List of full sensitivity spaced seeds for at most 8 mismatches

Valeriy Titarenko and Sofya Titarenko

Each spaced seed s is a periodic seed (b is a periodic block). It consists of n_b repetitions of the block and first n_d symbols of the blocks. Other parameters: w is the weight of the periodic seed, n_m is the maximum number of mismatches allowed to achieve the full sensitivity, L_{min} is the minimum length of a read required for the found seed.

We used the following selection criteria:

- by setting n_m and the length L of a read, we found all seeds of a maximum weight w;
- for a given weight w we found the shortest length L_{min} of reads when we are able to find seeds;
- ullet among all seeds found for n_m , w and L_{min} , we used only seeds of maximum length.

If a seed s is found, then its reverse version \bar{s} (all digits are in the reverse order) can also be used. To form the seeds below lists of seed blocks b were used. Those blocks were found for sizes from 10 to 50 for $n_m = 3, 4, \ldots, 9$ and from 10 to 70 for $n_m = 2$. For each block size only sequences of maximum weight were used. There is a possibility that in a future longer seed blocks can be found and new spaced seeds can be formed for a given weight w (it will be possible to use them for shorter reads, i.e. L_{min} will be smaller).

- 12) $n_m = 8$, w = 22, $L_{min} = 126$, $n_b = 2$, $n_d = 19$, b = 10000001110000001100000001
- 13) $n_m = 8$, w = 22, $L_{min} = 126$, $n_b = 2$, $n_d = 19$, b = 10010010000010010010010000000100000,
- 14) $n_m = 8$, w = 22, $L_{min} = 126$, $n_b = 2$, $n_d = 19$,

b = 10010000010010010010000000100000100,

15) $n_m = 8$, w = 22, $L_{min} = 126$, $n_b = 2$, $n_d = 19$,

b = 10001100000001100010001000000010000,

16) $n_m = 8$, w = 22, $L_{min} = 126$, $n_b = 2$, $n_d = 19$,

b = 11000000011000100010000000100001000

17) $n_m = 8$, w = 22, $L_{min} = 126$, $n_b = 2$, $n_d = 19$,

b = 100001010100001000100000010100000000

18) $n_m = 8$, w = 22, $L_{min} = 126$, $n_b = 2$, $n_d = 19$,

b = 10000000110001000110000000100010000,

19) $n_m = 8$, w = 22, $L_{min} = 126$, $n_b = 2$, $n_d = 19$,

b = 10000010010010010010000000100100000,

20) $n_m = 8$, w = 23, $L_{min} = 127$, $n_b = 2$, $n_d = 20$,

b = 11000000101000000111000000010000000

21) $n_m = 8$, w = 24, $L_{min} = 132$, $n_b = 2$, $n_d = 16$,

b = 10010010010010010000000100100000100000

22) $n_m = 8$, w = 25, $L_{min} = 138$, $n_b = 2$, $n_d = 22$,

b = 10010010010010010010010010000000100000,

23) $n_m = 8$, w = 25, $L_{min} = 138$, $n_b = 2$, $n_d = 22$,

b = 10010010010000010010010000000100000100,

24) $n_m = 8$, w = 25, $L_{min} = 138$, $n_b = 2$, $n_d = 22$,

b = 10000010010010010010010000000100100000,

25) $n_m = 8$, w = 26, $L_{min} = 141$, $n_b = 2$, $n_d = 25$,

b = 100100100100100000100100100000000100000.

