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STANDARD SIZES OF ANODIZED ALUMINUM PANELLING

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ABSTRACT

The licensees of a manufacturer of anodized aluminum panelling have to deliver their clients made to measure panelling in many different widths varying between 40 and 350 cm. The factory does not want to make all these sizes, but to confine itself to five or six standard segment sizes. These standards can be varied between 40 and 60 cm. Panelling widths larger than 60 cm can be composed of the standard sizes.

If it is allowed to compose different standard sizes to one demanded panelling width, there is a relatively small cutting loss. However, as colour differences occur between the batches, the licensees prefer to compose each aluminum panelling of the same standard size. Therefore the factory wanted to change the standard sizes, which cause high trim losses. The authors determined new standards with some favourable properties.

KEYWORDS

Anodized aluminum panelling , cutting stock, integer programming, P-median location.

STANDARD SIZES OF PANELLING

1. INTRODUCTION

This research was carried out at the request of a manufacturer of anodized aluminum panelling, who wishes to remain anonymous in this report.

The licensees of the manufacturer have to deliver their clients many different aluminum panellings varying in width between 40 and 350 cm. The length of the panelling is standard, not important in this paper.

The factory produced six standard segment sizes, called standards, of 35-40-45-50-55-60 cm. Each panelling between 40 and 350 cm had to be composed of these standards. Doing this overlaps of 2 cm are created as shown in Fig. 1.1. There are holes for the connecting parts centered on 1 cm of both ends.

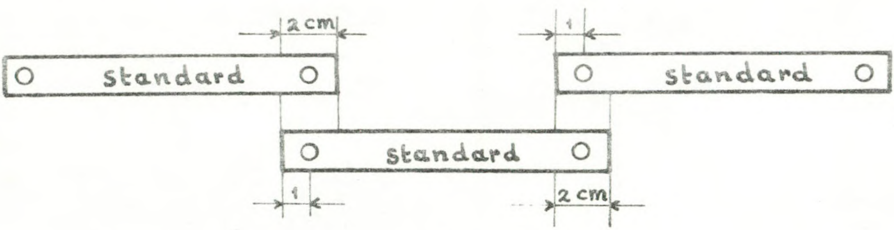

Fig. 1.1 Composing an anodized aluminum panelling.

Only those panellings were delivered, which gave no cutting losses and were composed of at most two different standards which differed not more than 5 cm in width. This means that it was not possible to deliver each demanded panelling size between 40 and 350 cm (see App. I). Another disadvantage of this policy was caused by the manufacturing process: it is practically impossible to make two batches with exactly the same colour. So it is desirable to compose each panelling width of standards from one and the same batch, as otherwise colour differences occur.

The factory was not quite happy with the situation just described. It was decided to advise the clients to use only one standard in composing a panelling. As a consequence, however, only a very limited number of sizes could be composed. Therefore it was advised to compose other sizes by cutting. With this new policy the old standards caused quite large cutting losses, so we were asked to find more favourable standards.

The definition of favourable in the last sentence changed somewhat during the consultation process. We will describe this process in its historical development in the next sections.

2. A FIRST DESCRIPTION

At first sight we were inclined to build a model in which the expectation of the total trim losses by all the clients was minimized. Very little, however, is known about the distribution function of the demand. Reasons are not only the many different colours and grades, but mainly the fact that the factory sells standards to the licensees and not final panellings.

As a consequence the factory took the marketing point of view and wished to introduce such a set of standards, that in general each width between 40 and 350 cm can be composed with small trim losses. Then the advertising material could show for each of these widths, how small the trim losses are, and from which standard it should be composed.

Concluding the company wished to adopt its policy to the following wishes:

a. The licensees are able to deliver panelling widths in each whole number of cm between 40 and 350.

b. Each panelling width should be composed of segments of one and the same standard size,

c. Given a uniform demand, i.e., one panelling of each width in cm´s between 40 and 350 is ordered, cutting losses should be minimum.

Alltogether it boiles down to the following problem description.

|| Given is a standard order set consisting of one (fixed length) specimen of each demanded panelling width between 40 and 350 cm. Determine 5, 6 or 7 standard segment sizes in cm´s such that the overall cutting losses are minimal.

Before constructing a mathematical model of this problem we make some observations which give rise to another criterion.

