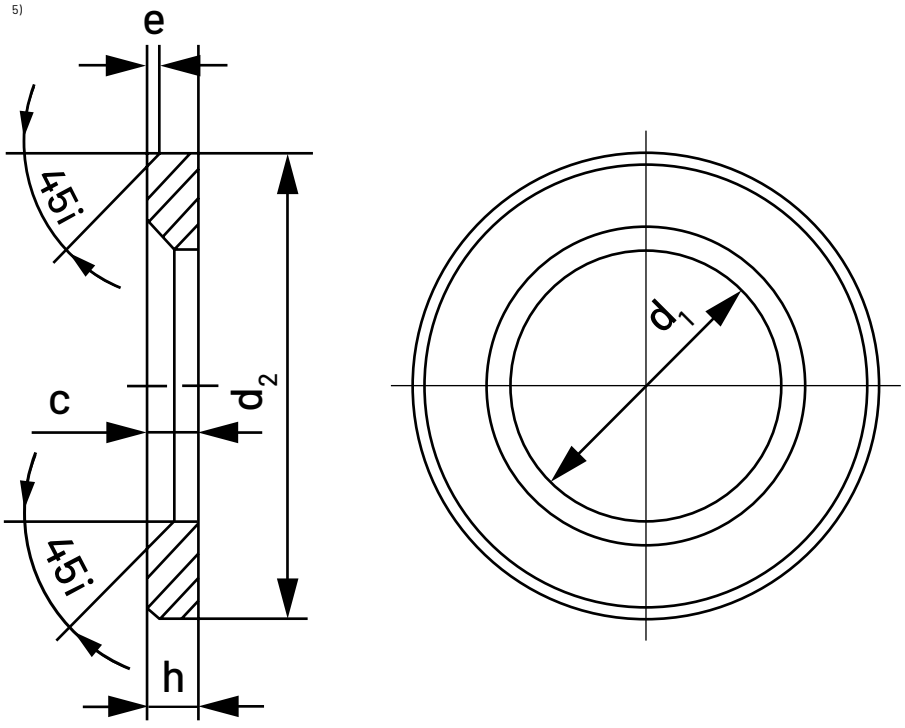


Dimensions of the nuts [4]						
d		M8 (6H)	M10 (6H)	M12 (6H)	M16 (6H)	M20 (6H)
P		1,25	1,5	1,75	2	2,5
d_a	max.	6,75	10,8	13	17,3	21,6
	min.	6	10	12	16	20
d_w	max.	14	17	22	27	32
	min.	12,5	15,5	21,1	24,9	29,5
e	min.	15,34	18,73	23,91	9,84	35,03
m	nom. = max.	6,8	8,4	10	13	16
	min.	6,44	8,04	9,64	12,3	14,9
m_w	min.	5,2	6,4	7,71	9,84	11,92
s	max.	14	17	22	27	32
	min.	13,57	16,57	21,16	26,16	31



Dimensions of the washers [5]						
d		M8	M10	M12	M16	M20
d_1	min.	8,4	10,5	13	17	21
	max.	8,62	10,77	13,27	17,27	21,33
d_2	min.	15,57	19,48	23,48	29,48	36,38
	max.	16	20	24	30	37
h	nom.	1,6	2	3	4	4
	min.	1,4	1,8	2,7	3,7	3,7
	max.	1,8	2,2	3,3	4,3	4,3

5)



Reduced surface pressure

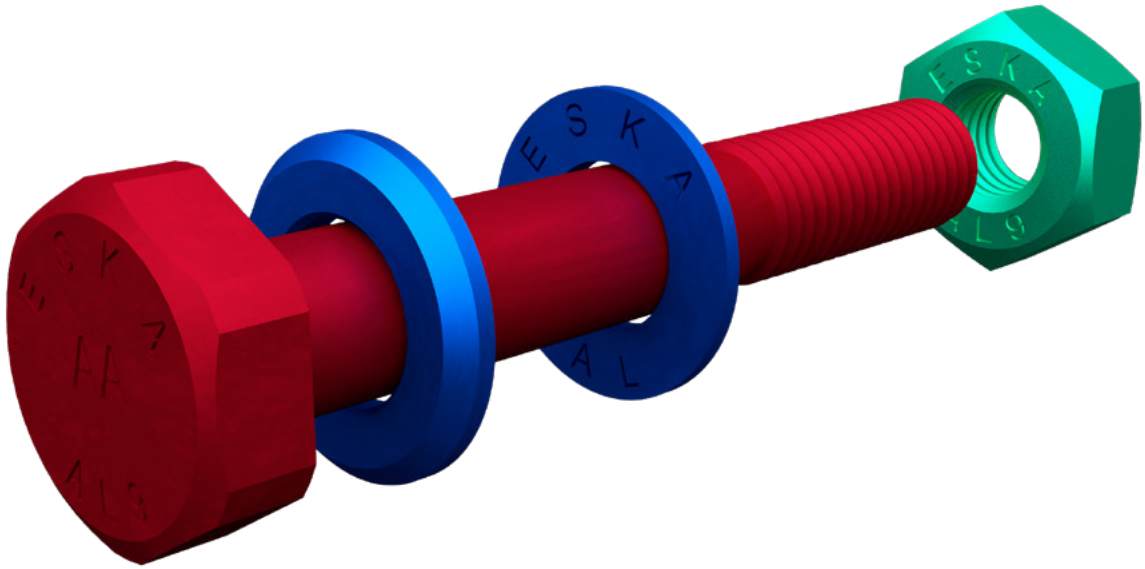
- Boltet joints with comparable steel HV-sets can lead to critical surface pressures due to excessive preload forces when installing in certain aluminum materials which causes and thus increased loss of preload.
- E.g.: surface pressure acc. to VDI 2230-1 for **AlMgSi1 F28: 325 MPa**

