1620 GENERAL PROGRAM LIBRARY Two Dimensional Trim Problem 10.3.025

Two Dimensional Trim Problem

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DECK KEY

1. Program Deck

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A. Purpose/Description: To solve the two dimensional trim problem by linear programming. Sample problem took 16 hours by hand, 0.3 hours with this program.

B. Method: Simplex Method

C. Restrictions and Range: Up to 10 plates can be handled at one time. A maximum of 30 width combinations and 120 length combinations is developed. Order quantities up to 99,999 can be handled for each plate.

D. Accuracy: N/A

E. Machine Configuration: Card program, requires 1622 and automatic divide.

F. Program Requirements: The program covers 19,295 storage positions plus tables.

G. Source Language: IBM 1620 SPS

H. Program Execution Time: N/A

I. Check-Out Status: N/A

J. Sample Problem Running Time: Approximately 20 minutes

K. Comments: This program and its documentation were written by an IBM employee. It was developed for a specific purpose and submitted for general distribution to interested parties in the hope that it might prove helpful to other members of the data processing community. The program and its documentation are essentially in the author's original form. IBM serves as the distribution agency in supplying this program. Questions concerning the use of the program should be directed to the author's attention.

Table of Contents

1.1 Problem

Division of large rectangular plates (designated hereafter by $A \cdot B$) into smaller plates (designated by $a_i . b_i$) provided that a_i is parallel to A and b_i is parallel to B. A predetermined number of the small plates is to be fitted into the larger ones in such a manner that a minimal waste (trim-loss) arises.

1.2 Possibilities of application

All industries in which larger plates have to be divided into smaller ones, as far as rectangles are concerned, such as those described under 1.1 (for example metal-plates, foils of all kinds, pressing plates in the rubber industry etc.)

The program can also be used for the paper industry when rolls are not to be cut below a certain minimal amount and when the quantities are given in the form of multiples of the minimal lengths. Naturally, as far as the trim-loss is concerned, the result is in this case less favorable than when this problem is treated according to the "one-dimensional trim-problem" program. (9.7.804 IBM Germany) However, this program can under certain circumstances yield better results since very small lengths of a combination do not fit into the solution and since thereby periods of readjustment are eliminated.

1.3 Method

First of all the widths are combined just as in the one-dimensional trim-loss-problem. A length $B^{(1)}$ is assigned to every combination obtained in this manner. Then these lengths are combined and a matrix is set up which indicates how many times each of the plates $a_i . b_i$ is present in the individual combinations. The thus obtained matrix is thereupon transformed according to the simplex method and eventually leads to the determination of the best solution.

1.3.1 Combination of the widths

At first the formation of width combinations is to be described. If we designate the widths by a_i and the initial width by A, then the formulation of the width-combination table is the same thing as the determination of all the n-tuples $(\nu_1, \nu_2, \nu_3, \dots, \nu_n)$ which fulfill the requirements:

$$\sum_{i=n}^{n} \nu_i \cdot a_i \leq A \quad \text{------} \quad (1)$$

$$A - \sum_{i=1}^{n} \nu_i \cdot a_i < a_n \quad \text{------} \quad (2)$$

$$\nu_i \geq 0 \quad \text{AND} \quad \text{-----} \quad (3)$$

if n stands for the number of plates $a_i . b_i$ and if the a_i are arranged according to size, with

$$a_n = \text{MIN} \{ a_i \}$$

The example following later shows the procedure in setting up the combination table.

1.3.2 Assignment of a length $B^{(l)}$ to every width combination

It was described in paragraph 1.3.1 how the width combinations are determined. Up to this point the procedure does not at all differ from the one-dimensional trim-loss-problem. What matters now is that each width combination be assigned a length $B^{(l)}$ so that these lengths can be combined a second time later on. Since in general, different lengths b_i belong to widths a_i which we combined up to now, it is now necessary to determine numbers

$$\mu_i^{(l)} > 0 \quad \text{------} \quad (5)$$

which occur in the individual combinations, so that

$$\underset{\nu_i, \nu_j \neq 0}{\text{MAX}_{i,j}} \left\{ \left| \mu_i^{(l)} \cdot b_i - \mu_j^{(l)} \cdot b_j \right| \right\} = \text{MIN} \text{-----} (6)$$

AND

$$B^{(l)} = \underset{\nu_i \neq 0}{\text{MAX}} \left\{ \mu_i^{(l)} \cdot b_i \right\} \leq B \quad \text{----} \quad (7)$$

Formula (6) states that we arrange the different b_i of a combination so often in a series that the greatest difference between the multiples of all possible pairs b_i, b_j is as small as possible. In doing so, the total length B must, according to formula (7) not be surpassed by the largest multiple of a b_i. This largest multiple of a b_i, as formula (7) likewise states, yields the length $B^{(\ell)}$ which we assign to the ℓ-width combination. We are aware of the fact that we have not exploited all the possibilities in considering the difference according to formula (6). Instead of this difference it would be better for example to keep the trim-loss areas, which result from the different lengths of the multiples of b_i, as small as possible. In the following we will designate these trim-loss areas as "interpattern trim-loss", while the unused marginal strip (according to paragraph 1. 3. 1) is called "cross trim-loss"; the remaining strip resulting from the length combination which is still to be described is called "longitudinal trim-loss".

As already mentioned, a formula corresponding to formula (6) could be expressed in such a way that the interpattern trim-loss would become minimal, and not the maximum difference of the multiples of b_i which we considered in that formula. In some cases such a formulation would lead to better results. However, we disregarded this possibility in order to be able to use this program on a machine with 20, 000 storage positions. A corresponding change for a larger machine would be possible.

1. 3. 3 Combination of the $B^{(\ell)}$

Just as the a_i were combined in paragraph 1. 3. 1, the $B^{(l)}$ are combined now, which means that numbers $\lambda^{(\ell)}$ are determined with:

$$\sum_{\ell=1}^{N} \lambda^{(\ell)} \cdot B^{(\ell)} \leq B \quad \text{-------} (8)$$

$$B - \sum_{\ell=1}^{N} \lambda^{(\ell)} \cdot B^{(\ell)} < B^{(N)} \quad \text{------} (9)$$

$$\lambda^{(\ell)} \geq 0 \quad \text{-----} (10)$$

In this context N stands for the number of the width combinations which we set up, and $B^{(N)}$ for the smallest of the $B^{(\ell)}$, since in the program the $B^{(\ell)}$ are arranged according to size.

A longitudinal trim-loss, namely the unused remainder of the length B, belongs to each one of these length combinations.

Since it is clear, that a width combination belongs to every $B^{(\ell)}$ we know now how often the individual plates $a_i . b_i$ occur in each of the length combinations which are now obtained. We designate these numbers $p_i^{(k)}$ as "plate frequency". $p_i^{(k)}$ indicates therefore how often the i-plate occurs in the k-length combination.

1. 3. 4 Objective function

To every plate division belongs a total loss which is composed of cross trim-loss, interpattern trim-loss and longitudinal trim-loss. The total trim-loss for the k-length combination is found by:

$$A \cdot B - \sum_{i=1}^{n} p_i^{(k)} \cdot a_i \cdot b_i \quad \text{--------} (11)$$

The total trim-loss to be minimized for all plates A. B considered, yields then the objective function which is of importance for the Linear-Programming that is going to follow:

$$\sum_{K=1}^{M} m_k \left\{ A \cdot B - \sum_{i=1}^{n} p_i^{(k)} \cdot a_i \cdot b_i \right\} = MIN \quad \text{----} (12)$$

in which M indicates the number of length combinations, and in which m_k 0 are the numbers to be calculated by the program, which indicate how often the individual length combinations should be cut in order to fulfill the given orders (quantities $a_i . b_i$).

1.3.5 Linear-programming

The minimizing of the objective function (12) then takes place according to the well-known simplex method, by starting out with an initial solution by which the orders are carried out in such a way that for each plate $A \cdot B$ exactly one plate $a_i . b_i$ is cut and that a very large uniform trim-loss for all plates $a_i . b_i$ which has not been exactly calculated is taken into consideration. A precise calculation of this uniform trim-loss is not necessary, since the vectors of this original basic solution are gradually replaced by the vectors from the combination table. The elements of the original matrix are precisely our plate frequencies $p_i^{(k)}$. Details about the simplex method can be found in the reference material, for instance

a) A. Charnes, W. W. Cooper and A. Henderson: "An Introduction to Linear Programming", Wiley & Sins, 1953

b) M. Bukman, "Lineare Planung Srechnung", Ludwigshafen, 1959

2.1 Limits for the scope of the problem

2.1.1 Amount of orders

Up to ten plates $a_i . b_i$ can be handled in one procedure.

2.1.2 Number of combinations

A maximum amount of 30 width combinations and 120 length combinations is developed.

2.1.3 Number of pieces per order

As number of pieces ordered quantities up to 99,999 can be fed in for each plate $a_i . b_i$.

2.2 Limits for the data, presentation of numbers

2.2.1 Plate format A. B

The measurement of the plates is fed in in the following way:

$\bar{X}XXXX\bar{X}XXXX$

WIDTH LENGTH

The feeding in is carried out without punctuation (RECORD) mark at the end.

2.2.2 Number of the $a_i . b_i$

This amount must be fed in as two digits with a dash over the first digit, thus:

$\bar{X}X$

2.2.3 Measuring of the plates $a_i . b_i$

The entry for each plate takes place as described under 2.1 for the plate $A \cdot B$. All the measurements are entered in succession with a command to read. That is to say, in this way:

$\bar{X}XXXX\bar{X}XXXX\bar{X}XXXX\bar{X}XXXX \ldots\ldots \bar{X}XXXX\bar{X}XXXX$

$a_1 \quad b_1 \quad a_2 \quad b_2 \quad a_n \quad b_n$

In doing so the following is to be taken into consideration:

$a_1 \quad a_2 \quad a_3 \ldots \quad a_n$

Moreover we must take into consideration that the program handles the plates in such a way that $a_i \parallel A$ and $b_i \parallel B$. This entry as well must not be ended by a punctuation (RECORD) mark.

2.2.4 Number of pieces for the plates $a_i \cdot b_i$

These pieces have to be entered in the form (5/3) in the same sequence as the $a_i . b_i$ were put in previously, namely:

$\bar{X}XXXXOOO\bar{X}XXXXOOO \ldots\ldots\ldots\ldots \bar{X}XXXXOOO$

Quantity of $a_1 b_1$ — Quantity of $a_2 b_2$ — Quantity of $a_n b_n$

This entry as well should not be ended with a punctuation (RECORD) mark, and is carried out with a command to read.

2.2.5 Unit of measure

Normally all the data concerning length and width must be given uniformly in mm, cm or inches etc. When applied to the paper industry differing units for lengths and widths can be convenient (for example m for lengths, cm for widths, then the trim-loss areas have the unit of measure m^2 with two digits after the decimal point).

3.1 Machine equipment

IBM 1620 with 20,000 core storage positions.

Punch strip unit or punch card unit (optional).

Additional equipment: Automatic Division.

3.2 Storage space requirement

The program takes up the storage places from 13,306 to 19,696 (6,391 places); for data the spaces from 402 to 13,305 (12,904) are required. Furthermore some auxiliary storage spaces are placed in commands to skip (branch). Thus, as a whole, the program covers 19,295 spaces plus tables.

3.3 Time requirement

The time required depends on the following:

a) number of plates $a_i \cdot b_i$

b) size ratio between the plates $a_i \cdot b_i$ and $A \cdot B$

c) number of iteration steps of the linear-programming

Therefore an indication of time must be disregarded.

4. Entry data

All entries are carried out by typewriter (change to entry by strips or cards is easily possible). At the first reading command entry of A and B takes place according to 2.2.1.

At the second reading command entry of n takes place according to 2.2.2.

At the third reading command entry of the a_i and b_i takes place according to 2.2.3.

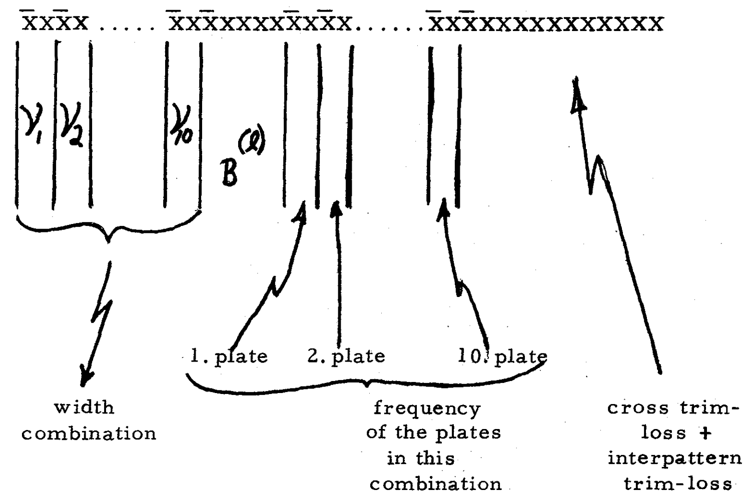
These entries take place directly one after the other, while the fourth entry is carried out only after the combination tables are set up. It refers to the amount of pieces of the plates $a_i \cdot b_i$ desired and has to be carried out in the manner described in paragraph 2.2.4.

No entry should be ended by a punctuation mark.

5. Results, output data

5.1 Output of the width combination table

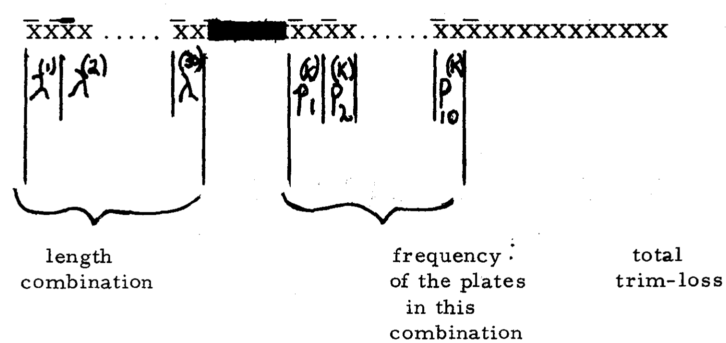
After the first three entries ($A, B, n, a_1, b_1, \ldots, a_n, b_n$) the machine renders at first the width combination table in the following form:



If less than 10 plates $a_i \cdot b_i$ are considered, $\overline{0}0$ appears in the remaining spaces. As many width combinations as the machine finds are put out in succession, however a maximum of 30 (see 2.1.2). One line is necessary for every combination.

5.2 Output of the length combination table

Right after the output of the width combination table follows the output of the length combination table in the following form:



This output requires two lines (or a broader carriage) for each combination. The separation can be guided by setting the margin.

Here as well all the combinations which the machine can find are put out, however not more than 120 length combinations (see 2. 1. 2).

In the later interpretation of the output it should be taken into consideration that $\lambda^{(1)}$ does not refer to the $B^{(\lambda)}$ which is formed first, but to the largest of all $B^{(\lambda)}$. Correspondingly $\lambda^{(2)}$ to the second largest etc. When two $B^{(\lambda)}$ are of the same size, the one found first in the width combination has the smaller index.