Take a panelling width of 233 cm and the standards 35, 40, 45, 50, 55, and 60 cm. The width 233 can be composed of 7 * standard 35, which gives

245 - 6 * 2 (overlap) = 233 with no cutting loss (a)

Another possibility is 4 * standard 60, which gives

240 - 3 * 2 = 234 with cutting loss 1 cm. (b)

The total losses - cutting loss and overlap loss - are 12 cm for (a) and 7 cm for (b). So with (b) there is 5 cm less material needed.

This leads us to the conclusion that we need apart from cutting losses another criterion: <u>material needed</u>, or equivalently, total loss.

In fact we have to look at the following six quantities which can all be different (see robustness in panelling width, Table 6.3).

criterion cutting loss	criterion material needed
cutting loss	cutting loss
overlap loss	overlap loss
total loss	total loss

Note that overlap loss with criterion material needed is always smaller than overlap loss with criterion cutting loss for otherwise total loss with criterion cutting loss had been less than total loss with criterion material needed.

If we maintain the standards 35, 40, 45, 50, 55 and 60, we have the following losses (Table 2.1).

Table 2.1 Losses with standards 35-40-45-50-55-60.

criterion	cutting loss	material needed
cutting loss	2.39%	2.91%
overlap loss	3.77%	3.19%
total loss	6.17%	6.09%

The criterion material needed clearly is more relevant to the consumer than the criterion cutting loss. The factory had not been aware of the difference between them before, and in all advertising material only cutting losses were considered. It was decided not to change the criterion in the advertising, but in order to estimate all possibilities, to look at both models. Also it was remarked that in general people will choose a panelling with minimal material unless, at the cost of some more overlap, it is possible to have a pattern without cutting loss.

In fact changing criteria caused for 104 out of 311 panelling widths a change of standard used. This indicates that the use of standards is quite sensitive to the criterion used.

Another observation is that a small change in one of the standards gives rise to a great change in the proportions of standard segments needed for composing the standard order set (see Table 2.2).

Table 2.2 Example of change in standards

							cutting loss (%)
standards	40	43	46	49	52	$\boxed{55}$	
numbers needed	293	268	242	228	222	129	2.31
standards	40	43	46	49	52	$\boxed{56}$	
numbers needed	292	208	222	204	222	210	2.30

3. MATHEMATICAL MODELS

3.1 Mixed integer linear programming

The problem of minimizing licensees cutting losses can be described as a mixed integer linear programming problem. First we assume that the standards are continuous.

We use indices

i = panelling width (cm) : 40,...,350 ,

j = index of standard size : 1,...,6 ,

k = number of standards needed for a panelling width : 1,...,10 *)

$$10 = \left\lceil \frac{350-2}{40-2} \right\rceil$$

and variables

s_j = j-th standard size ,

$$x_{ijk} = \begin{cases} 1 & \text{if panelling width } i \text{ is composed of } k \text{ times standard } s_j , \\ 0 & \text{otherwise ,} \end{cases}$$

v_i = cutting loss with panelling i .

The model is:

$$\text{minimize} \quad \sum_{i=40}^{350} v_i$$

$$\text{subject to} \quad s_1 \geq 40; \quad s_{j-1} \leq s_j \quad j=2,\ldots,6; \quad s_6 \leq 60 \qquad (1),(2),(3)$$

$$k.s_j - 2.(k-1) \geq i.x_{ijk} \qquad \forall i,j,k \qquad (4)$$

$$\sum_{j=1}^{6} \sum_{k=1}^{10} x_{ijk} = 1 \quad \forall i \qquad (5)$$

*) $\lceil a \rceil$: smallest integer greater than or equal to a

$$v_i \geq k.s_j - 2.(k-1) - i - M.(1-x_{ijk}) \quad \forall i,j,k \qquad (6)$$

where M is a large integer

$$x_{ijk} \in \{0,1\} \quad \forall i,j,k \qquad (7)$$

(1), (2) and (3) give a ranking of the standards in increasing order; a ranking is not necessary, but limitates the number of alternatives. (4) quarantees that a panelling width can be composed of the used standards minus their overlap. (5) guarantees that each panelling width is made once. (6) is only operational if $x_{ijk}=1$.

If we want the standards with minimal material needed as a criterion, we get:

$$\text{minimize} \quad \sum_{i=40}^{350} y_i$$

subject to (1), (2), (3), (4), (5), (7), and

$$y_i \geq k.s_j - M.(1-x_{ijk}) \quad \forall i \qquad (8)$$

3.2 P-median location version

In the real situation it is sufficient to look for the standards in an integer number of cm´s.