Dimension	$F_{bi,max}$ HA $\geq 0{,}9 \times f_{ub}$ [6] $\times A_s$ [7] [kN]	$F_{bi,max}$ HV $\geq 0{,}9 \times f_{ub}$ [6] $\times A_s$ [7] [kN]	Surface pressure HA-SCHRAUBEN-GARNITUREN® [MPa] [8]	Surface pressure HV-bolt-set [MPa] [8]
M12	31,1	78,9	105	268
M16	57,9	147,0	129	**328**
M20	90,4	229,3	144	**365**

[6] f_{ub}(Al) = 410 N/mm²; f_{ub}(HV;10.9) = 1040 N/mm²

[7] A_s = stress cross section acc.DIN EN ISO 898-1 [mm]

[8] determined from max. inner diameter, min. outer diameter/min. washer height acc. DIN EN 14399-6 and, if applicable, min. outer diameter of the screw according to DIN EN 14399-4



Technical Table TT843	Package thicknesses t_{s2} and clamping lengths ∑t for ESKA - HA-SCHRAUBENGARNITUREN®																			
d	M8*				M10				M12				M16				M20			
l	Package thickness $t_{s2,min}$ / $t_{s2,max}$ & clamping lengths $\sum t_{min}$/ $\sum t_{max}$																			
nom.	$t_{s2,min}$	$t_{s2,max}$	$\sum t_{min}$	$\sum t_{max}$	$t_{s2,min}$	$t_{s2,max}$	$\sum t_{min}$	$\sum t_{max}$	$t_{s2,min}$	$t_{s2,max}$	$\sum t_{min}$	$\sum t_{max}$	$t_{s2,min}$	$t_{s2,max}$	$\sum t_{min}$	$\sum t_{max}$	$t_{s2,min}$	$t_{s2,max}$	$\sum t_{min}$	$\sum t_{max}$
40	23	27	25	30																
45	28	32	30	35	23	29	26	33												
50	33	37	35	40	28	34	31	38	22	30	27	37								
55	38	41	40	45	33	39	36	43	27	35	32	41								
60	43	46	45	50	38	44	41	48	32	40	37	46	21	34	28	43				
65	48	51	50	55	43	49	46	53	37	45	42	51	26	39	33	48				
70	53	56	55	60	48	54	51	58	42	50	47	56	31	44	38	53				
75	58	61	60	65	53	59	56	63	47	55	52	61	36	49	43	58	28	46	35	55
80	63	66	65	70	58	64	61	68	52	60	57	66	41	54	48	63	33	51	40	60
85	68	71	70	75	63	68	66	73	57	64	62	71	46	59	53	68	38	56	45	64
90					68	73	71	78	62	69	67	76	51	64	58	73	43	61	50	69
95					73	78	76	83	67	74	72	81	56	69	63	78	48	66	55	74
100					78	83	81	88	72	79	77	86	61	74	68	83	53	71	60	79
105					83	88	86	93	77	84	82	91	66	79	73	88	58	76	65	84
110					88	93	91	98	82	89	87	96	71	84	78	93	63	81	70	89
115					93	98	96	103	87	94	92	101	76	89	83	98	68	86	75	94
120					98	103	101	108	92	99	97	106	81	94	88	103	73	91	80	99
125					103	108	106	113	97	104	102	11	86	99	93	108	78	95	85	104
130					108	113	111	118	102	109	107	116	91	104	98	113	83	100	90	109
135					113	118	116	123	107	114	112	121	96	109	103	118	88	105	95	114
140					118	123	121	128	112	119	117	126	101	114	108	123	93	110	100	119
145					123	128	126	133	117	124	122	131	106	119	113	128	98	115	105	124
150					128	133	131	138	122	129	127	136	111	124	118	133	103	120	110	129
155					133	138	136	143	127	134	132	141	116	129	123	138	108	125	115	134
160													121	134	128	143	113	130	120	139
165													126	139	133	148	118	135	125	144
170													131	144	138	153	123	140	130	149
175													136	149	143	158	128	145	135	154

Remark: Minimum values rounded up to integer numbers, maximum values rounded down / * other graduations are available for missing package thicknesses and clamping lengths