5. 3 Output of the linear-programming

The output of the linear-programming takes place right after the entry of the quantities required by the plates $a_i \cdot b_i$ and after each iteration step in the following form:

$\bar{\text{X}}$XXXX	$\bar{\text{X}}$XXXXXXX
Number of the basis vectors	Quantity to be cut in the manner determined by the basis vector, in the numerical representation (5/3).

The output is composed of n of such lines. All the original unit vectors still contained in the basis solution in question have as the first digit of the number a $\bar{1}$. Because of the fact that the length combinations are limited to 120 length combinations, the already exchanged vectors cannot go beyond the number $\bar{0}$0120 and are therefore clearly discernable.

5. 4 Output of the value of the objective function (total trim-loss)

After every iteration step the objective function is put out in the form

$\bar{\text{X}}$XXXXXXXXXXXXXXXXXXX (of 20 digits)

Here the unit vectors were covered according to 1. 3. 5 with a uniform trim-loss which was put at

100000000000 (of 12 digits)

The outputs 5. 3 and 5. 4 are repeated until the program no longer finds a possibility of a further reduction of the objective function. Then END is written out.

6. Operating instructions

a) Erasing of the stored data

b) Load program

Strips: RESET, INSERT, entry of the command 36 00000 00300, RELEASE and START

Cards: RESET, LOAD on card unit

c) Machine stops at 48 at the OR, push START

d) Machine stops at 36 at the OR, entry of A, B according to 2. 2. 2, RELEASE and START

e) Machine stops at 36 at the OR, entry of n according to 2. 2. 2, RELEASE and START

f) Machine stops at 36 at the OR, entry of $a_1, b_1, \ldots, a_n, b_n$ according to 2. 2. 3, RELEASE and START

g) Machine writes width combination table according to 5. 1

h) Machine writes length combination table according to 5. 2

i) Machine stops at 36 at the OR, entry of the quantities according to 2. 2. 4, RELEASE and START

j) Machine writes the previously found basis and the objective function according to 5. 3 and 5. 4. This step is carried out repeatedly.

k) Machine writes END and stops at 48 at the OR. After START the program jumps to point d) and is ready to receive a new order.

7. Method of calculation shown in an example

7. 1 Given data

A. B = 100 $\cdot$ 300

			Quantities
Plate 1:	$a_1 \cdot b_1$	= 40. 30	350 pieces
Plate 2:	$a_2 \cdot b_2$	= 35. 40	500 pieces
Plate 3:	$a_3 \cdot b_3$	= 30. 50	252 pieces

7. 2 Width combinations and assignment of the $B^{(\lambda)}$

If the widths a_i are sorted according to the size then, as is well known, the following combination table is obtained:

	a_1	a_2	a_3	B		Plate frequency 1	2	3	Cross trim-loss + interpattern trim-loss
1	2	-	-	30	$B^{(6)}$	2	-	-	600
2	1	1	-	120	$B^{(4)}$	4	3	-	3,000
3	1	-	2	150	$B^{(3)}$	5	-	6	0
4	-	2	1	200	$B^{(1)}$	-	10	4	0
5	-	1	2	200	$B^{(2)}$	-	5	8	1,000
6	-	-	3	50	$B^{(5)}$	-	-	3	500

7.3 Length combinations

	$B^{(1)}$ 200	$B^{(2)}$ 200	$B^{(3)}$ 150	$B^{(4)}$ 120	$B^{(5)}$ 50	$B^{(6)}$ 30	Plate frequency 1	2	3	Total trim-loss
1	1	-	-	-	2	-	-	10	10	1 000
2	1	-	-	-	1	1	2	10	7	3 100
3	1	-	-	-	-	3	6	10	4	2 800
4	-	1	-	-	2	-	-	5	14	2 000
5	-	1	-	-	1	1	2	5	11	4 100
6	-	1	-	-	-	3	6	5	8	3 800
7	-	-	2	-	-	-	10	-	12	0
8	-	-	1	1	-	1	11	3	6	3 600
9	-	-	1	-	3	-	5	-	15	1 500
10	-	-	1	-	2	1	7	-	12	3 600
11	-	-	1	-	1	3	11	-	9	3 300
12	-	-	1	-	-	5	15	-	6	3 000
13	-	-	-	2	1	-	8	6	3	7 500
14	-	-	-	2	-	2	12	6	-	7 200
15	-	-	-	1	3	1	6	3	9	5 100
16	-	-	-	1	2	2	8	3	6	7 200
17	-	-	-	1	1	4	12	3	3	6 900
18	-	-	-	1	-	6	16	3	-	6 600
19	-	-	-	-	6	-	-	-	18	3 000
20	-	-	-	-	5	1	2	-	15	5 100
21	0	-	-	-	4	3	6	-	12	4 800
22	-	-	-	-	3	5	10	-	9	4 500
23	-	-	-	-	2	6	12	-	6	6 600
24	-	-	-	-	1	8	16	-	3	6 300
25	-	-	-	-	-	10	20	-	-	6 000

The above table was obtained by arranging the B according to size and by forming the length combinations in the well known manner.

7.4 Application of the simplex-method

We now apply the simplex-method to these combinations by first starting out with the unit vectors P_I, P_{II}, P_{III}, and by choosing as initial solution:

$$Q = P_I \cdot 350 + P_{II} \cdot 500 + P_{III} \cdot 252$$

If we designate the trim-loss of this unit solution for each vector by w the following total trim-loss is obtained:

$$V = 1{,}102 \cdot w$$

Now the individual combinations have to be expressed in terms of unit vectors, and we arrive at the following table:

P_i	P_I	P_{II}	P_{III}	z	c - z	
1	-	10	10	20 w	1 000 - 20 w	
2	2	10	7	19 w	3 100 - 19 w	
3	6	10	4	20 w	2 800 - 20 w	
4	-	5	14	19 w	2 000 - 19 w	
5	2	5	11	18 w	4 100 - 18 w	
6	6	5	8	19 w	3 800 - 19 w	
7	10	-	12	22 w	- 22 w	(Min)
8	11	3	6	20 w	3 600 - 20 w	
9	5	-	15	20 w	1 500 - 20 w	
10	7	-	12	19 w	3 600 - 19 w	
11	11	-	9	20 w	3 300 - 20 w	
12	15	-	6	21 w	3 000 - 21 w	
13	8	6	3	17 w	7 500 - 17 w	
14	12	6	-	18 w	7 200 - 18 w	
15	6	3	9	18 w	5 100 - 18 w	
16	8	3	6	17 w	7 200 - 17 w	
17	12	3	3	18 w	6 900 - 18 w	
18	16	3	-	19 w	6 600 - 19 w	
19	-	-	18	18 w	3 000 - 18 w	
20	2	-	15	17 w	5 100 - 17 w	
21	6	-	12	18 w	4 800 - 18 w	
22	10	-	9	19 w	4 500 - 19 w	
23	12	-	6	18 w	6 600 - 18 w	
24	16	-	3	19 w	6 300 - 19 w	
25	20	-	-	20 w	6 000 - 20 w	

Thus the initial formula for the determination of the new basis is as follows:

$$Q = P_I(350 - 10 \cdot \Theta) + P_{II}(500 - 0 \cdot \Theta) + P_{III}(252 - 12 \cdot \Theta) + P_7 \cdot \Theta$$

and

$$\Theta = \underset{>0}{MIN} \left\{ \frac{350}{10}, \frac{500}{0}, \frac{252}{12} \right\} = 21$$

and finally

$$Q = P_I \cdot 140 + P_{II} \cdot 500 + P_7 \cdot 21$$

and the total trim-loss is

$$V = 640 \cdot w$$

P_{III} was eliminated from the basis and P_7 was taken up into the basis.

The next step is similar and yields the following table:

P_i	P_I	P_{II}	P_7	z	c - z
1	-25/3	10	5/6	5/3 w	1 000 - 5/3 w
2	-23/6	10	7/12	37/6 w	3 100 - 37/6 w
3	8/3	10	1/3	38/3 w	2 800 - 38/3 w
4	-35/3	5	7/6	-20/3 w	2 000 + 20/3 w
5	-43/6	5	11/12	-13/6 w	4 100 + 13/6 w
6	- 2/3	5	2/3	13/3 w	3 800 - 13/3 w
7	-	-	1	0	0
8	6	3	1/2	9 w	3 600 - 9 w
9	-15/2	-	5/4	-15/2 w	1 500 + 15/2 w
10	- 3	-	1	- 3 w	3 600 + 3 w
11	7/2	-	3/4	7/2 w	3 300 - 7/2 w
12	10	-	1/2	10 w	3 000 - 10 w
13	11/2	6	1/4	23/2 w	7 500 - 23/2 w
14	12	6	1	18 w	7 200 - 18 w
15	- 3/2	3	3/4	3/2 w	5 100 - 3/2 w
16	3	3	1/2	6 w	7 200 - 6 w
17	19/2	3	1/4	25/2 w	6 900 - 25/2 w
18	16	3	-	19 w	6 600 - 19 w
19	- 15	-	3/2	-15 w	3 000 + 15 w
20	-21/2	-	5/4	-21/2 w	5 100 + 21/2 w
21	- 4	-	1	- 4 w	4 800 + 4 w
22	5/2	-	3/4	5/2 w	4 500 - 5/2 w
23	7	-	1/2	7 w	6 000 - 7 w
24	27/2	-	1/4	27/2 w	6 300 - 27/2 w
25	20	-	-	20 w	6 000 - 20 w (Min)
I	- 5/6	0	1/12	- 5/6 w	1/6 w

As for the first step the result is:

$$Q = P_I(140 - \Theta \cdot 20) + P_{II}(500 - \Theta \cdot 0)$$

and

$$\Theta = \underset{>0}{MIN}\left\{\frac{140}{20}, \frac{500}{0}, \frac{21}{0}\right\} = 7$$

and finally the new basis is

$$Q = 7\,P_{25} + 500\ P_{II} + 21\ P_7$$

and the total trim-loss

$$V = 500\ .w + 42{,}000$$

Thus, in this case the vector P_{25} was introduced into the basis instead of the vector P_I.

At the third step we can find quite analogously:

P_i	P_{25}	P_{II}	P_7	z	c - z	
1	- 5/12	10	5/6	-2 500 + 10 w	3 500 - 10 w	
2	-23/120	10	7/12	-1 150 + 10 w	4 250 - 10 w	
3	2/15	10	1/3	800 + 10 w	2 000 - 10 w	(Min)
4	- 7/12	5	7/6	-3 500 + 5 w	5 500 - 5 w	
5	-43/120	5	11/12	-2 150 + 5 w	6 250 - 5 w	
6	- 1/30	5	2/3	- 200 + 5 w	4 000 - 5 w	
7	-	-	1	0	0	
8	3/10	3	1/2	1 800 + 3 w	1 800 - 3 w	
9	- 3/8	-	5/4	-2 250	3 750	
10	- 3/20	-	1	- 900	4 500	
11	7/40	-	3/4	1 050	2 250	
12	1/2	-	1/2	3 000	0	
13	11/40	6	1/4	1 650 + 6 w	5 850 - 6 w	
14	3/5	6	-	3 600 + 6 w	3 600 - 6 w	
15	- 3/40	3	3/4	- 450 - 3 w	5 550 - 3 w	
16	3/20	3	1/2	900 + 3 w	6 300 - 3 w	
17	19/40	3	1/4	2 850 + 3 w	4 050 - 3 w	
18	4/5	3	-	4 800 + 3 w	1 800 - 3 w	
19	- 3/4	-	3/2	-4 500	7 500	
20	-21/40	-	5/4	-3 150	8 250	
21	- 1/5	-	1	-1 200	6 000	
22	1/8	-	3/4	750	3 750	
23	7/20	-	1/2	2 100	4 500	
24	27/40	-	1/4	4 050	2 250	
25	1	-	-	6 000	0	

P_i	P_{25}	P_{II}	P_7	z	c - z
I	- 1/24		1/12	- 250	250 + w
III	1/20			300	- 300 + w

The determination of the new basis is carried out according to:

$$\varphi = P_{25}(7-\theta\cdot 2/15) + P_{II}(500-\theta\cdot 10) + P_7(21-\theta\cdot 1/3) + P_3\cdot\theta$$

and

$$\theta = \underset{>0}{MIN}\left\{\frac{7}{2/15},\ \frac{500}{10},\ \frac{21}{1/3}\right\} = 50$$

and we find as new basis

$$\varphi = P_{25}\left(\frac{1}{3}\right) + P_3\cdot 50 + P_7\left(\frac{13}{3}\right)$$

and as total trim-loss

V = 142,000 = 8.7% of the used material

From the following table can be deduced therefore, that now all the c-z $\geq$ O.

P_i	P_{25}	P_3	P_7	z	c - z
1	-11/20	1	1/2	- 500	1 500
2	-13/40	1	1/4	950	2 150
3	-	1	-	2 800	0
4	-13/20	1/2	1	-2 500	4 500
5	-17/40	1/2	3/4	-1 150	5 250
6	- 1/10	1/2	1/2	800	3 000
7	-	-	1	0	0
8	13/50	3/10	2/5	2 400	1 200
9	- 3/8	-	5/4	-2 250	3 750
10	- 3/20	-	1	- 900	4 500
11	7/40	-	3/4	1 050	2 250
12	1/2	-	1/2	3 000	0
13	39/200	3/5	1/20	2 850	4 650
14	13/25	3/5	- 1/5	4 800	2 400
15	-23/200	3/10	13/20	150	4 950
16	11/100	3/10	2/5	1 500	5 700
17	87/200	3/10	3/20	3 450	3 450
18	19/25	3/10	- 1/10	5 400	1 200
19	- 3/4	-	3/2	-4 500	7 500
20	-21/40	-	5/4	-3 150	8 250
21	- 1/5	-	1	-1 200	6 000
22	1/8	-	3/4	750	3 750
23	7/20	-	1/2	2 100	4 500
24	27/40	-	1/4	4 050	2 250

P_i	P_{25}	P_3	P_7	z	c - z
25	1	-	-	6 000	0
I	- 1/24		1/12	- 250	250 + w
II	- 4/15	1/10	- 1/30	-1 320	1 320 + w
III	1/20			300	- 300 + w

In this case the total solution for this example is therefore:

$$\frac{1}{3}\begin{pmatrix}0\\0\\20\end{pmatrix} + 50\begin{pmatrix}4\\10\\6\end{pmatrix} + \frac{13}{3}\begin{pmatrix}12\\0\\10\end{pmatrix} = \begin{pmatrix}252\\500\\350\end{pmatrix}$$

Normally we will seek a solution with whole numbers which, however, can easily be obtained by rounding off to the nearest lower or higher decimal place, depending on the tolerances which are permitted for the quantities to be delivered.

8. The same example with the entries and outputs of the machine

8.1 Entries

8.1 CON'T

```
0010000300RS  ———————— A · B INPUT
03RS          ———— n
000400030     ———————— a1 · b1
00035000040   ———————— a2 · b2
0003000050RS  ———————— a3 · b3
```

8. 2 Output of the width combination table

Combination — B(1) — Plate frequency — Cross-trim-loss and interpattern trim-loss

```
#1  020000000000000000000003002000000000000000000000000000600
#2  010100000000000000000001200403000000000000000000000003000
#3  010002000000000000000001500500060000000000000000000000000
#4  000201000000000000000002000010040000000000000000000000000
#5  000102000000000000000002000005000000000000000000000001000
#6  000003000000000000000005000000300000000000000000000000500
```

STUDY WIDTH COMBINATION SKETCHES FOR INTERPRETATION OF OUTPUT.