The indices used are the following:

i = panelling width , i=40,...,350

j = standard segment size , j=40,...,60

The cutting loss c_{ij} is calculated in the following way

$\left\lceil \frac{i-2}{j-2} \right\rceil$: the number of standard j needed for panelling i

$b_{ij} = \left\lceil \frac{i-2}{j-2} \right\rceil . j$ = material needed for panelling i

$$c_{ij} = \left\lceil \frac{i-2}{j-2} \right\rceil . (j-2) + 2 - i \text{ : cutting loss of standard } j \text{ if used for panelling } i$$

We used the following variables :

$$x_{ij} = \begin{cases} 1 & \text{if panelling } i \text{ is composed of standard } j \text{ ,} \\ 0 & \text{otherwise .} \end{cases}$$

$$z_j = \begin{cases} 1 & \text{if standard } j \text{ is used ,} \\ 0 & \text{otherwise .} \end{cases}$$

The model is :

$$\text{minimize} \quad \sum_{i=40}^{350} \sum_{j=40}^{60} c_{ij} . x_{ij}$$

$$\text{subject to} \quad \sum_{j=40}^{60} x_{ij} = 1 \quad , \forall i \qquad (1)$$

$$x_{ij} \leq z_j \quad , \forall i,j \qquad (2)$$

$$\sum_{j=40}^{60} z_j = 6 \quad , \qquad (3)$$

$$x_{ij} , z_j \geq 0 \text{ and integer , } \forall i,j \quad (4),(5)$$

(1) guarantees that each panelling is composed of one standard. (2) causes z_j to be 1 if $x_{ij} = 1$. (3) indicates that we used six standards.

If the material needed has to be minimized, the objective function will be replaced by

$$\sum_{i=40}^{350} \sum_{j=40}^{60} b_{ij} . x_{ij} \quad .$$

These models can be interpreted as P-median location problems in the following way.

Suppose that the standards are presented by warehouses and the panellings by customers. If each customer is supplied by one warehouse, we have a 6-median problem [Hansen, 1974] (see Fig. 3.1.).

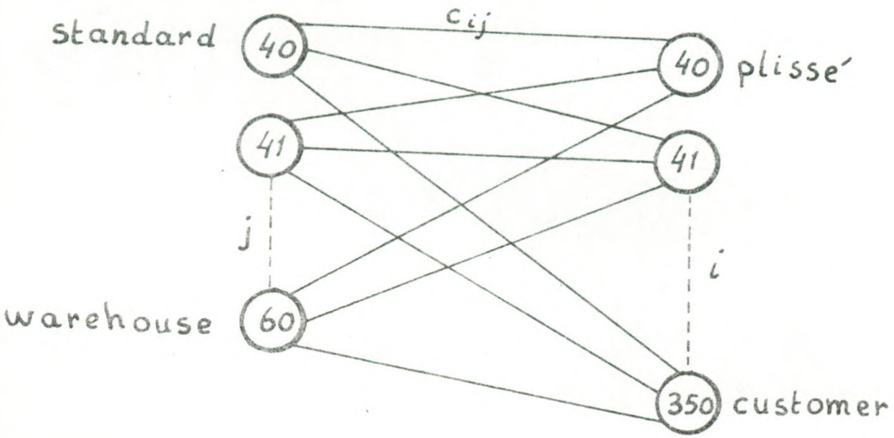

Fig. 3.1 Determining the standards as a P-median location problem (P=6).

4. ALGORITHMS

4.1 Heuristic

First we tried a greedy algorithm descibed by Hansen [1974], called Babel, followed by an algorithm of Teitz & Bart [1968].

In the Babel algorithm one starts with using only that standard size, which gives the smallest cutting losses, and then successively adds those standards which result in maximal reductions of cutting losses until the wanted number of standard sizes is reached. After that, following Teitz and Bart one tries to improve the solution in a number of steps, in each of which one used size is exchanged with an unused size as long as the cutting losses decrease.

We found the standards of 41-43-45-48-52-58 cm with a cutting loss of 2.17%.

The main disadvantage of this heuristic approach was that we were not only interested in one optimal solution, but also in a set of suboptimal solutions in order to choose from them a solution that had other favourable properties.

4.2 Exact

We used in principle complete enumeration for determining the most favourable standards.