26) $n_m = 8$, w = 27, $L_{min} = 146$, $n_b = 3$, $n_d = 3$,

b = 1110000000100000011000000101000000,

- 40) $n_m = 8$, w = 30, $L_{min} = 162$, $n_b = 3$, $n_d = 19$,
 - b = 10000000110001000110000000100010000
- 41) $n_m = 8$, w = 30, $L_{min} = 162$, $n_b = 3$, $n_d = 19$,
 - b = 10000010010010010010000000100100000,
- 42) $n_m = 8$, w = 31, $L_{min} = 163$, $n_b = 3$, $n_d = 20$,
 - b = 11000000101000000111000000010000000
- 43) $n_m = 8$, w = 32, $L_{min} = 168$, $n_b = 3$, $n_d = 13$,
 - b = 10010010010010010010010010000000100000
- 44) $n_m = 8$, w = 32, $L_{min} = 168$, $n_b = 3$, $n_d = 13$,
 - b = 10010010010010010000000100100000100000
- 45) $n_m = 8$, w = 32, $L_{min} = 168$, $n_b = 3$, $n_d = 13$,
 - b = 10010010010010000000100100000100000100
- 46) $n_m = 8$, w = 33, $L_{min} = 171$, $n_b = 3$, $n_d = 16$,
 - b = 10010010010010010000000100100000100000.
- 47) $n_m = 8$, w = 34, $L_{min} = 177$, $n_b = 3$, $n_d = 22$,
 - b = 10010010010010010010010010000000100000
- 48) $n_m = 8$, w = 34, $L_{min} = 177$, $n_b = 3$, $n_d = 22$,
 - b = 10010010010000010010010000000100000100,
- 49) $n_m = 8$, w = 34, $L_{min} = 177$, $n_b = 3$, $n_d = 22$,
 - b = 10000010010010010010010000000100100000,
- 50) $n_m = 8$, w = 35, $L_{min} = 180$, $n_b = 3$, $n_d = 25$,
 - b = 10010010010010000010010010000000100000
- 51) $n_m = 8$, w = 36, $L_{min} = 186$, $n_b = 3$, $n_d = 31$,
- 52) $n_m = 8$, w = 36, $L_{min} = 186$, $n_b = 3$, $n_d = 31$,

53) $n_m = 8$, w = 37, $L_{min} = 190$, $n_b = 4$, $n_d = 11$,

- 54) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 11000000101000000111000000010000000,

- 55) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 1000000101000000111000000010000001

- 56) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 10100001000100001010100000001000000.

- 57) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 10000100010000101010000000100000010

- 58) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 100000011100000010100000001100000000

- 59) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 10010010000010010010010000000100000.

60) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 10010000010010010010000000100000100,

- 61) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 100011000000011000100010000000010000

- 62) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 11000000011000100010000000100001000.

- 63) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 100001010100001000100000010100000000

- 64) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 10000000110001000110000000100010000

- 65) $n_m = 8$, w = 38, $L_{min} = 198$, $n_b = 4$, $n_d = 19$,

b = 10000010010010010010000000100100000

66) $n_m = 8$, w = 39, $L_{min} = 199$, $n_b = 4$, $n_d = 20$,

b = 11000000101000000111000000010000000.

- 67) $n_m = 8$, w = 40, $L_{min} = 204$, $n_b = 4$, $n_d = 10$,

b = 10010010010010010010010010000000100000,

- 68) $n_m = 8$, w = 40, $L_{min} = 204$, $n_b = 4$, $n_d = 10$,

b = 10010010010000010010010000000100000100

- 69) $n_m = 8$, w = 40, $L_{min} = 204$, $n_b = 4$, $n_d = 10$,

b = 10010010010010010000000100100000100000.

- 70) $n_m = 8$, w = 40, $L_{min} = 204$, $n_b = 4$, $n_d = 10$,

b = 10010010010010000000100100000100000100

- 71) $n_m = 8$, w = 40, $L_{min} = 204$, $n_b = 4$, $n_d = 10$,

b = 10010010010000000100100000100000100100

- 72) $n_m = 8$, w = 41, $L_{min} = 207$, $n_b = 4$, $n_d = 13$,

b = 100100100100100000100100100000000100000.

73) $n_m = 8$, w = 41, $L_{min} = 207$, $n_b = 4$, $n_d = 13$,

b = 10010010010010010000000100100000100000,

- 74) $n_m = 8$, w = 41, $L_{min} = 207$, $n_b = 4$, $n_d = 13$,

b = 10010010010010000000100100000100000100

- 75) $n_m = 8$, w = 42, $L_{min} = 210$, $n_b = 4$, $n_d = 16$,

b = 10010010010010010000000100100000100000.