8. 3 Output of length combination table

The first line of each combination contains the actual combination and the second line the plate frequency and the total trim-loss.

```
0100000020000000000000000000000000000000000000000000000
0101000000000000000000001000
0100000010100000000000000000000000000000000000000000000
2100700000000000000000003100
0100000000300000000000000000000000000000000000000000000
0100400000000000000000002300
0001000020000000000000000000000000000000000000000000000
0051400000000000000000002000
0001000010100000000000000000000000000000000000000000000
2051100000000000000000004100
0001000003000000000000000000000000000000000000000000000
6050000000000000000000003?00
000020000000000000000000000000000000000000000000000000T
0001200000000000000000000000
000001010001000000000000000000000000000000000000000000T
1030600000000000000000003?00
0000010003000000000000000000000000000000000000000000000
5001500000000000000000001500
0000010002010000000000000000000000000000000000000000000
7001200000000000000000003600
000001000103000000000000000000000000000000000000000000T
1000?00000000000000000003300
000001000005000000000000000000000000000000000000000000T
5000600000000000000000003000
0000000201000000000000000000000000000000000000000000000
?0?0200000000000000000007500
000000200020000000000000000000000000000000000000000000T
2000000000000000000000007200
0000001030100000000000000000000000000000000000000000000
0030?00000000000000000005100
0000000102020000000000000000000000000000000000000000000
?020600000000000000000007200
000000010104000000000000000000000000000000000000000000T
2030300000000000000000006?00
000000010006000000000000000000000000000000000000000000T
6030000000000000000000006600
0090000006000000000000000000000000000000000000000000000
0001800000000000000000003000
0000000005010000000000000000000000000000000000000000000
2001500000000000000000005100
0000000004030000000000000000000000000000000000000000000
?001200000000000000000004?00
000000000305000000000000000000000000000000000000000000T
000??000000000000000000004500
000000000206000000000000000000000000000000000000000000T
2000?00000000000000000006600
000000000100000000000000000000000000000000000000000000T
?000200000000000000000006300
?00000000010000000000000000000000000000000000000000000?2
????????????????????????????000
```

8.5 Output of the basis and of the total trim-loss after every interation step

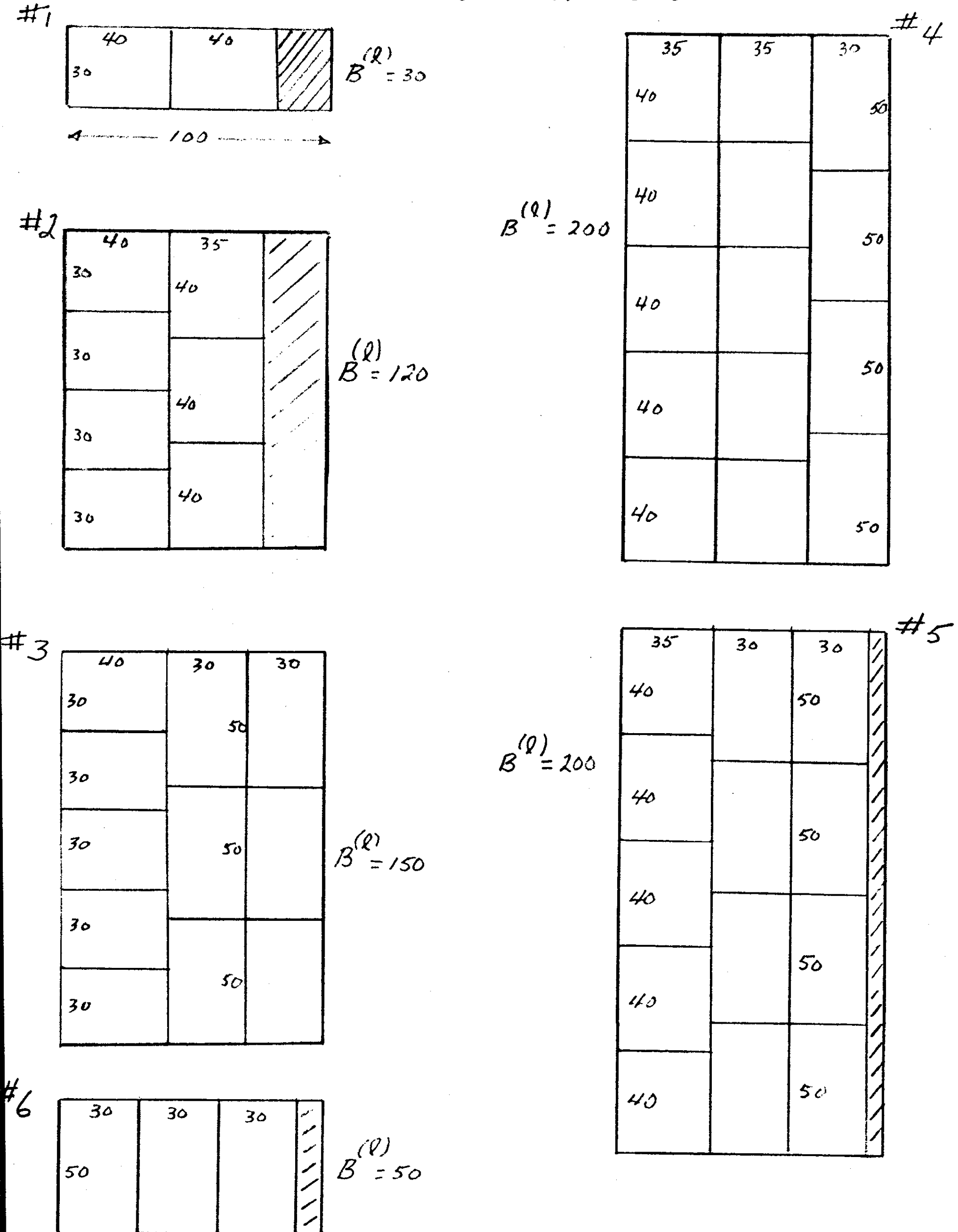
```
Ø Ø35ØØØØ   } QUANTITY INPUT
ØØ5ØØØØØ
ØØ252ØØØ5
```

```
TØØØ1                     ØØ35ØØØØ
TØØØ2                     ØØ5ØØØØØ
TØØØ3                     ØØ252ØØØ
ØØØØ11Ø2ØØØØØØØØØØØ

TØØØ1                     ØØ14ØØØØ
TØØØ2                     ØØ5ØØØØØ
ØØØØ7                     ØØØ21ØØØ
ØØØØØ64ØØØØØØØØØØØØ

ØØØ25                     ØØØØ7ØØØ
TØØØ2                     ØØ5ØØØØØ
ØØØØ7                     ØØØ21ØØØ
ØØØØØ5ØØØØØØØØ42ØØØ

ØØØ25                     ØØØØØ35Ø
ØØØØ3                     ØØØ5ØØØØ
ØØØØ7                     ØØØØ435Ø
ØØØØØØØØØØØØØ1421ØØ
ENDE
```


8.6 Comparison of the manual solution and of the machine solution

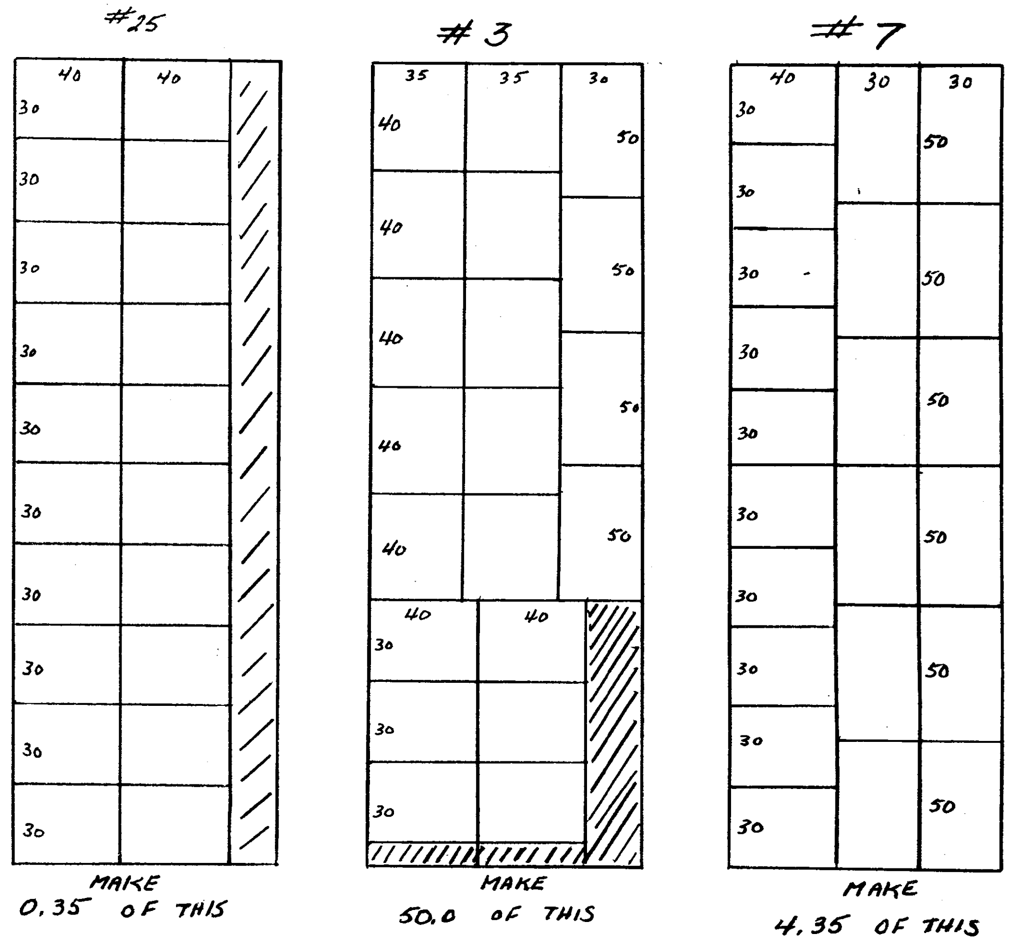
Basis solution	Manual		Machine	
Time requirement	approx. 16 hours		approx. 0.3 hours	
	25	0.333	25	0.350
	3	50.000	3	50.000
	7	4.333	7	4.350
	Vector	Quantity	Vector	Quantity

WIDTH COMBINATIONS



SAMPLE PROBLEM - FINAL BASIS

LENGTH COMBINATIONS

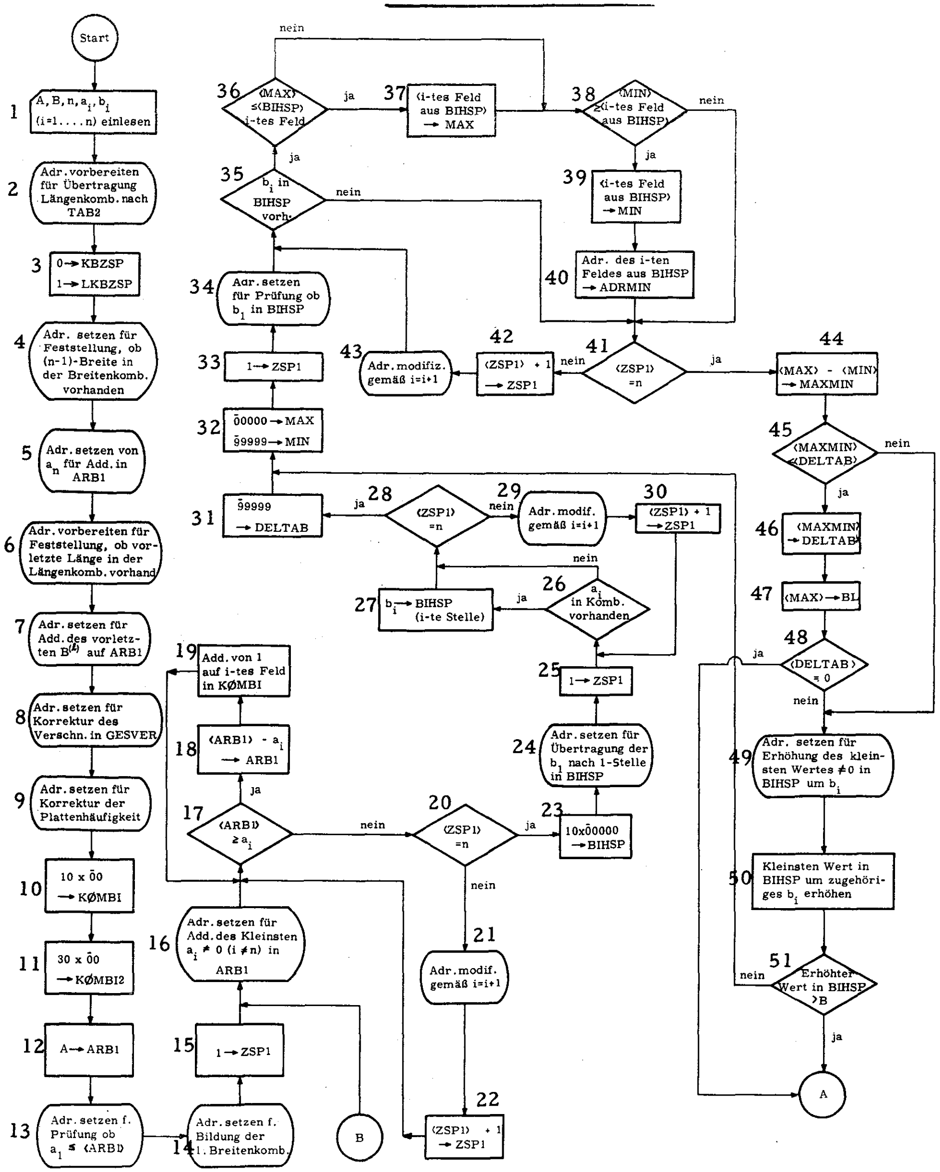


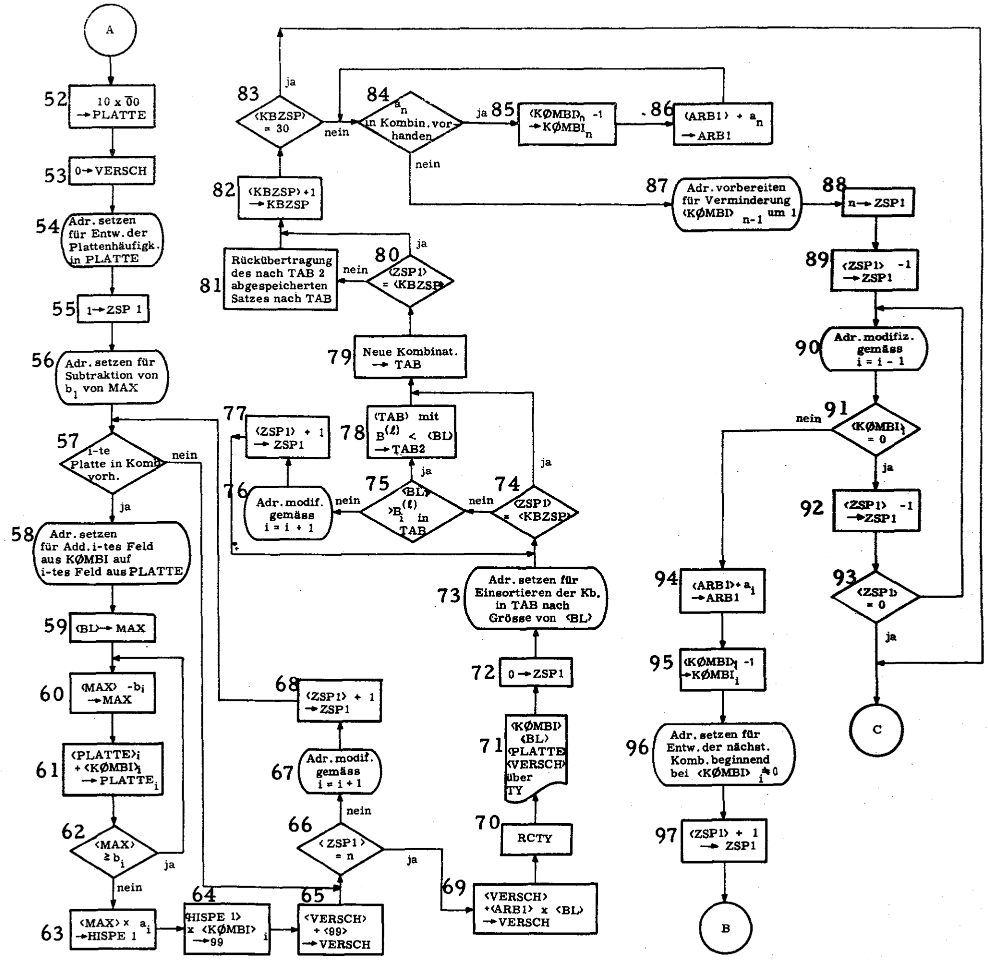
(25)