The total number of possible standards is: $\binom{21}{6} = 54{,}264$.

If we want to know the six optimal ones with respect to cutting loss within a CPU-time of 10 min. ,we have to check per second

$$\frac{54{,}264}{600} \approx 90 \text{ possibilities.}$$

We can attain this number by using the following reductions while looking at one combination of standards.

Let's take the standards 35-40-45-50-55-60. The minimal cutting loss standard of which, for example, the panelling width of 79 cm is composed, can be determined in the following way.

a) determine for each standard j which number is needed for panelling 79 :

$$k = \left\lceil \frac{79 - 2}{j - 2} \right\rceil ,$$

b) that standard will be choosen for which $k.j - 2(k-1) - 79$ is minimum.

This will be reached for j=45 and k=2 . The cutting loss is 9 cm. Panelling 80 has the same solution - minimum according to b) gives the same standard - with cutting loss 8 cm. Upto panelling 88 (79+9) everything is known. With panelling 89 the procedures a) and b) have to be repeated.

As this explicit enumeration method was feasible and gave rather satisfying results, we did not try to obtain solutions to the mixed integer model, described in section 3.1.

5. COMPARING DIFFERENT NUMBERS OF STANDARDS

In this section we compare results with 5, 6 and 7 standards. First we look at the criterion minimal cutting loss under uniform demand.

Table 5.1 Optimal standards with min cutting loss under uniform demand

								cutting loss(%)
5 standards	: 41	43	45	48	58			2.61
6 standards	: 40	42	44	46	49	56		2.15
7 standards	: 40	42	44	47	49	54	60	1.82
present used standards	: 35	40	45	50	55	60		2.39

The present used standards are clearly not the optimal ones. The heuristic solution of 4.1 is not optimal too.

We also investigated the effect of replacing the uniform demand distribution by the distribution of Table 5.2, which was suggested by the factory.

Table 5.2 Weighted demand

panelling	demand(%)	material(%)
40 - 79	18	5.06
80 - 119	35	16.45
120 - 179	25	26.48
180 - 259	17	35.77
260 - 350	5	16.23

According to the criterion minimal cutting loss and weighted demand, we have the solution of Table 5.3 .

Table 5.3 Optimal standards with minimal cutting loss and weighted demand

								cutting loss(%)
5 standards :	41	45	48	51	58			3.21
6 standards :	41	43	45	48	52	58		2.61
7 standards :	40	42	44	47	51	57	60	2.37
present used standards:	35	40	45	50	55	60		2.82

Although other standards were obtained, this solution did not give much new insights.

6. ANOTHER CONSIDERATION

Another important factor are the costs for the licensees, caused by the quantities they have in stock. So with equal cutting losses they would prefer to have 5 over 6 standards in stock. This is the more important as they want to have stock of standard panellings in a lot of different colours and grades.

In case of uniform demand 5 standards cause 15 % less material in stock than the present used standards as can be concluded from Table 6.1.

Table 6.1 Material in stock with uniform demand; one piece per standard.

5 standards	41	45	48	51	58		: 243 m^2
present used standards	35	40	45	50	55	60	: 285 m^2

Looking at these figures we decided, in consultation with the firm, to look for an optimal set of 5 standards.

The best 10 alternatives of 5 standards with respect to minimal cutting loss are presented in Table 6.2 .

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Table 6.2 Top-10 of 5 standards

standard					cutting loss(%)
40	42	44	47	56	2.67
40	42	44	47	57	2.63
40	42	44	47	60	2.66
40	42	44	49	60	2.65
40	43	45	48	54	2.67
40	43	48	54	60	2.65
40	44	46	49	56	2.64
41	43	45	48	55	2.67
* 41	43	45	48	58	2.61 *
41	45	48	51	58	2.65

We also looked at standards on 0.5 cm, but that gave no improvement.

We tried to get some insight in the sensitivity of the results to changes by varying the range of possible widths in the demand. Only the top-10 of Table 6.2 were considered. In accordance with section 2 we investigated the losses both from the viewpoint of a cutting loss and of a minimal material minimizer (see Table 6.3).