- 76) $n_m = 8$, w = 43, $L_{min} = 216$, $n_b = 4$, $n_d = 22$,

b = 10010010010010000010010010000000100000

- 77) $n_m = 8$, w = 43, $L_{min} = 216$, $n_b = 4$, $n_d = 22$,

b = 10010010010000010010010000000100000100

- 78) $n_m = 8$, w = 43, $L_{min} = 216$, $n_b = 4$, $n_d = 22$,

b = 10000010010010010010010000000100100000

79) $n_m = 8$, w = 44, $L_{min} = 219$, $n_b = 4$, $n_d = 25$,

b = 10010010010010010010010010000000100000

- 80) $n_m = 8$, w = 45, $L_{min} = 225$, $n_b = 4$, $n_d = 31$,

81) $n_m = 8$, w = 45, $L_{min} = 225$, $n_b = 4$, $n_d = 31$,

82) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 11000000101000000111000000010000000.

83) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 1000000101000000111000000010000001

84) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 10100001000100001010100000001000000.

85) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 10000100010000101010000000100000010

86) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 100000011100000010100000001100000000,

87) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 10010010000010010010010000000100000

88) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 10010000010010010010000000100000100,

89) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 10001100000001100010001000000010000

90) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 11000000011000100010000000100001000

- 91) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

- 92) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 10000000110001000110000000100010000,

- 93) $n_m = 8$, w = 46, $L_{min} = 234$, $n_b = 5$, $n_d = 19$,

b = 10000010010010010010000000100100000

- s = 100000100100100100100100000001001000001
- 94) $n_m = 8$, w = 47, $L_{min} = 235$, $n_b = 5$, $n_d = 20$,

b = 11000000101000000111000000010000000

- 95) $n_m = 8$, w = 48, $L_{min} = 240$, $n_b = 5$, $n_d = 7$,

b = 10010010010010010010010010000000100000

- 96) $n_m = 8$, w = 48, $L_{min} = 240$, $n_b = 5$, $n_d = 7$,

b = 10010010010000010010010000000100000100,

- 97) $n_m = 8$, w = 48, $L_{min} = 240$, $n_b = 5$, $n_d = 7$,

b = 10010010000010010010000000100000100100,

- 98) $n_m = 8$, w = 48, $L_{min} = 240$, $n_b = 5$, $n_d = 7$,

b = 10010010000000100000100100100100100000,

- 99) $n_m = 8$, w = 48, $L_{min} = 240$, $n_b = 5$, $n_d = 7$,

b = 10010010010010010000000100100000100000

- 100) $n_m = 8$, w = 48, $L_{min} = 240$, $n_b = 5$, $n_d = 7$,

b = 10010010010010000000100100000100000100

- 101) $n_m = 8$, w = 48, $L_{min} = 240$, $n_b = 5$, $n_d = 7$,
 - b = 10010010010000000100100000100000100100,
- 102) $n_m = 8$, w = 48, $L_{min} = 240$, $n_b = 5$, $n_d = 7$,
- 103) $n_m = 8$, w = 49, $L_{min} = 243$, $n_b = 5$, $n_d = 10$,
 - b = 10010010010010010010010010000000100000
- 104) $n_m = 8$, w = 49, $L_{min} = 243$, $n_b = 5$, $n_d = 10$,
 - b = 10010010010010010010010000000100000100
- 105) $n_m = 8$, w = 49, $L_{min} = 243$, $n_b = 5$, $n_d = 10$,
- 106) $n_m = 8$, w = 49, $L_{min} = 243$, $n_b = 5$, $n_d = 10$,
 - b = 10010010010010000000100100000100000100
- 107) $n_m = 8$, w = 49, $L_{min} = 243$, $n_b = 5$, $n_d = 10$,
 - b = 10010010010000000100100000100000100100
- 108) $n_m = 8$, w = 50, $L_{min} = 246$, $n_b = 5$, $n_d = 13$,
 - b = 10010010010010010010010010000000100000
- 109) $n_m = 8$, w = 50, $L_{min} = 246$, $n_b = 5$, $n_d = 13$,
 - b = 10010010010010010000000100100000100000
- 110) $n_m = 8$, w = 50, $L_{min} = 246$, $n_b = 5$, $n_d = 13$,
 - b = 10010010010010000000100100000100000100,