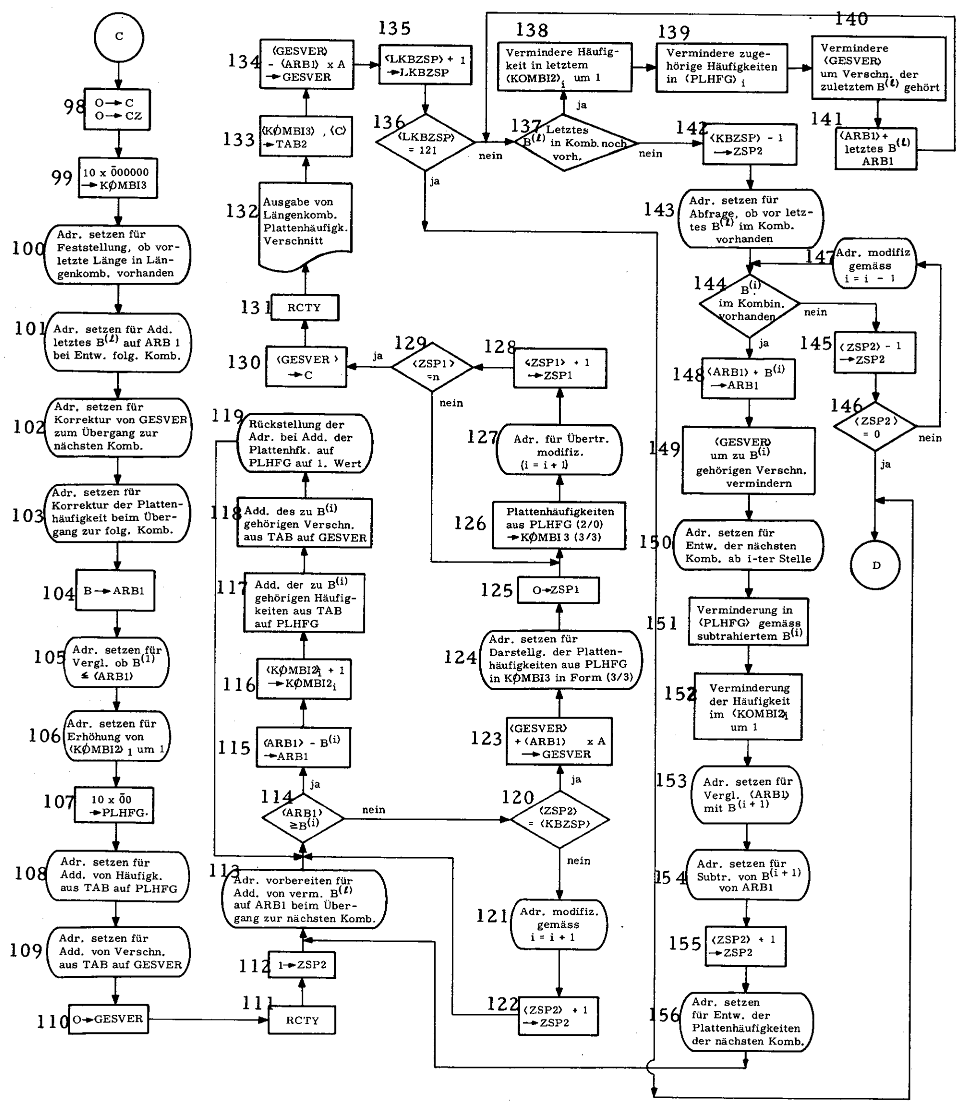
COMPUTER TECHNOLOGY

(26)

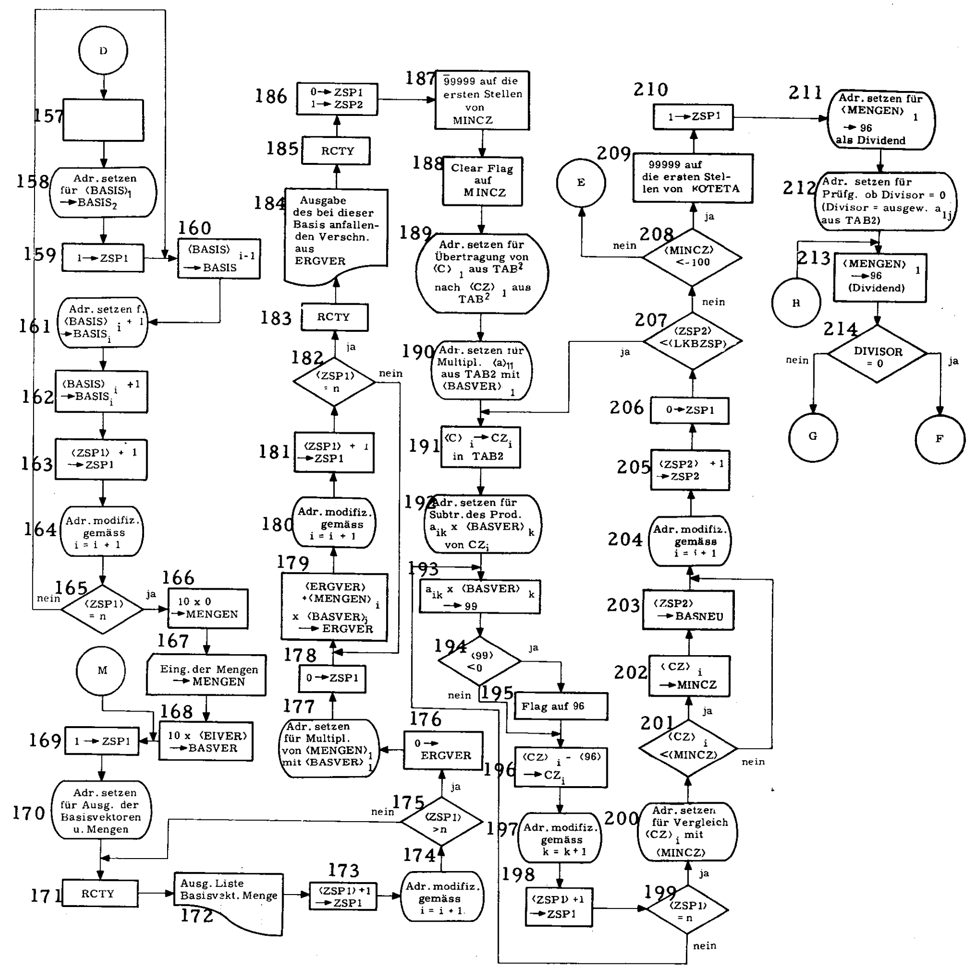
BLOCKDIAGRAMM



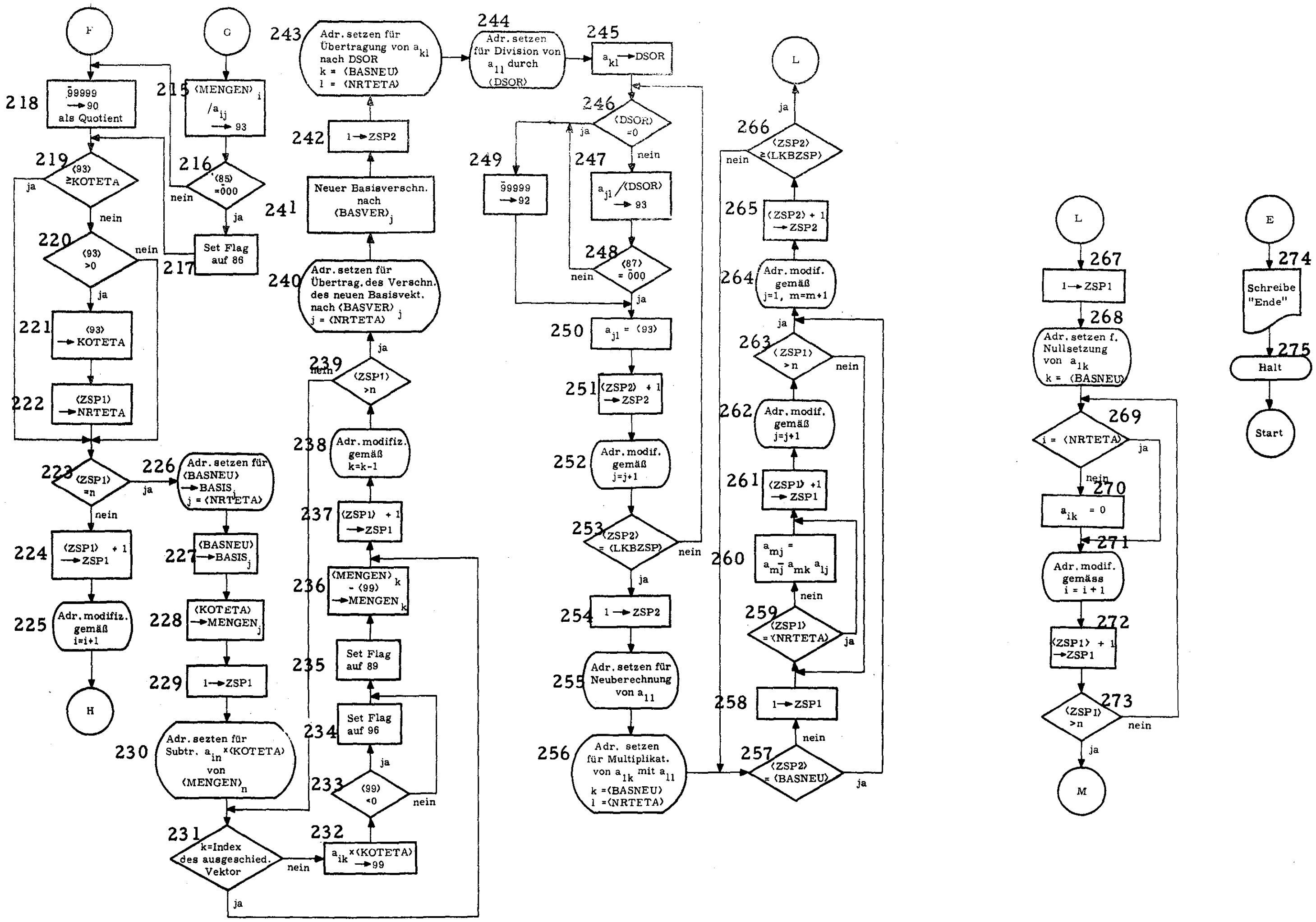




C
98 O → C O → CZ
99 10 x 000000 → KØMBI3
100 Adr. setzen für Feststellung, ob vorletzte Länge in Längenkomb. vorhanden
101 Adr. setzen für Add. letztes B^(l) auf ARB 1 bei Entw. folg. Komb.
102 Adr. setzen für Korrektur von GESVER zum Übergang zur nächsten Komb.
103 Adr. setzen für Korrektur der Plattenhäufigkeit beim Übergang zur folg. Komb.
104 B → ARB1
105 Adr. setzen für Vergl. ob B^(i) ≤ ⟨ARB1⟩
106 Adr. setzen für Erhöhung von ⟨KØMBI2⟩ 1 um 1
107 10 x 00 → PLHFG.
108 Adr. setzen für Add. von Häufigk. aus TAB auf PLHFG
109 Adr. setzen für Add. von Verschn. aus TAB auf GESVER
110 O → GESVER
111 RCTY
112 1 → ZSP2
113 Adr. vorbereiten für Add. von verm. B^(l) auf ARB1 beim Übergang zur nächsten Komb.
114 ⟨ARB1⟩ ≥ B^(i)
ja
nein
115 ⟨ARB1⟩ - B^(i) → ARB1
116 ⟨KØMBI2⟩ i + 1 → KØMBI2 i
117 Add. der zu B^(i) gehörigen Häufigkeiten aus TAB auf PLHFG
118 Add. des zu B^(i) gehörigen Verschn. aus TAB auf GESVER
119 Rückstellung der Adr. bei Add. der Plattenhfk. auf PLHFG auf 1. Wert
120 ⟨ZSP2⟩ = ⟨KBZSP⟩
121 Adr. modifiz. gemäss i = i + 1
122 ⟨ZSP2⟩ + 1 → ZSP2
123 ⟨GESVER⟩ + ⟨ARB1⟩ x A → GESVER
124 Adr. setzen für Darstellg. der Plattenhäufigkeiten aus PLHFG in KØMBI3 in Form (3/3)
125 O → ZSP1
126 Plattenhäufigkeiten aus PLHFG (2/0) → KØMBI 3 (3/3)
127 Adr. für Übertr. modifiz. (i = i + 1)
128 ⟨ZSP1⟩ + 1 → ZSP1
129 ⟨ZSP1⟩ = n
130 ⟨GESVER⟩ → C
131 RCTY
132 Ausgabe von Längenkomb. Plattenhäufigk. Verschnitt
133 ⟨KØMBI3⟩, ⟨C⟩ → TAB2
134 ⟨GESVER⟩ - ⟨ARB1⟩ x A → GESVER
135 ⟨LKBZSP⟩ + 1 → LKBZSP
136 ⟨LKBZSP⟩ = 121
137 Letztes B^(l) in Komb. noch vorh.
138 Vermindere Häufigkeit in letztem ⟨KOMBI2⟩ i um 1
139 Vermindere zugehörige Häufigkeiten in ⟨PLHFG⟩ i
140 Vermindere ⟨GESVER⟩ um Verschn. der zuletztem B^(l) gehört
141 ⟨ARB1⟩ + letztes B^(l) → ARB1
142 ⟨KBZSP⟩ - 1 → ZSP2
143 Adr. setzen für Abfrage, ob vor letztes B^(l) im Komb. vorhanden
144 B^(i) im Kombin. vorhanden
145 ⟨ZSP2⟩ - 1 → ZSP2
146 ⟨ZSP2⟩ = 0
147 Adr. modifiz gemäss i = i - 1
148 ⟨ARB1⟩ + B^(i) → ARB1
149 ⟨GESVER⟩ um zu B^(i) gehörigen Verschn. vermindern
150 Adr. setzen für Entw. der nächsten Komb. ab i-ter Stelle
151 Verminderung in ⟨PLHFG⟩ gemäss subtrahiertem B^(i)
152 Verminderung der Häufigkeit im ⟨KOMBI2⟩ i um 1
153 Adr. setzen für Vergl. ⟨ARB1⟩ mit B^(i + 1)
154 Adr. setzen für Subtr. von B^(i + 1) von ARB1
155 ⟨ZSP2⟩ + 1 → ZSP2
156 Adr. setzen für Entw. der Plattenhäufigkeiten der nächsten Komb.
D