Table 6.3 Robustness in panelling width of top-10.

	criterion cutting loss					criterion min. material				
panelling width	standards					standards				
100 - 350										
min cutting loss	41	43	45	48	58	41	43	45	48	58
min overlap	41	45	48	51	58	40	43	48	54	60
min total loss	41	45	48	51	58	41	45	48	51	58
40 - 300										
min cutting loss	40	42	44	47	57	40	42	44	47	57
min overlap	41	45	48	51	58	40	43	48	54	60
min total loss	41	45	48	51	58	41	45	48	51	58
40 - 400										
min cutting loss	40	42	44	47	57	40	42	44	47	57
min overlap	41	45	48	51	58	40	43	48	54	60
min total loss	41	45	48	51	58	41	45	48	51	58
40 - 350										
min cutting loss	41	43	45	48	58	41	43	45	48	58
min overlap	41	45	48	51	58	40	43	48	54	60
min total loss	41	45	48	51	58	41	45	48	51	58

Clearly the standards 41-45-48-51-58 are the most robust ones with respect to the six quantities described in section 2 and nearly optimal with respect to both cutting loss and material needed.

7. TRIM LOSSES IN FACTORY

After having obtained the results described in the last section, we found out that in the existing situation there were nearly no trim losses, but that the inventory of the factory showed a great surplus of the standard 35 cm. As a matter of fact this surplus could be seen as a loss for the factory itself. The standards are cut from a 150 cm wide and 4000 cm long master segment. Therefore we calculated the firm's trim losses due to the cutting of the master segment of 150 cm width into the number of standards demanded with uniform and weighted demand for the best four sets of standards with respect to the licensees cutting losses. As criterion we took the minimal number of master segments.

These problems were solved with the well-known LP-column generation technique described by Gilmore & Gomory [1963, 1966]. The results are shown in Table 7.1 .

Table 7.1 Evaluation of four sets of standards.

					cutting loss (%)		trim loss (%)	
standards					uniform	weighted	uniform	weighted
40	42	44	47	57	2.63	3.41	11.85	11.25
40	44	46	49	56	2.64	3.27	8.97	8.77
41	43	45	48	58	$\boxed{2.61}$	3.39	10.55	9.26
41	45	48	51	58	2.65	$\boxed{3.23}$	$\boxed{5.83}$	$\boxed{5.23}$

The standards 41-45-48-51-58 are optimal in three of the four cases.

8. CONCLUSION

Considering the outcoms the firm decided to accept as new standards 41-45-48-51-58. Table 6.1 shows that these standards lower considerably the stocks with the licensees. From table 7.1 it can be seen that the cutting losses for the licensees are reasonable low and the trim losses of the firm are minimal.

The 5 new standards are accepted now and licensees can find minimal cutting loss patterns according to the list as presented in appendix II. After a year of experience with the new standards the financial results of the firm are strongly improved.

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APPENDIX I OLD STANDARDS

SEGMENTEN VEROSOL / SEGMENTS / SEGMENTE

35	35
40	40
45	45
50	50
55	55
60	60
68	35 + 35
73	35 + 40
78	40 + 40
83	40 + 45
88	45 + 45
93	45 + 50
98	50 + 50
101	35 + 35 + 35
103	50 + 55
106	35 + 40 + 35
108	55 + 55
111	40 + 35 + 40
113	55 + 60
116	40 + 40 + 40
118	60 + 60
121	40 + 45 + 40
126	45 + 40 + 45
131	45 + 45 + 45
134	35 + 35 + 35 + 35
136	45 + 50 + 45
139	35 + 35 + 35 + 40
141	50 + 45 + 50
144	35 + 40 + 40 + 35
146	50 + 50 + 50
149	35 + 40 + 40 + 40
151	50 + 55 + 50
154	40 + 40 + 40 + 40
156	55 + 50 + 55
159	40 + 40 + 40 + 45
161	55 + 55 + 55
164	40 + 45 + 45 + 40
166	55 + 60 + 55