111) $n_m = 8$, w = 51, $L_{min} = 249$, $n_b = 5$, $n_d = 16$,

b = 10010010010010010000000100100000100000,

- 112) $n_m = 8$, w = 52, $L_{min} = 255$, $n_b = 5$, $n_d = 22$,

b = 10010010010010010010010010000000100000

- 113) $n_m = 8$, w = 52, $L_{min} = 255$, $n_b = 5$, $n_d = 22$,

b = 10010010010000010010010000000100000100

- 114) $n_m = 8$, w = 52, $L_{min} = 255$, $n_b = 5$, $n_d = 22$,

b = 10000010010010010010010000000100100000

- 115) $n_m = 8$, w = 53, $L_{min} = 258$, $n_b = 5$, $n_d = 25$,

b = 10010010010010010010010010000000100000,

- s = 100100100100100100100100100100100000010
- 116) $n_m = 8$, w = 54, $L_{min} = 264$, $n_b = 5$, $n_d = 31$,

- 117) $n_m = 8$, w = 54, $L_{min} = 264$, $n_b = 5$, $n_d = 31$,

- 118) $n_m = 8$, w = 55, $L_{min} = 271$, $n_b = 6$, $n_d = 20$,

b = 11000000101000000111000000010000000

- 119) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,

b = 100100100100100000100100100000000100000,

- 120) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,

b = 1001001001001001001001000000100000100,

- 121) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,

b = 10010010000010010010000000100000100100,

- 122) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
- 123) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
 - b = 10010010000000100000100100100100100000
- 124) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
 - b = 10010000000100000100100100100100000100.
- 125) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
- 126) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
- 127) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
 - b = 10010010010010000000100100000100000100
- 128) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
- 129) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
- 130) $n_m = 8$, w = 56, $L_{min} = 276$, $n_b = 6$, $n_d = 4$,
- 131) $n_m = 8$, w = 57, $L_{min} = 279$, $n_b = 6$, $n_d = 7$,
 - b = 10010010010010010010010010000000100000

132) $n_m = 8$, w = 57, $L_{min} = 279$, $n_b = 6$, $n_d = 7$,

b = 10010010010000010010010000000100000100,

133) $n_m = 8$, w = 57, $L_{min} = 279$, $n_b = 6$, $n_d = 7$,

b = 10010010000010010010000000100000100100.