D
157
158 Adr. setzen für ⟨BASIS⟩ 1 → BASIS 2
159 1 → ZSP1
160 ⟨BASIS⟩ i-1 → BASIS
161 Adr. setzen f. ⟨BASIS⟩ i + 1 → BASIS i
162 ⟨BASIS⟩ i + 1 → BASIS i
163 ⟨ZSP1⟩ + 1 → ZSP1
164 Adr. modifiz. gemäss i = i + 1
165 ⟨ZSP1⟩ = n
166 10 x 0 → MENGEN
167 Eing. der Mengen → MENGEN
168 10 x ⟨EIVER⟩ → BASVER
M
169 1 → ZSP1
170 Adr. setzen für Ausg. der Basisvektoren u. Mengen
171 RCTY
172 Ausg. Liste Basisvekt. Menge
173 ⟨ZSP1⟩ + 1 → ZSP1
174 Adr. modifiz. gemäss i = i + 1
175 ⟨ZSP1⟩ > n
176 0 → ERGVER
177 Adr. setzen für Multipl. von ⟨MENGEN⟩ 1 mit ⟨BASVER⟩ 1
178 0 → ZSP1
179 ⟨ERGVER⟩ + ⟨MENGEN⟩ i x ⟨BASVER⟩ i → ERGVER
180 Adr. modifiz. gemäss i = i + 1
181 ⟨ZSP1⟩ + 1 → ZSP1
182 ⟨ZSP1⟩ = n
183 RCTY
184 Ausgabe des bei dieser Basis anfallenden Verschn. aus ERGVER
185 RCTY
186 0 → ZSP1 1 → ZSP2
187 99999 auf die ersten Stellen von MINCZ
188 Clear Flag auf MINCZ
189 Adr. setzen für Übertragung von ⟨C⟩ 1 aus TAB2 nach ⟨CZ⟩ 1 aus TAB2
190 Adr. setzen für Multipl. ⟨a⟩ 11 aus TAB2 mit ⟨BASVER⟩ 1
191 ⟨C⟩ i → CZ i in TAB2
192 Adr. setzen für Subtr. des Prod. a ik x ⟨BASVER⟩ k von CZ i
193 a ik x ⟨BASVER⟩ k → 99
194 ⟨99⟩ <0
195 Flag auf 96
196 ⟨CZ⟩ i - ⟨96⟩ → CZ i
197 Adr. modifiz. gemäss k = k + 1
198 ⟨ZSP1⟩ +1 → ZSP1
199 ⟨ZSP1⟩ = n
200 Adr. setzen für Vergleich ⟨CZ⟩ i mit ⟨MINCZ⟩
201 ⟨CZ⟩ i <⟨MINCZ⟩
202 ⟨CZ⟩ i → MINCZ
203 ⟨ZSP2⟩ → BASNEU
204 Adr. modifiz. gemäss i = i + 1
205 ⟨ZSP2⟩ + 1 → ZSP2
206 0 → ZSP1
207 ⟨ZSP2⟩ <⟨LKBZSP⟩
208 ⟨MINCZ⟩ <-100
209 99999 auf die ersten Stellen von KOTETA
E
210 1 → ZSP1
211 Adr. setzen für ⟨MENGEN⟩ 1 → 96 als Dividend
212 Adr. setzen für Prüfg. ob Divisor = 0 (Divisor = ausgew. a 1j aus TAB2)
213 ⟨MENGEN⟩ 1 → 96 (Dividend)
214 DIVISOR = 0
H
G
F



F
G
218
99999 → 90 als Quotient
215
⟨MENGEN⟩i /a1j → 93
219
⟨93⟩ ≥KOTETA
ja
nein
216
⟨85⟩ =000
nein
ja
220
⟨93⟩ >0
nein
217
Set Flag auf 86
ja
221
⟨93⟩ → KOTETA
222
⟨ZSP1⟩ → NRTETA
223
⟨ZSP1⟩ =n
ja
226
Adr. setzen für ⟨BASNEU⟩ → BASISj j = ⟨NRTETA⟩
nein
224
⟨ZSP1⟩ + 1 → ZSP1
227
⟨BASNEU⟩ → BASISj
225
Adr. modifiz. gemäß i=i+1
228
⟨KOTETA⟩ → MENGENj
H
229
1 → ZSP1
230
Adr. sezten für Subtr. ain × ⟨KOTETA⟩ von ⟨MENGEN⟩n
231
k=Index des ausgeschied. Vektor
nein
ja
232
aik × ⟨KOTETA⟩ → 99
233
⟨99⟩ <0
nein
ja
234
Set Flag auf 96
235
Set Flag auf 89
236
⟨MENGEN⟩k - ⟨99⟩ → MENGENk
237
⟨ZSP1⟩ + 1 → ZSP1
238
Adr. modifiz. gemäß k=k-1
239
⟨ZSP1⟩ >n
nein
ja
240
Adr. setzen für Übertrag. des Verschn. des neuen Basisvekt. nach ⟨BASVER⟩j j = ⟨NRTETA⟩
241
Neuer Basisverschn. nach ⟨BASVER⟩j
242
1 → ZSP2
243
Adr. setzen für Übertragung von akl nach DSOR k = ⟨BASNEU⟩ l = ⟨NRTETA⟩
244
Adr. setzen für Division von a11 durch ⟨DSOR⟩
245
akl → DSOR
246
⟨DSOR⟩ =0
ja
nein
249
99999 → 92
247
aj1 /⟨DSOR⟩ → 93
248
⟨87⟩ = 000
nein
ja
250
aj1 = ⟨93⟩
251
⟨ZSP2⟩ + 1 → ZSP2
252
Adr. modif. gemäß j=j+1
253
⟨ZSP2⟩ = ⟨LKBZSP⟩
nein
ja
254
1 → ZSP2
255
Adr. setzen für Neuberechnung von a11
256
Adr. setzen für Multiplikat. von a1k mit a11 k = ⟨BASNEU⟩ l = ⟨NRTETA⟩
L
ja
266
⟨ZSP2⟩ ≥⟨LKBZSP⟩
nein
265
⟨ZSP2⟩ + 1 → ZSP2
264
Adr. modif. gemäß j=1, m=m+1
ja
263
⟨ZSP1⟩ >n
nein
262
Adr. modif. gemäß j=j+1
261
⟨ZSP1⟩ +1 → ZSP1
260
amj = amj - amk alj
nein
259
⟨ZSP1⟩ = ⟨NRTETA⟩
ja
258
1 → ZSP1
nein
257
⟨ZSP2⟩ = ⟨BASNEU⟩
ja
L
267
1 → ZSP1
268
Adr. setzen f. Nullsetzung von a1k k = ⟨BASNEU⟩
269
i = ⟨NRTETA⟩
ja
nein
270
aik = 0
271
Adr. modif. gemäss i = i + 1
272
⟨ZSP1⟩ + 1 → ZSP1
273
⟨ZSP1⟩ >n
nein
ja
M
E
274
Schreibe "Ende"
275
Halt
Start

Numbers correspond to numbers appearing on block diagram, pp. 27-32.

1. Read in A, B, n, a_i, b_i ($i = 1, \ldots, n$)
2. Addresses prepared for transfer of length combination to TAB2
3. 0 ⟶ KBZSP, 1 ⟶ LKBZSP
4. Addresses set for establishing whether (n-1)"th width is in width combination.
5. Addresses of an set for addition into ARB1
6. Addresses prepared for establishing whether next to last length is in length combination.
7. Addresses set for addition of the next to last $B^{(1)}$ to ARB1
8. Addresses set for correction of the trim losses in GESVER
9. Addresses set for correction of the plate frequency
10. 10 X $\bar{0}$0 ⟶ KØMBIZ
11. 30 X $\bar{0}$0 ⟶ KØMBIZ
12. A ⟶ ARB1
13. Addresses set for testing whether a_1 ≤ <ARB1>
14. Addresses set for construction of the first width combination
15. 1 ⟶ ZSP1
16. Addresses set for addition of the smallest $a_i \neq 0$ ($i \neq n$) in ARB1
17. Is <ARB1> ≥ a_i ?
18. <ARB1> - a_i ⟶ ARB1
19. Addition from first to i'th field in KØMBI
20. Is <ZSP1> = n ?
21. Addresses modified according to $i = i + 1$
22. <ZSP1> + 1 ⟶ ZSP1
23. 10 X $\bar{0}$0000 ⟶ BIHSP
24. Addresses set for transfer of b_1 to first position in BIHSP
25. 1 ⟶ ZSP1
26. Is a_i in combination?
27. b_i ⟶ BIHSP (i'th position)
28. Is <ZSP1> = n?
29. Addresses modified according to $i = i + 1$
30. <ZSP1> + 1 ⟶ ZSP1
31. $\bar{9}$9999 ⟶ DELTAB
32. $\bar{0}$0000 ⟶ MAX, $\bar{9}$9999 ⟶ MIN
33. 1 ⟶ ZSP1
34. Addresses set for testing whether b_1 is in BIHSP
35. Is b_i in BIHSP?
36. Is <MAX> ≤ <i'th field of BIHSP> ?
37. <i'th field of BIHSP> ⟶ MAX
38. Is <MIN> ≥ <i'th field of BIHSP>?
39. <i'th field of BIHSP> ⟶ MIN
40. Address of the i'th field of BIHSP ⟶ ADRMIN
41. Is <ZSP1> = n?
42. <ZSP1> + 1 ⟶ ZSP1
43. Addresses modified according to $i = i + 1$
44. <MAX> - <MIN> ⟶ MAXMIN
45. Is <MAXMIN> ≤ <DELTAB>
46. <MAXMIN> ⟶ DELTAB
47. <MAX> ⟶ BL
48. Is <DELTAB> =0?
49. Addresses set for increase of the smallest value ≠ 0 in BIHSP by b_i
50. Smallest value in BIHSP increased by appropriate b_i
51. Is the increased value in BIHSP > B?
52. 10X$\bar{0}$0 ⟶ PLATTE
53. 0 ⟶ VERSCH
54. Addresses set for the formation of the plate frequency in PLATTE
55. 1 ⟶ ZSP1
56. Addresses set for subtraction of b_i from MAX
57. Is i'th plate in combination?
58. Addresses set for adding i'th field of KØMBI to i'th field of PLATTE
59. <BL> ⟶ MAX
60. <MAX> - b_i ⟶ MAX
61. <PLATTE>$_i$ + <KØMBI>$_i$ ⟶ PLATTE$_i$
62. Is <MAX> ≥ b_i ?
63. <MAX> × a_i ⟶ HISPE1
64. <HISPE 1> × <KØMBI>$_i$ ⟶ 99
65. <VERSCH> + <99> ⟶ VERSCH
66. Is <ZSP1> = n?
67. Addresses modified according to $i = i + 1$
68. <ZSP1> +1 ⟶ ZSP1
69. <VERSCH> + <ARB1> × <BL> ⟶ VERSCH
70. RCTY
71. Type list of combinations, $B^{(1)}$'s, Plate Frequencies, and trim losses
72. 0 ⟶ ZSP1
73. Addresses set for arrangement of the combination according to the size of <BL>
74. Is <ZSP1> = <KBZSP> ?
75. Is <BL> > $B_i^{(1)}$ in TAB ?
76. Addresses modified according to $i = i + 1$
77. <ZSP1> +1 ⟶ ZSP1
78. <TAB> with $B^{(1)}$ < <BL> ⟶ TAB2
79. New combination ⟶ TAB
80. Is <ZSP1> = <KBZSP> ?
81. Transfer back to TAB the contents of TAB2
82. <KBZSP> +1 KB SP
83. Is < KBZSP > = 30?
84. Is a_n in combination?