Maatsysteem / Mass system / Système de mesures / System of measures

breedte breite Largeur width	Standaard segmentbreedte Standard Segmentbreite Largeur de segment standard Standard segment size	Snijmaat Schneidemass Mesure découp. Cutting size
40	1 × 41	40
41	1 × 41	—
42	1 × 45	42
43	1 × 45	43
44	1 × 45	44
45	1 × 45	—
46	1 × 48	46
47	1 × 48	47
48	1 × 48	—
49	1 × 51	49
50	1 × 51	50
51	1 × 51	—
52	1 × 58	52
53	1 × 58	53
54	1 × 58	54
55	1 × 58	55
56	1 × 58	56
57	1 × 58	57
58	1 × 58	—
59	2 × 41	30,5
60	2 × 41	31
61	2 × 41	31,5
62	2 × 41	32
63	2 × 41	32,5
64	2 × 41	33
65	2 × 41	33,5
66	2 × 41	34
67	2 × 41	34,5
68	2 × 41	35
69	2 × 41	35,5
70	2 × 41	36
71	2 × 41	36,5
72	2 × 41	37
73	2 × 41	37,5
74	2 × 41	38
75	2 × 41	38,5
76	2 × 41	39
77	2 × 41	39,5
78	2 × 41	40
79	2 × 41	40,5
80	2 × 41	—
81	2 × 45	41,5
82	2 × 45	42
83	2 × 45	42,5
84	2 × 45	43
85	2 × 45	43,5
86	2 × 45	44
87	2 × 45	44,5
88	2 × 45	—
89	2 × 48	45,5
90	2 × 48	46
91	2 × 48	46,5
92	2 × 48	47
93	2 × 48	47,5
94	2 × 48	—
95	2 × 51	48,5
96	2 × 51	49
97	2 × 51	49,5
98	2 × 51	50
99	2 × 51	50,5
100	2 × 51	—
101	2 × 58	51,5
102	2 × 58	52
103	2 × 58	52,5
104	2 × 58	53
105	2 × 58	53,5
106	2 × 58	54
107	2 × 58	54,5
108	2 × 58	55
109	2 × 58	55,5
110	2 × 58	56
111	2 × 58	56,5
112	2 × 58	57
113	2 × 58	57,5
114	2 × 58	—
115	3 × 41	39,7
116	3 × 41	40
117	3 × 41	40,3
*118	3 × 41	40,5
119	3 × 41	—
120	3 × 45	41,3
121	3 × 45	41,7
122	3 × 45	42
123	3 × 45	42,3
124	3 × 45	42,7
125	3 × 45	43
126	3 × 45	43,3
127	3 × 45	43,7
128	3 × 45	44
129	3 × 45	44,3
*130	3 × 45	44,5
131	3 × 45	—
132	3 × 48	45,3
133	3 × 48	45,7
134	3 × 48	46
135	3 × 48	46,3
136	3 × 48	46,7
137	3 × 48	47
138	3 × 48	47,3
*139	3 × 48	47,5
140	3 × 48	—
141	3 × 51	48,3
142	3 × 51	48,7
143	3 × 51	49
144	3 × 51	49,3
145	3 × 51	49,7
146	3 × 51	50
147	3 × 51	50,3
*148	3 × 51	50,5
149	3 × 51	—
150	4 × 41	39
151	4 × 41	39,2
152	4 × 41	39,5
153	4 × 41	39,7
154	4 × 41	40
155	4 × 41	40,2
156	4 × 41	40,5
*157	4 × 41	40,5
158	4 × 41	—
159	3 × 58	54,3
160	3 × 58	54,7
161	3 × 58	55
162	3 × 58	55,3
163	3 × 58	55,7
164	3 × 58	56
165	3 × 58	56,3
166	3 × 58	56,7
167	3 × 58	57
168	3 × 58	57,3
*169	3 × 58	57,5
170	3 × 58	—
171	4 × 45	44,2
172	4 × 45	44,5
*173	4 × 45	44,5
174	4 × 45	—
175	4 × 48	45,2
176	4 × 48	45,5
177	4 × 48	45,7
178	4 × 48	46
179	4 × 48	46,2
180	4 × 48	46,5
181	4 × 48	46,7
182	4 × 48	47
183	4 × 48	47,2
184	4 × 48	47,5
*185	4 × 48	47,5
186	4 × 48	—
187	5 × 41	39
188	5 × 41	39,2
189	5 × 41	39,4
190	5 × 41	39,6
191	5 × 41	39,8
192	5 × 41	40
193	5 × 41	40,2
194	5 × 41	40,4
195	5 × 41	40,6
*196	5 × 41	40,5
197	5 × 41	—
198	4 × 51	—
199	5 × 45	41,4
200	5 × 45	41,6
201	5 × 45	41,8