85. <KØMBI>$_n$ -1 ⟶ KØMBI$_n$
86. <ARB1> + a_n → ARB1
87. Addresses prepared for decrementing <KØMBI>$_{n-1}$ by 1
88. n → SP1
89. <ZSP1> -1 ⟶ ZSP1
90. Addresses modified according to $i = i-1$
91. Is <KØMBI> =0 ?
92. <ZSP1> -1 ⟶ ZSP1
93. Is <ZSP1> =0 ?
94. <ARB1> + a_i → ARB1
95. <KØMBI>$_i$ -1 ⟶ KØMBI$_i$
96. Addresses set for formation of the next combination starting with <KØMBI>$_i$ ≠ 0
97. <ZSP1> +1 → ZSP1
98. 0 → C, 0 → CZ
99. 10X$\bar{0}$00000 ⟶ KØMBI3
100. Addresses set for testing whether next to last length is in length combination
101. Addresses set for adding last $B^{(1)}$ to ARB1 in the formation of the following combination
102. Addresses set for correction of GESVER for transition to next combination
103. Addresses set for correction of the plate frequency in the transition to the following combination
104. B ⟶ ARB1
105. Addresses set for determining whether $B^{(1)}$ ≮ <ARB1>
106. Addresses set for increasing <KØMBI2>$_1$ by 1
107. 10 X$\bar{0}$0 ⟶ PLHFG
108. Addresses set for addition of plate frequency in TAB to PLHFG
109. Addresses set for addition of trim loss in TAB to GESVER
110. 0 ⟶ GESVER
111. RCTY
112. 1 SP2
113. Addresses prepared for adding decreased $B^{(1)}$ to ARB1 in the transition to the next combination
114. Is <ARB1> ≯ $B^{(i)}$?
115. <ARB1> - $B^{(i)}$ → ARB1
116. <KØMBI2> +1 ⟶ KØMBI2
117. Addition of the frequencies in TAB corresponding to $B^{(i)}$ to PLHFG
118. Addition of the trim loss in TAB corresponding to $B^{(i)}$ to GESVER
119. Resetting of the addresses by adding the plate frequency to the first value of PLHFG
120. Is <ZSP2> = <KBZSP>?
121. Addresses modified according to $i = i+1$
122. <ZSP2> + 1 ⟶ ZSP2
123. <GESVER> + <ARB1> ×A → GESVER
124. Addresses set for the representation of the plate frequencies in PLHFG (2/0) KØMBI3 (3/3)
125. 0 → ZSP1

126. Plate frequencies in PLHFG (2/0) ⟶ KØMBI3 (3/3)
127. Addresses for transition modified
128. <ZSP1> +1 ⟶ ZSP1
129. Is ZSP1 =n?
130. <GESVER> ⟶ C
131. RCTY
132. Listing of Length Combination, Plate Frequencies, and Trim Loss
133. <KØMBI3> , <C> ⟶ TAB2
134. <GESVER> - <ARB1> × A ⟶ GESVER
135. LKBZSP +1 ⟶ LKBZSP
136. Is <LKBZSP>=121?
137. Is last $B^{(1)}$ still in combination?
138. Decrease frequency in last <KØMBI2>$_i$ by 1
139. Decrease appropriate frequencies in PLHFG
140. Decrease <GESVER> by trim loss which corresponds to the last $B^{(1)}$
141. <ARB1> + last $B^{(1)}$ ⟶ ARB1
142. <KBZSP> -1 ⟶ ZSP2
143. Addresses set for determining whether next to last $B^{(1)}$ is in combination
144. Is $B^{(i)}$ in combination ?
145. <ZSP2> -1 ⟶ ZSP2
146. Is ZSP2 =0
147. Addresses modified according to $i = i-1$
148. <ARB1> +$B^{(i)}$ ⟶ ARB1
149. GESVER decreased by trim loss corresponding to $B^{(i)}$
150. Addresses set for formation of the next combination from the ith position
151. Decrement in <PLHFG> in conformity with subtracted $B^{(i)}$
152. Decrease of the frequency in <KØMBI2>$_i$ by 1
153. Addresses set for comparing <ARB1> with $B^{(i+1)}$
154. Addresses set for subtracting $B^{(i+1)}$ from ARB1
155. <ZSP2> +1 ⟶ ZSP2
156. Addresses set for formation of the plate frequency of the next combination
157.
158. Addresses set for <BASIS>$_1$ ⟶ <BASIS>$_2$
159. 1 ⟶ ZSP1
160. <BASIS>$_{i-1}$ ⟶ BASIS
161. Addresses set for <BASIS>$_{i+1}$ ⟶ BASIS$_i$
162. <BASIS>$_{i+1}$ ⟶ BASIS$_i$
163. <ZSP1> + 1 ⟶ ZSP1
164. Addresses modified according to $i = i+1$
165. Is <ZSP1> = n ?
166. 10 X 0 ⟶ MENGEN
167. Read quantities from typewriter into MENGEN
168. 10 X <EIVER> ⟶ BASVER
169. 1 ⟶ ZSP1
170. Addresses set for listing of the basis rectors and quantities
171. RCTY

172. Listing of basis vector quantities
173. <ZSP1> +1⟶ZSP1
174. Addresses modified according to $i=i+1$
175. <ZSP1> > n ?
176. 0⟶ERGVER
177. Addresses set for multiplication of <MENGEN>$_1$ By <BASVER>$_1$
178. 0⟶ZSP1
179. <ERGVER> + <MENGEN>$_i$ X <BASVER>$_j$⟶ERGVER
180. Addresses modified according to $i=i+1$
181. <ZSP1> +1⟶ZSP1
182. Is <ZSP1> =n?
183. RCTY
184. Listing of the Trim Loss arising from this basis
185. RCTY
186. 0⟶ZSP1, 1⟶ZSP2
187. $\bar{9}$9999 to the first position of MINCZ
188. Clear flag at MINCZ
189. Addresses set for transfer of <C>$_1$, in TAB2 to <CZ>$_1$ in TAB2
190. Addresses set for multiplication of <a>$_{11}$ in TAB2 with <BASVER>$_1$
191. <C>$_i$⟶ CZ$_i$ in TAB2
192. Addresses set for subtraction of the product a_{ik} × <BASVER>$_k$ from CZ$_j$
193. a_{ik} × <BASVER>⟶99
194. Is <99> < 0?
195. Set flag at 96
196. <CZ>$_i$ - <96> ⟶ CZ$_i$
197. Addresses modified according to K = K + 1
198. <ZSP1> +1⟶ZSP1
199. Is <ZSP1> = n?
200. Addresses set for comparing <CZ>$_i$ with <MINCZ>
201. Is <CZ>$_i$ < <MINCZ> ?
202. <CZ>$_i$⟶MINCZ
203. <ZSP2>⟶BASNEU
204. Addresses modified according to $i=i+1$
205. <ZSP2> +1⟶ZSP2
206. 0⟶ZSP1
207. Is <ZSP2> < <LKBZSP> ?
208. Is <MINCZ> < -100 ?
209. $\bar{9}$9999 at first position of KOTETA
210. 1⟶ZSP1
211. Addresses set for <MENGEN>$_1$⟶96 as dividend
212. Addresses set for testing whether divisor = 0
(Divisor = appropriate a_{1j} in TAB2)
213. <MENGEN>$_1$⟶96 (Dividend)
214. Is DIVISOR = 0?
215. <MENGEN>$_i$ /a_{ij} ⟶ 93
216. Is <85> = $\bar{0}$00 ?
217. Set flag at 86
218. $\bar{9}$9999⟶90 as quotient

219. Is <93> ≥ KOTETA ?
220. Is <93> > 0?
221. <93>⟶KOTETA
222. <ZSP1>⟶ NRTETA
223. Is <ZSP1> = n?
224. <ZSP1> +1⟶ ZSP1
225. Addresses modified according to i=i+1
226. Addresses set for <BASNEU>⟶BASIS$_j$ j = NRTETA
227. <BASNEU>⟶ BASIS$_j$
228. <KOTETA>⟶MENGEN$_j$
229. 1⟶ZSP1
230. Addresses set for subtracting a_{in} × <KOTETA>from<MENGEN>$_n$
231. Is K=Index of rejected vector ?
232. a_{ik}×<KOTETA> ⟶ 99
233. Is <99> < 0 ?
234. Set flag at 96
235. Set flag at 89
236. <MENGEN>$_k$ - <99> MENGEN $_k$
237. <ZSP1> + 1⟶ZSP1
238. Addresses modified according to K=K-1
239. Is <ZSP1> > n?
240. Addresses set for transfer of the trim loss of the new basis vector to <BASVER>$_j$ j=NRTETA
241. New basis vector to <BASVER>$_j$
242. 1⟶ZSP2
243. Addresses set for transfer of a_{kl} to DSOR k= <BASNEU>, l=NRTE+A
244. Addresses set for division of a_n by <DSOR>
245. a_{kl}⟶DSOR
246. Is <DSOR> = 0?
247. a_{ji} /DSOR⟶ 93
248. Is <87> = $\bar{0}$00 ?
249. $\bar{9}$9999⟶92
250. a_{jl} = <93>
251. <ZSP2> + 1⟶ZSP2
252. Addresses modified according to $j=j+1$
253. Is <ZSP2> = <LKB Z SP> ?
254. 1⟶ZSP2
255. Addresses set for the new calculation of a_{11}
256. Addresses set for multiplication of a_{1K} by a_{11}
257. Is <ZSP2> = <BASNEU> ?
258. 1⟶ZSP1
259. Is <ZSP1> = <NRTETA> ?
260. $a_{mj} = a_{mj}\, a_{mk}\, a_{1j}$
261. <ZSP1> + 1⟶ ZSP1
262. Addresses modified according to $j=j+1$
263. Is <ZSP1> > n?
264. Addresses modified according to j=1, m=m+1

265. <ZSP2> + 1→ZSP2
266. Is <ZSP2> ≥ <LKBZSP>
267. 1→ZSP1
268. Addresses set for setting a_{ik} to zero
269. Is i = <NRTETA> ?
270. = 0
271. Addresses modified according to $i:i+1$
272. <ZSP1> + 1→ZSP1
273. Is <ZSP1> > n?
274. Write "End"
275. Halt

Translated by Michael S. Lubell

PROGRAMMLISTE

```
00402                          DORG 402Z
00406          5 00000    A      DS   5Z
00411          5 00000    B      DS   5Z
00426         15 00000    NULL   DC   15,0Z
00446         20 00000    KOMBI  DS   20Z
00451          5 00000    BL     DS   5Z
00471         20 00000    PLATTE DS   20Z
00483         12 00000    VERSCH DS   12Z
00484          1 00000           DC   1,@Z
00534         50 00000    BIHSP  DS   50Z
00539          5 00000    A1     DS   5Z
00634         95 00000           DS   95Z
00644         10 00000    HISPE1 DS   10Z
02355       1711 00000    TAB    DS   1711Z
02415         60 00000    KOMBI2 DS   60Z
02435         20 00000    PLHFG  DS   20Z
02447         12 00000    GESVER DS   12Z
02448          1 00000           DC   1,@Z
12889      10441 00000    TAB2   DS   10441Z
12949         60 00000    KOMBI3 DS   60Z
12961         12 00000    C      DS   12Z
12976         15 00000    CZ     DS   15Z
12977          1 00000           DC   1,@Z
13027         50 00000    BASIS  DS   50Z
13028          1 00000           DC   1,@Z
13108         80 00000    MENGEN DS   80Z
13109          1 00000           DC   1,@Z
13229        120 00000    BASVER DS   120Z
13241         12 00000    EIVER  DC   12,100000000000Z
13261         20 00000    ERGVER DS   20Z
13262          1 00000           DC   1,@Z
13277         15 00000    MINCZ  DS   15Z
13280          3 00000    BASNEU DS   3Z
13286          6 00000    DSOR   DS   6Z
13294          8 00000    KOTETA DS   8Z
13296          2 00000    NRTETA DS   2Z
13304          8 00000    AUS    DS   8Z
13305          1 00000           DC   1,@Z
13306 36 00402 00100      START  RNTY A-4Z
13318 36 13736 00100             RNTY N-1Z
13330 36 00535 00100             RNTY A1-4Z
13342 16 16372 -2362             TFM  AUSG2+30,TAB2-10527Z
13354 16 15321 000-0             TFM  KBZSP,0,10Z
13366 16 15319 00-01             TFM  LKBZSP,1,9Z
13378 16 15256 -0426             TFM  KBFOLG+42,KOMBI-20Z
13390 21 15256 13737             A    KBFOLG+42,NZ
13402 21 15256 13737             A    KBFOLG+42,NZ
13414 16 15309 -0529             TFM  VORBKB+11,A1-10Z
13426 16 16432 -2355             TFM  LKBFLG+42,KOMBI2-60Z
13438 16 16581 -0612             TFM  VRBLKB+11,TAB-1743Z
13450 16 16569 -0644             TFM  VRBLKB-1,TAB-1711Z
13462 16 16497 -0614             TFM  LKBFLG+107,TAB-1741Z
13474 21 15308 13737             A    VORBKB+10,NZ
13486 16 13504 -0428             TFM  UENULL+6,KOMBI-18Z
13498 26 00000 00413      UENULL TF   0,NULL-13Z
13510 11 13504 -0002             AM   UENULL+6,2Z
13522 14 13504 -0448             CM   UENULL+6,KOMBI+2Z
13534 47 13498 01200             BNE  UENULLZ
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13546 16 13564 -2357          TFM  UENULL+66,KOMBI2-58Z
13558 26 00000 00413          TF   0,NULL-13Z
13570 11 13564 -0002          AM   UENULL+66,2Z
13582 14 13564 -2417          CM   UENULL+66,KOMBI2+2Z
13594 47 13558 01200          BNE  UENULL+60Z
13606 26 13809 00406          TF   ARB1,AZ
13618 16 13677 -0539          TFM  VERGL1+11,A1Z
13630 16 13720 -0428          TFM  ABZUG+18,KOMBI-18Z
13642 16 13735 000-1          TFM  ZSP1,1,10Z
13654 16 15465 -0529          TFM  MINDAI+11,A1-10Z
13666 24 13809 00000   VERGL1 C    ARB1,0Z
13678 47 13738 01300          BL   ADRM1Z
13690 26 13713 13677          TF   ABZUG+11,VERGL1+11Z
13702 22 13809 00000   ABZUG  S    ARB1,0Z
13714 11 00000 000-1          AM   0,1,10Z
13726 49 13666 00000          B    VERGL1Z
13737           2 00000   N      DS   2,ABZUG+35Z
13735           2 00000   ZSP1   DS   2,ABZUG+33Z
13738 24 13735 13737   ADRM1  C    ZSP1,NZ
13750 46 13810 01200          BE   BLBESTZ
13762 11 13677 -0010          AM   VERGL1+11,10Z
13774 11 13720 -0002          AM   ABZUG+18,2Z
13786 11 13735 000-1          AM   ZSP1,1,10Z
13798 49 13666 00000          B    VERGL1Z
13809           5 00000   ARB1   DS   5,ADRM1+71Z
13810 16 13840 -0539   BLBEST TFM  BLBEST+30,BIHSP+5Z
13822 12 13840 -0005          SM   BLBEST+30,5Z
13834 26 00000 00416          TF   0,NULL-10Z
13846 14 13840 -0489          CM   BLBEST+30,BIHSP-45Z
13858 47 13822 01200          BNE  BLBEST+12Z
13870 16 13924 -0428          TFM  VERGL2+6,KOMBI-18Z
13882 16 13948 -0489          TFM  VERGL2+30,BIHSP-45Z
13894 16 13953 -0544          TFM  VERGL2+35,A1+5Z
13906 16 13735 000-1          TFM  ZSP1,1,10Z
13918 14 00000 000-0   VERGL2 CM   0,0,10Z
13930 46 13954 01200          BE   VERGL2+36Z
13942 26 00000 00000          TF   0,0Z
13954 24 13735 13737          C    ZSP1,NZ
13966 46 14038 01200          BE   BEMINAZ
13978 11 13924 -0002          AM   VERGL2+6,2Z
13990 11 13948 -0005          AM   VERGL2+30,5Z
14002 11 13953 -0010          AM   VERGL2+35,10Z
14014 11 13735 000-1          AM   ZSP1,1,10Z
14026 49 13918 00000          B    VERGL2Z
14037           5 00000   NEUN   DC   5,99999,VERGL2+119Z
14038 26 14925 14037   BEMINA TF   DELTAB,NEUNZ
14050 26 15561 00416          TF   MAX,NULL-10Z
14062 26 14313 14037          TF   MIN,NEUNZ
14074 16 13735 000-1          TFM  ZSP1,1,10Z
14086 16 14109 -0489          TFM  VERGL3+11,BIHSP-45Z
14098 24 00416 00000   VERGL3 C    NULL-10,0Z
14110 46 14254 01200          BE   ADRM3Z
14122 26 14145 14109          TF   VERGL4+11,VERGL3+11Z
14134 24 15561 00000   VERGL4 C    MAX,0Z
14146 46 14182 01300          BNL  MAXNEU+12Z
14158 26 14181 14145          TF   MAXNEU+11,VERGL4+11Z
14170 26 15561 00000   MAXNEU TF   MAX,0Z
14182 26 14205 14145          TF   VERGL5+11,VERGL4+11Z
14194 24 14313 00000   VERGL5 C    MIN,0Z
14206 47 14254 01300          BL   ADRM3Z
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14218 26 14241 14205          TF   MINNEU+11,VERGL5+11Z
14230 26 14313 00000   MINNEU TF   MIN,0Z
14242 26 14956 14241          TF   ADRMIN,MINNEU+11Z
14254 24 13735 13737   ADRM3  C    ZSP1,NZ
14266 46 14314 01200          BE   DELTAZ
14278 11 13735 000-1          AM   ZSP1,1,10Z
14290 11 14109 -0005          AM   VERGL3+11,5Z
14302 49 14098 00000          B    VERGL3Z
14313           5 00000   MIN    DS   5,ADRM3+59Z
14529           5 00000   MAXMIN DS   5,ADRM3+275Z
14314 26 14529 15561   DELTA  TF   MAXMIN,MAXZ
14326 22 14529 14313          S    MAXMIN,MINZ
14338 24 14529 14925   VERGL6 C    MAXMIN,DELTABZ
14350 46 14410 01300          BNL  BMIERHZ
14362 26 14925 14529          TF   DELTAB,MAXMINZ
14374 26 00451 15561          TF   BL,MAXZ
14386 24 14925 00416          C    DELTAB,NULL-10Z
14398 46 14530 01200          BE   ABF1Z
14410 26 14476 14956   BMIERH TF   BMIERH+66,ADRMINZ
14422 16 14481 -0534          TFM  BMIERH+71,A1-5Z
14434 12 14956 -0484          SM   ADRMIN,BIHSP-50Z
14446 21 14481 14956          A    BMIERH+71,ADRMINZ
14458 21 14481 14956          A    BMIERH+71,ADRMINZ
14470 21 00000 00000          A    0,0Z
14482 26 14500 14476          TF   VERGL7+6,BMIERH+66Z
14494 24 00000 00411   VERGL7 C    0,BZ
14506 46 14530 01100          BH   ABF1Z
14518 49 14050 00000          B    BEMINA+12Z
14530 16 14548 -0453   ABF1   TFM  ABF1+18,PLATTE-18Z
14542 26 00000 00413          TF   0,NULL-13Z
14554 11 14548 -0002          AM   ABF1+18,2Z
14566 14 14548 -0473          CM   ABF1+18,PLATTE+2Z
14578 47 14542 01200          BNE  ABF1+12Z
14590 26 00483 00423          TF   VERSCH,NULL-3Z
14602 16 14656 -0428          TFM  ABF2+6,KOMBI-18Z
14614 16 14716 -0453          TFM  ABF2+66,PLATTE-18Z
14626 16 13735 000-1          TFM  ZSP1,1,10Z
14638 16 14709 -0544          TFM  ABF2+59,A1+5Z
14650 14 00000 000-0   ABF2   CM   0,0,10Z
14662 46 14842 01200          BE   ABF3Z
14674 26 14721 14656          TF   ABF2+71,ABF2+6Z
14686 26 15561 00451          TF   MAX,BLZ
14698 22 15561 00000          S    MAX,0Z
14710 21 00000 00000          A    0,0Z
14722 26 14745 14709          TF   ABF2+95,ABF2+59Z
14734 24 15561 00000          C    MAX,0Z
14746 46 14698 01300          BNL  ABF2+48Z
14758 26 14793 14709          TF   ABF2+143,ABF2+59Z
14770 12 14793 -0005          SM   ABF2+143,5Z
14782 23 15561 00000          M    MAX,0Z
14794 26 00644 00099          TF   HISPE1,99Z
14806 26 14829 14721          TF   ABF3-13,ABF2+71Z
14818 23 00644 00000          M    HISPE1,0Z
14830 21 00483 00099          A    VERSCH,99Z
14842 24 13735 13737   ABF3   C    ZSP1,NZ
14854 46 14926 01200          BE   ABF4Z
14866 11 14656 -0002          AM   ABF2+6,2Z
14878 11 14709 -0010          AM   ABF2+59,10Z
14890 11 14716 -0002          AM   ABF2+66,2Z
14902 11 13735 000-1          AM   ZSP1,1,10Z
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14914 49 14650 00000            B    ABF2Z
14925           5 00000  DELTAB DS   5,ABF3+83Z
14926 23 13809 00451     ABF4   M    ARB1,BLZ
14938 21 00483 00099            A    VERSCH,99Z
14950 34 00000 00102            RCTY Z
14956           5 00000  ADRMIN DS   5,ABF4+30Z
14962 38 00427 00100     AUSG1  WNTY KOMBI-19Z
14974 16 13735 000-0            TFM  ZSP1,0,10Z
14986 16 15141 -0645            TFM  AUSG1+179,TAB-1710Z
14998 16 15148 -0645            TFM  AUSG1+186,TAB-1710Z
15010 16 15057 -0669            TFM  AUSG1+95,TAB-1686Z
15022 24 13735 15321            C    ZSP1,KBZSPZ
15034 46 15142 01200            BE   AUSG1+180Z
15046 24 00451 00000            C    BL,0Z
15058 46 15130 01100            BH   AUSG1+168Z
15070 11 15141 -0057            AM   AUSG1+179,57Z
15082 11 15148 -0057            AM   AUSG1+186,57Z
15094 11 15057 -0057            AM   AUSG1+95,57Z
15106 11 13735 000-1            AM   ZSP1,1,10Z
15118 49 15022 00000            B    AUSG1+60Z
15130 31 02449 00000            TR   TAB2-10440,0Z
15142 31 00000 00427            TR   0,KOMBI-19Z
15154 24 13735 15321            C    ZSP1,KBZSPZ
15166 46 15214 01200            BE   KBFOLGZ
15178 26 15208 15141            TF   AUSG1+246,AUSG1+179Z
15190 11 15208 -0057            AM   AUSG1+246,57Z
15202 31 00000 02449            TR   0,TAB2-10440Z
15214 11 15321 000-1     KBFOLG AM   KBZSP,1,10Z
15226 14 15321 000L0            CM   KBZSP,30,10Z
15238 46 15562 01200            BE   VORKB3Z
15250 14 00000 000-0            CM   0,0,10Z
15262 46 15322 01200            BE   VORBKB+24Z
15274 26 15292 15256            TF   KBFOLG+78,KBFOLG+42Z
15286 12 00000 000-1            SM   0,1,10Z
15298 21 13809 00000     VORBKB A    ARB1,0Z
15310 49 15250 00000            B    KBFOLG+36Z
15321           2 00000  KBZSP  DS   2,VORBKB+23Z
15319           3 00000  LKBZSP DS   3,VORBKB+21Z
15322 26 15376 15256            TF   VORBKB+78,KBFOLG+42Z
15334 26 13735 13737            TF   ZSP1,NZ
15346 12 13735 000-1            SM   ZSP1,1,10Z
15358 12 15376 -0002            SM   VORBKB+78,2Z
15370 14 00000 000-0            CM   0,0,10Z
15382 47 15442 01200            BNE  VORBKB+144Z
15394 12 13735 000-1            SM   ZSP1,1,10Z
15406 14 13735 000-0            CM   ZSP1,0,10Z
15418 47 15358 01200            BNE  VORBKB+60Z
15430 49 15562 00000            B    VORKB3Z
15441           3 00000  ZSP2   DS   3,VORBKB+143Z
15442 21 15464 13735            A    MINDAI+10,ZSP1Z
15454 21 13809 00000     MINDAI A    ARB1,0Z
15466 26 15484 15376            TF   MINDAI+30,VORBKB+78Z
15478 12 00000 000-1            SM   0,1,10Z
15490 26 13677 15465            TF   VERGL1+11,MINDAI+11Z
15502 11 13677 -0010            AM   VERGL1+11,10Z
15514 26 13720 15484            TF   ABZUG+18,MINDAI+30Z
15526 11 13720 -0002            AM   ABZUG+18,2Z
15538 11 13735 000-1            AM   ZSP1,1,10Z
15550 49 13654 00000            B    VERGL1-12Z
15561           5 00000  MAX    DS   5,MINDAI+107Z
```