202	5 × 45	42
203	5 × 45	42,2
204	5 × 45	42,4
205	5 × 45	42,6
206	5 × 45	42,8
207	5 × 45	43
208	5 × 45	43,2
209	5 × 45	43,4
210	5 × 45	43,6
211	5 × 45	43,8
212	5 × 45	44
213	5 × 45	44,2
214	5 × 45	44,4
215	5 × 45	44,6
*216	5 × 45	44,5
217	5 × 45	—
218	4 × 58	56
219	4 × 58	56,2
220	4 × 58	56,5
221	4 × 58	56,7
222	4 × 58	57
223	4 × 58	57,2
224	4 × 58	57,5
*225	4 × 58	57,5
226	4 × 58	—
227	5 × 48	47
228	5 × 48	47,2
229	5 × 48	47,4
*230	5 × 48	47
*231	5 × 48	47,5
232	5 × 48	—
233	6 × 41	40,5
*234	6 × 41	40
*235	6 × 41	40,5
236	6 × 41	—
237	5 × 51	49
238	5 × 51	49,2
239	5 × 51	49,4
240	5 × 51	49,6
241	5 × 51	49,8
242	5 × 51	50
243	5 × 51	50,2
244	5 × 51	50,4
*245	5 × 51	50
*246	5 × 51	50,5
247	5 × 51	—
248	6 × 45	43
249	6 × 45	43,2
250	6 × 45	43,3
251	6 × 45	43,5
252	6 × 45	43,7
253	6 × 45	43,8
254	6 × 45	44
255	6 × 45	44,2
256	6 × 45	44,3
257	6 × 45	44,5
*258	6 × 45	44
*259	6 × 45	44,5
260	6 × 45	—
261	7 × 41	39
262	7 × 41	39,1
263	7 × 41	39,3
264	7 × 41	39,4
265	7 × 41	39,5
266	7 × 41	39,7
267	7 × 41	39,9
268	7 × 41	40
269	7 × 41	40,1
270	7 × 41	40,3
271	7 × 41	40,4
272	7 × 41	40,6
*273	7 × 41	40
*274	7 × 41	40,5
275	7 × 41	—
*276	6 × 48	47
*277	6 × 48	47,5
278	6 × 48	—
279	5 × 58	57,4
*280	5 × 58	57
*281	5 × 58	57,5
282	5 × 58	—
283	6 × 51	48,8
284	6 × 51	49
285	6 × 51	49,2
286	6 × 51	49,3
287	6 × 51	49,5
288	6 × 51	49,7
289	6 × 51	49,8
290	6 × 51	50
291	6 × 51	50,2
292	6 × 51	50,3
293	6 × 51	50,5
*294	6 × 51	50
*295	6 × 51	50,5
296	6 × 51	—
297	7 × 45	44,1
298	7 × 45	44,3
299	7 × 45	44,4
300	7 × 45	44,6
*301	7 × 45	44
*302	7 × 45	44,5
303	7 × 45	—
304	8 × 41	39,7
305	8 × 41	39,9
306	8 × 41	40
307	8 × 41	40,1
308	8 × 41	40,2
309	8 × 41	40,4
310	8 × 41	40,5
311	8 × 41	40,6
*312	8 × 41	40
*313	8 × 41	40,5
314	8 × 41	—
315	7 × 48	46,7
316	7 × 48	46,9
317	7 × 48	47
318	7 × 48	47,1
319	7 × 48	47,3
320	7 × 48	47,4
321	7 × 48	47,6
*322	7 × 48	47
*323	7 × 48	47,5
324	7 × 48	—
325	6 × 58	55,8
326	6 × 58	56
327	6 × 58	56,2
328	6 × 58	56,3
329	6 × 58	56,5
330	6 × 58	56,7
331	6 × 58	56,8
332	6 × 58	57
333	6 × 58	57,2
334	6 × 58	57,3
335	6 × 58	57,5
*336	6 × 58	57
*337	6 × 58	57,5
338	6 × 58	—
339	7 × 51	50,1
340	7 × 51	50,3
341	7 × 51	50,4
342	7 × 51	50,6
*343	7 × 51	50
*344	7 × 51	50,5
345	7 × 51	—
346	8 × 45	—
347	9 × 41	40,3
348	9 × 41	40,4
349	9 × 41	40,6
*350	9 × 41	39,5

Bij de met een * aangegeven breedte maten worden alleen de buitenste segmenten versneden.

Bei den mit * bezeichneten breitenmassen werden nur die ausseren Segmente zugeschnitten

Pour les largeurs marquées avec * ce ne sont que les segments extérieurs qui sont découpés.

For widths marked with * only the outer segments are cut