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15562 26 12961 00423     VORKB3 TF   C,NULL-3Z
15574 26 12976 00426            TF   CZ,NULLZ
15586 16 15604 J2895            TFM  VORKB3+42,KOMBI3-54Z
15598 26 00000 00417            TF   0,NULL-9Z
15610 11 15604 -0006            AM   VORKB3+42,6Z
15622 14 15604 J2955            CM   VORKB3+42,KOMBI3+6Z
15634 47 15598 01200            BNE  VORKB3+36Z
15646 21 16432 15321     LKB    A    LKBFLG+42,KBZSPZ
15658 21 16432 15321            A    LKBFLG+42,KBZSPZ
15670 13 15321 000N7            MM   KBZSP,57,10Z
15682 21 16581 00099            A    VRBLKB+11,99Z
15694 21 16569 00099            A    VRBLKB-1,99Z
15706 21 16497 00099            A    LKBFLG+107,99Z
15718 26 13809 00411            TF   ARB1,BZ
15730 16 15897 -0669            TFM  LVGL1+11,TAB-1686Z
15742 16 15940 -2357            TFM  BLABZ+18,KOMBI2-58Z
15754 16 15772 -2417            TFM  LKB+126,PLHFG-18Z
15766 26 00000 00413            TF   0,NULL-13Z
15778 11 15772 -0002            AM   LKB+126,2Z
15790 14 15772 -2435            CM   LKB+126,PLHFGZ
15802 47 15766 01100            BNH  LKB+120Z
15814 16 15969 -0671            TFM  BLABZ+47,TAB-1684Z
15826 16 16029 -0701            TFM  LADRM1-25,TAB-1654Z
15838 26 02447 00423            TF   GESVER,NULL-3Z
15850 34 00000 00102            RCTY Z
15862 16 15441 00-01            TFM  ZSP2,1,9Z
15874 16 16749 -0612            TFM  MINDBL+11,TAB-1743Z
15886 24 13809 00000     LVGL1  C    ARB1,0Z
15898 47 16054 01300            BL   LADRM1Z
15910 26 15933 15897            TF   BLABZ+11,LVGL1+11Z
15922 22 13809 00000     BLABZ  S    ARB1,0Z
15934 11 00000 000-1            AM   0,1,10Z
15946 16 15964 -2417            TFM  BLABZ+42,PLHFG-18Z
15958 21 00000 00000            A    0,0Z
15970 11 15964 -0002            AM   BLABZ+42,2Z
15982 11 15969 -0002            AM   BLABZ+47,2Z
15994 14 15964 -2435            CM   BLABZ+42,PLHFGZ
16006 47 15958 01100            BNH  BLABZ+36Z
16018 21 02447 00000            A    GESVER,0Z
16030 12 15969 -0020            SM   BLABZ+47,20Z
16042 49 15886 00000            B    LVGL1Z
16054 24 15441 15321     LADRM1 C    ZSP2,KBZSPZ
15066 46 16150 01200            BE   LVERZ
16078 11 15897 -0057            AM   LVGL1+11,57Z
16090 11 15940 -0002            AM   BLABZ+18,2Z
16102 11 15969 -0057            AM   BLABZ+47,57Z
16114 11 16029 -0057            AM   LADRM1-25,57Z
16126 11 15441 000-1            AM   ZSP2,1,10Z
16138 49 15886 00000            B    LVGL1Z
16150 23 13809 00406     LVER   M    ARB1,AZ
16162 21 02447 00099            A    GESVER,99Z
16174 16 16216 J2892            TFM  LVER+66,KOMBI3-57Z
16186 16 16221 -2417            TFM  LVER+71,PLHFG-18Z
16198 16 13735 000-0            TFM  ZSP1,0,10Z
16210 26 00000 00000            TF   0,0Z
16222 26 16252 16216            TF   *+30,LVER+66Z
16234 12 16252 -0001            SM   *+18,1Z
16246 33 00000 00000            CF   0Z
16258 11 16216 -0006            AM   LVER+66,6Z
16270 11 16221 -0002            AM   LVER+71,2Z
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16282 11 13735 000-1          AM    ZSP1,1,10Z
16294 24 13735 13737          C     ZSP1,NZ
16306 47 16210 01200          BNE   LVER+60Z
16318 26 12961 02447          TF    C,GESVERZ
16330 34 00000 00102          RCTY  Z
16342 38 02356 00100  AUSG2   WNTY  KOMBI2-59Z
16354 11 16372 -0087          AM    AUSG2+30,87Z
16366 31 00000 12890          TR    0,KOMBI3-59Z
16378 22 02447 00099          S     GESVER,99Z
15390 11 15319 00-01  LKBFLG  AM    LKBZSP,1,9Z
16402 14 15319 00J21          CM    LKBZSP,121,9Z
16414 46 17026 01200          BE    LPRZ
16426 14 00000 000-0          CM    0,0,10Z
16438 46 16594 01200          BE    VRBLKB+24Z
16450 26 16468 16432          TF    LKBFLG+78,LKBFLG+42Z
16462 12 00000 000-1          SM    0,1,10Z
16474 16 16492 -2417          TFM   LKBFLG+102,PLHFG-18Z
16486 22 00000 00000          S     0,0Z
16498 11 16492 -0002          AM    LKBFLG+102,2Z
16510 11 16497 -0002          AM    LKBFLG+107,2Z
16522 14 16492 -2435          CM    LKBFLG+102,PLHFGZ
16534 47 16486 01100          BNH   LKBFLG+96Z
16546 12 16497 -0020          SM    LKBFLG+107,20Z
16558 22 02447 00000          S     GESVER,0Z
16570 21 13809 00000  VRBLKB  A     ARB1,0Z
16582 49 16426 00000          B     LKBFLG+36Z
16594 26 16648 16432          TF    VRBLKB+78,LKBFLG+42Z
16606 26 15441 15321          TF    ZSP2,KBZSPZ
16618 12 15441 000-1          SM    ZSP2,1,10Z
16630 12 16648 -0002          SM    VRBLKB+78,2Z
16642 14 00000 000-0          CM    0,0,10Z
16654 47 16714 01200          BNE   VRBLKB+144Z
16666 12 15441 000-1          SM    ZSP2,1,10Z
16678 14 15441 000-0          CM    ZSP2,0,10Z
16690 47 16630 01200          BNE   VRBLKB+60Z
16702 49 17026 00000          B     LPRZ
16714 13 15441 000N7          MM    ZSP2,57,10Z
16726 21 16749 00099          A     MINDBL+11,99Z
16738 21 13809 00000  MINDBL  A     ARB1,0Z
16750 26 16785 16749          TF    MINDBL+47,MINDBL+11Z
16762 11 16785 -0032          AM    MINDBL+47,32Z
16774 22 02447 00000          S     GESVER,0Z
16786 26 16029 16785          TF    LADRM1-25,MINDBL+47Z
16798 11 16029 -0057          AM    LADRM1-25,57Z
16810 26 16857 16749          TF    MINDBL+119,MINDBL+11Z
16822 11 16857 -0002          AM    MINDBL+119,2Z
16834 16 16852 -2417          TFM   MINDBL+114,PLHFG-18Z
16846 22 00000 00000          S     0,0Z
15858 11 16852 -0002          AM    MINDBL+114,2Z
16870 11 16857 -0002          AM    MINDBL+119,2Z
16882 14 16852 -2435          CM    MINDBL+114,PLHFGZ
16894 47 16846 01100          BNH   MINDBL+108Z
16906 26 16924 16648          TF    MINDBL+186,VRBLKB+78Z
16918 12 00000 000-1          SM    0,1,10Z
16930 26 15897 16749          TF    LVGL1+11,MINDBL+11Z
16942 11 15897 -0057          AM    LVGL1+11,57Z
16954 26 15940 16924          TF    BLABZ+18,MINDBL+186Z
16966 11 15940 -0002          AM    BLABZ+18,2Z
16978 11 15441 000-1          AM    ZSP2,1,10Z
16990 26 15969 16857          TF    BLABZ+47,MINDBL+119Z
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17002 11 15969 -0037          AM    BLABZ+47,37Z
17014 49 15874 00000          B     LVGL1-12Z
17026 16 12982 J0001  LPR     TFM   BASIS-45,10001Z
17038 16 17080 J2987          TFM   LPR+54,BASIS-40Z
17050 16 17085 J2982          TFM   LPR+59,BASIS-45Z
17062 16 13735 000-1          TFM   ZSP1,1,10Z
17074 26 00000 00000          TF    0,0Z
17086 26 17104 17080          TF    LPR+78,LPR+54Z
17098 11 00000 -0001          AM    0,1Z
17110 11 13735 000-1          AM    ZSP1,1,10Z
17122 11 17080 -0005          AM    LPR+54,5Z
17134 11 17085 -0005          AM    LPR+59,5Z
17146 24 13735 13737          C     ZSP1,NZ
17158 47 17074 01200          BNE   LPR+48Z
17170 16 17188 J3036  ANZ     TFM   ANZ+18,MENGEN-72Z
17182 26 00000 00419          TF    0,NULL-7Z
17194 11 17188 -0008          AM    ANZ+18,8Z
17206 14 17188 J3116          CM    ANZ+18,MENGEN+8Z
17218 47 17182 01200          BNE   ANZ+12Z
17230 36 13029 00100          RNTY  MENGEN-79Z
17242 16 17260 J3121          TFM   ANZ+90,BASVER-108Z
17254 26 00000 13241          TF    0,EIVERZ
17266 11 17260 -0012          AM    ANZ+90,12Z
17278 14 17260 J3241          CM    ANZ+90,BASVER+12Z
17290 47 17254 01200          BNE   ANZ+84Z
17302 16 13735 000-1          TFM   ZSP1,1,10Z
17314 16 17397 J3036  AUSG3   TFM   AUSG3+83,MENGEN-72Z
17326 16 17361 J2982          TFM   AUSG3+47,BASIS-45Z
17338 34 00000 00102          RCTY  Z
17350 26 13304 00000          TF    AUS,0Z
17362 38 13300 00100          WNTY  AUS-4Z
17374 34 00000 00108          TBTY  Z
17386 26 13304 00000          TF    AUS,0Z
17398 38 13297 00100          WNTY  AUS-7Z
17410 11 13735 000-1          AM    ZSP1,1,10Z
17422 11 17397 -0008          AM    AUSG3+83,8Z
17434 11 17361 -0005          AM    AUSG3+47,5Z
17446 24 13735 13737          C     ZSP1,NZ
17458 47 17338 01100          BNH   AUSG3+24Z
17470 26 13261 00426          TF    ERGVER,NULLZ
17482 26 13247 00417          TF    ERGVER-14,NULL-9Z
17494 16 17536 J3036          TFM   MULT+6,MENGEN-72Z
17506 16 17541 J3121          TFM   MULT+11,BASVER-108Z
17518 16 13735 000-0          TFM   ZSP1,0,10Z
17530 23 00000 00000  MULT    M     0,0Z
17542 21 13261 00096          A     ERGVER,96Z
17554 11 17536 -0008          AM    MULT+6,8Z
17566 11 17541 -0012          AM    MULT+11,12Z
17578 11 13735 000-1          AM    ZSP1,1,10Z
17590 24 13735 13737          C     ZSP1,NZ
17602 47 17530 01200          BNE   MULTZ
17614 34 00000 00102  AUSG4   RCTY  Z
17626 38 13242 00100          WNTY  ERGVER-19Z
17638 34 00000 00102          RCTY  Z
17650 16 13735 000-0  BERCZ   TFM   ZSP1,0,10Z
17662 16 15441 00-01          TFM   ZSP2,1,9Z
17674 26 13267 14037          TF    MINCZ-10,NEUNZ
17686 33 13277 00000          CF    MINCZZ
17698 16 17745 -2520          TFM   BERCZ+95,TAB2-10369Z
17710 16 17740 -2535          TFM   BERCZ+90,TAB2-10354Z
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17722 16 17812 -2454          TFM  BERCZ+162,TAB2-10435Z
17734 26 00000 00000          TF   0,0Z
17746 26 17776 17740          TF   *+30,BERCZ+90Z
17758 12 17776 -0011          SM   *+18,11Z
17770 16 00000 0-000          TFM  0,0,8Z
17782 16 17817 J3121          TFM  BERCZ+167,BASVER-108Z
17794 26 17848 17740          TF   BERCZ+198,BERCZ+90Z
17806 23 00000 00000          M    0,0Z
17818 44 17842 00099          BNF  *+24,99Z
17830 32 00096 00000          SF   96Z
17842 22 00000 00096          S    0,96Z
17854 11 17812 -0006          AM   BERCZ+162,6Z
17866 11 17817 -0012          AM   BERCZ+167,12Z
17878 11 13735 000-1          AM   ZSP1,1,10Z
17890 24 13735 13737          C    ZSP1,NZ
17902 47 17806 01200          BNE  BERCZ+156Z
17914 26 17932 17848   MINVGL TF   MINVGL+18,BERCZ+198Z
17926 24 00000 13277          C    0,MINCZZ
17938 46 17986 01300          BNL  MINVGL+72Z
17950 26 17973 17932          TF   MINVGL+59,MINVGL+18Z
17962 26 13277 00000          TF   MINCZ,0Z
17974 26 13280 15441          TF   BASNEU,ZSP2Z
17986 11 17740 -0087          AM   BERCZ+90,87Z
17998 11 17745 -0087          AM   BERCZ+95,87Z
18010 13 13737 000-6          MM   N,6,10Z
18022 22 17812 00099          S    BERCZ+162,99Z
18034 11 17812 -0087          AM   BERCZ+162,87Z
18046 11 15441 00-01          AM   ZSP2,1,9Z
18058 24 15441 15319          C    ZSP2,LKBZSPZ
18070 16 13735 000-0          TFM  ZSP1,0,10Z
18082 47 17734 01300          BL   BERCZ+84Z
18094 14 13277 -010-          CM   MINCZ,-100Z
18106 46 19666 01300          BNL  EXITZ
18118 26 13291 14037          TF   KOTETA-3,NEUNZ
18130 16 13735 000-1   DIV1   TFM  ZSP1,1,10Z
18142 16 18201 J3036          TFM  *+59,MENGEN-72Z
18154 16 18213 -2367          TFM  DIV1+83,TAB2-10522Z
18166 13 13280 000Q7          MM   BASNEU,87,10Z
18178 21 18213 00099          A    DIV1+83,99Z
18190 28 00096 00000          LD   96,0Z
18202 24 00417 00000          C    NULL-9,0Z
18214 47 18250 01200          BNE  *+36Z
18226 26 00090 14037          TF   90,NEUNZ
18238 49 18310 00000          B    TETAZ
18250 26 18273 18213          TF   *+23,DIV1+83Z
18262 29 00089 00000          D    89,0Z
18274 14 00085 00-00          CM   85,0,9Z
18286 47 18226 01200          BNE  *-60Z
18298 32 00086 00000          SF   86Z
18310 24 00093 13294   TETA   C    93,KOTETAZ
18322 46 18382 01300          BNL  TETA+72Z
18334 24 00093 00419          C    93,NULL-7Z
18346 47 18382 01100          BNH  *+36Z
18358 26 13294 00093          TF   KOTETA,93Z
18370 26 13296 13735          TF   NRTETA,ZSP1Z
18382 24 13735 13737          C    ZSP1,NZ
18394 46 18454 01200          BE   MGNZ
18406 11 13735 000-1          AM   ZSP1,1,10Z
18418 11 18201 -0008          AM   DIV1+71,8Z
18430 11 18213 -0006          AM   DIV1+83,6Z
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18442 49 18190 00000          B    DIV1+60Z
18454 16 18496 J2977   MGN    TFM  MGN+42,BASIS-50Z
18466 13 13296 000-5          MM   NRTETA,5,10Z
18478 21 18496 00099          A    MGN+42,99Z
18490 26 00000 13280          TF   0,BASNEUZ
18502 26 18532 18496          TF   MGN+78,MGN+42Z
18514 12 18532 -0002          SM   MGN+78,2Z
18526 16 00000 00-00          TFM  0,0,9Z
18538 16 18580 J3028          TFM  MGN+126,MENGEN-80Z
18550 13 13296 000-8          MM   NRTETA,8,10Z
18562 21 18580 00099          A    MGN+126,99Z
18574 26 00000 13294          TF   0,KOTETAZ
18586 16 13735 000-1   MGN2   TFM  ZSP1,1,10Z
18598 16 18724 J3028          TFM  MGN2+138,MENGEN-80Z
18610 13 13737 000-8          MM   N,8,10Z
18622 21 18724 00099          A    MGN2+138,99Z
18634 26 18681 18213          TF   MGN2+95,DIV1+83Z
18646 24 18724 18580          C    MGN2+138,MGN+126Z
18658 46 18730 01200          BE   MGN2+144Z
18670 23 13294 00000          M    KOTETA,0Z
18682 44 18706 00099          BNF  *+24,99Z
18694 32 00096 00000          SF   96Z
18706 32 00089 00000          SF   89Z
18718 22 00000 00096          S    0,96Z
18730 11 13735 000-1          AM   ZSP1,1,10Z
18742 12 18681 -0006          SM   MGN2+95,6Z
18754 12 18724 -0008          SM   MGN2+138,8Z
13766 24 13735 13737          C    ZSP1,NZ
18778 47 18646 01100          BNH  MGN2+60Z
18790 16 18868 J3109   MGN3   TFM  MGN3+78,BASVER-120Z
18802 16 18873 -2433          TFM  MGN3+83,TAB2-10456Z
18814 13 13296 000J2          MM   NRTETA,12,10Z
18826 21 18868 00099          A    MGN3+78,99Z
18838 13 13280 000Q7          MM   BASNEU,87,10Z
18850 21 18873 00099          A    MGN3+83,99Z
18862 26 00000 00000          TF   0,0Z
18874 16 15441 00-01   MGN4   TFM  ZSP2,1,9Z
18886 16 18981 -2361          TFM  *+95,TAB2-10528Z
18898 13 13296 000-6          MM   NRTETA,6,10Z
18910 21 18981 00099          A    *+71,99Z
18922 26 19041 18981         •TF   MGN5+11,*+59Z
18934 11 19041 -0087         •AM   MGN5+11,87Z
18946 13 13280 000Q7          MM   BASNEU,87,10Z
18958 21 18981 00099          A    *+23,99Z
18970 26 13286 00000          TF   DSOR,0Z
18982 24 13286 00417          C    DSOR,NULL-9Z
18994 47 19030 01200          BNE  MGN5Z
19006 26 00092 14037          TF   92,NEUNZ
19018 49 19090 00000         •B    MGN5+60Z
19030 28 00096 00000   MGN5  •LD   96,0Z
19042 29 00091 13286         •D    91,DSORZ
19054 14 00087 00-00          CM   87,0,9Z
19066 47 19006 01200          BNE  MGN5-24Z
19078 32 00088 00000          SF   88Z
19090 26 19108 19041         •TF   *+18,MGN5+11Z
19102 26 00000 00093          TF   0,93Z
19114 11 15441 00-01          AM   ZSP2,1,9Z
19126 11 19041 -0087         •AM   MGN5+11,87Z
19138 24 15441 15319          C    ZSP2,LKBZSPZ
19150 47 18982 01200          BNE  MGN5-48Z
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19162 16 15441 00-01       MGN6    TFM  ZSP2,1,9Z
19174 16 19384 -2454               TFM  MGN6+222,TAB2-10435Z
19186 16 19341 -2367               TFM  MGN6+179,TAB2-10522Z
19198 13 13280 00007               MM   BASNEU,87,10Z
19210 21 19341 00099               A    MGN6+179,99Z
19222 26 19336 19384               TF   MGN6+174,MGN6+222Z
19234 13 13296 000-6               MM   NRTETA,6,10Z
19246 12 00099 000-6               SM   99,6,10Z
19258 21 19336 00099               A    MGN6+174,99Z
19270 24 15441 13280               C    ZSP2,BASNEUZ
19282 46 19486 01200               BE   EXIT-180Z
19294 16 13735 000-1               TFM  ZSP1,1,10Z
19306 24 13735 13296               C    ZSP1,NRTETAZ
19318 46 19390 01200               BE   MGN6+228Z
19330 23 00000 00000               M    0,0Z
19342 32 00091 00000               SF   91Z
19354 44 19378 00099               BNF  *+24,99Z
19366 32 00096 00000               SF   96Z
19378 22 00000 00096               S    0,96Z
19390 11 13735 000-1               AM   ZSP1,1,10Z
19402 11 19384 -0006               AM   MGN6+222,6Z
19414 11 19341 -0006               AM   MGN6+179,6Z
19426 24 13735 13737               C    ZSP1,NZ
19438 47 19306 01100               BNH  MGN6+144Z
19450 13 13737 000-6               MM   N,6,10Z
19462 22 19384 00099               S    MGN6+222,99Z
19474 22 19341 00099               S    MGN6+179,99Z
19486 11 19384 -0087               AM   MGN6+222,87Z
19498 11 19336 -0087               AM   MGN6+174,87Z
19510 11 15441 000-1               AM   ZSP2,1,10Z
19522 24 15441 15319               C    ZSP2,LKBZSPZ
19534 47 19270 01300               BL   MGN6+108Z
19546 16 13735 000-1               TFM  ZSP1,1,10Z
19558 26 19600 19341               TF   *+42,MGN6+179Z
19570 24 13735 13296               C    ZSP1,NRTETAZ
19582 46 19606 01200               BE   *+24Z
19594 26 00000 00417               TF   0,NULL-9Z
19606 11 19600 -0006               AM   *-6,6Z
19618 11 13735 000-1               AM   ZSP1,1,10Z
19630 24 13735 13737               C    ZSP1,NZ
19642 47 19570 01100               BNH  *-72Z
19654 49 17302 00000               B    AUSG3-12Z
19666 39 19681 00100       EXIT    WATY EXIT+15Z
19678 48 0000C 00000               H    Z
19681           5 00000            DAC  5,ENDE@,EXIT+15Z
19690 49 13306 00000               B    STARTZ
15562                      VORKB3  DS   ,VORKB3Z ← ?
13306                              DEND STARTZ
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|LAST