134) $n_m = 8$, w = 57, $L_{min} = 279$, $n_b = 6$, $n_d = 7$,

b = 10010010000000100000100100100100100000

135) $n_m = 8$, w = 57, $L_{min} = 279$, $n_b = 6$, $n_d = 7$,

b = 10010010010010010000000100100000100000

136) $n_m = 8$, w = 57, $L_{min} = 279$, $n_b = 6$, $n_d = 7$,

b = 10010010010010000000100100000100000100,

137) $n_m = 8$, w = 57, $L_{min} = 279$, $n_b = 6$, $n_d = 7$,

b = 10010010010000000100100000100000100100,

138) $n_m = 8$, w = 57, $L_{min} = 279$, $n_b = 6$, $n_d = 7$,

139) $n_m = 8$, w = 58, $L_{min} = 282$, $n_b = 6$, $n_d = 10$,

b = 10010010010010010010010010000000100000

s = 100100100100100100100100100100100000010001000100100100100100100100100

140) $n_m = 8$, w = 58, $L_{min} = 282$, $n_b = 6$, $n_d = 10$,

b = 10010010010000010010010000000100000100,

141) $n_m = 8$, w = 58, $L_{min} = 282$, $n_b = 6$, $n_d = 10$,

b = 10010010010010010000000100100000100000

142) $n_m = 8$, w = 58, $L_{min} = 282$, $n_b = 6$, $n_d = 10$,

b = 10010010010010000000100100000100000100

- 143) $n_m = 8$, w = 58, $L_{min} = 282$, $n_b = 6$, $n_d = 10$,
 - b = 10010010010000000100100000100000100100,
- 144) $n_m = 8$, w = 59, $L_{min} = 285$, $n_b = 6$, $n_d = 13$,
 - b = 10010010010010010010010010000000100000
 - s = 100100100100100100100100100100100000010001001001001001001001001001001001001001001001001001001000100100100100100100100100100100100
- 145) $n_m = 8$, w = 59, $L_{min} = 285$, $n_b = 6$, $n_d = 13$,
 - b = 10010010010010010000000100100000100000.
- 146) $n_m = 8$, w = 59, $L_{min} = 285$, $n_b = 6$, $n_d = 13$,
 - b = 10010010010010000000100100000100000100
- 147) $n_m = 8$, w = 60, $L_{min} = 288$, $n_b = 6$, $n_d = 16$,
 - b = 10010010010010010000000100100000100000
- 148) $n_m = 8$, w = 61, $L_{min} = 294$, $n_b = 6$, $n_d = 22$,
 - b = 10010010010010000010010010000000100000
 - s = 100100100100100100100100100100100000011001
- 149) $n_m = 8$, w = 61, $L_{min} = 294$, $n_b = 6$, $n_d = 22$,
 - b = 10010010010000010010010000000100000100
- 150) $n_m = 8$, w = 61, $L_{min} = 294$, $n_b = 6$, $n_d = 22$,
 - b = 100000100100100100100000000100100000.
- 151) $n_m = 8$, w = 62, $L_{min} = 297$, $n_b = 6$, $n_d = 25$,
 - b = 10010010010010010010010010000000100000,
- 152) $n_m = 8$, w = 63, $L_{min} = 303$, $n_b = 6$, $n_d = 31$,

153) $n_m = 8$, w = 63, $L_{min} = 303$, $n_b = 6$, $n_d = 31$,

154) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

155) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

b = 10010010010010010010010010000000100000

156) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

b = 10010010010000010010010000000100000100

157) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

b = 10010010000010010010000000100000100100,

158) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

159) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

160) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

b = 10010010000000100000100100100100100000

161) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

b = 10010000000100000100100100100100000100

162) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

b = 10000000100000100100100100100000100100,

163) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,

- 164) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,
 - b = 100000100000100100100100100100000000100
 - s = 100000100000100100100100100100100000001
- 165) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,
 - b = 10000010010010010010010000000100100000
- 166) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,
 - b = 10010010010010010000000100100000100000.
- 167) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,
 - b = 10010010010010000000100100000100000100
- 168) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,
- 169) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,
- 170) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,
- 171) $n_m = 8$, w = 64, $L_{min} = 312$, $n_b = 7$, $n_d = 1$,
- 172) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,
 - b = 10010010010010010010010010000000100000
- 173) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,
 - b = 10010010010000010010010000000100000100,

174) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

b = 10010010000010010010000000100000100100,

175) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

176) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

b = 10010010000000100000100100100100100000

177) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

b = 10010000000100000100100100100100100000100

178) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

179) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

b = 10010010010010010000000100100000100000,

180) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

b = 10010010010010000000100100000100000100,

181) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

182) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

183) $n_m = 8$, w = 65, $L_{min} = 315$, $n_b = 7$, $n_d = 4$,

184) $n_m = 8$, w = 66, $L_{min} = 318$, $n_b = 7$, $n_d = 7$,

b = 10010010010010010010010010000000100000

- 185) $n_m = 8$, w = 66, $L_{min} = 318$, $n_b = 7$, $n_d = 7$,
 - b = 10010010010000010010010000000100000100,
 - s = 100100100100100100100100100100000011001
- 186) $n_m = 8$, w = 66, $L_{min} = 318$, $n_b = 7$, $n_d = 7$,
 - b = 10010010000010010010000000100000100100,
- 187) $n_m = 8$, w = 66, $L_{min} = 318$, $n_b = 7$, $n_d = 7$,
 - b = 10010010000000100000100100100100100000
- 188) $n_m = 8$, w = 66, $L_{min} = 318$, $n_b = 7$, $n_d = 7$,
 - b = 10010010010010010000000100100000100000
- 189) $n_m = 8$, w = 66, $L_{min} = 318$, $n_b = 7$, $n_d = 7$,
 - b = 10010010010010000000100100000100000100
- 190) $n_m = 8$, w = 66, $L_{min} = 318$, $n_b = 7$, $n_d = 7$,
- 191) $n_m = 8$, w = 66, $L_{min} = 318$, $n_b = 7$, $n_d = 7$,
- 192) $n_m = 8$, w = 67, $L_{min} = 321$, $n_b = 7$, $n_d = 10$,
 - b = 10010010010010010010010010000000100000
 - s = 100100100100100100100100100100100000010001000100100100100100
- 193) $n_m = 8$, w = 67, $L_{min} = 321$, $n_b = 7$, $n_d = 10$,
 - b = 10010010010000010010010000000100000100,
 - s = 100100100100100100100100100100000011001
- 194) $n_m = 8$, w = 67, $L_{min} = 321$, $n_b = 7$, $n_d = 10$,
 - b = 10010010010010010000000100100000100000

195) $n_m = 8$, w = 67, $L_{min} = 321$, $n_b = 7$, $n_d = 10$,

b = 10010010010010000000100100000100000100

- 196) $n_m = 8$, w = 67, $L_{min} = 321$, $n_b = 7$, $n_d = 10$,

b = 10010010010000000100100000100000100100

- 197) $n_m = 8$, w = 68, $L_{min} = 324$, $n_b = 7$, $n_d = 13$,

b = 10010010010010010010010010000000100000

- 198) $n_m = 8$, w = 68, $L_{min} = 324$, $n_b = 7$, $n_d = 13$,

b = 10010010010010010000000100100000100000

- 199) $n_m = 8$, w = 68, $L_{min} = 324$, $n_b = 7$, $n_d = 13$,

b = 10010010010010000000100100000100000100

- 200) $n_m = 8$, w = 69, $L_{min} = 327$, $n_b = 7$, $n_d = 16$,

b = 10010010010010010000000100100000100000,

- 201) $n_m = 8$, w = 70, $L_{min} = 333$, $n_b = 7$, $n_d = 22$,

b = 10010010010010000010010010000000100000

- 202) $n_m = 8$, w = 70, $L_{min} = 333$, $n_b = 7$, $n_d = 22$,

b = 10010010010000010010010000000100000100,

- 203) $n_m = 8$, w = 70, $L_{min} = 333$, $n_b = 7$, $n_d = 22$,

b = 10000010010010010010010000000100100000.

- 204) $n_m = 8$, w = 71, $L_{min} = 336$, $n_b = 7$, $n_d = 25$,

b = 100100100100100000100100100000000100000.

205) $n_m = 8$, w = 72, $L_{min} = 342$, $n_b = 7$, $n_d = 31$,

- 206) $n_m = 8$, w = 72, $L_{min} = 342$, $n_b = 7$, $n_d = 31$,

- 207) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

- 208) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 100100100100100000100100100000000100000,

- 209) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 10010010010010010010010000000100000100

- 210) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 10010010000010010010000000100000100100

- 211) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

- 212) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

- 213) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 10010010000000100000100100100100100000

214) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 10010000000100000100100100100100000100

- 215) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

- 216) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

- 217) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 100000100000100100100100100100000000100,

- 218) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 10000010010010010010010000000100100000

- 219) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 10010010010010010000000100100000100000

- 220) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

b = 10010010010010000000100100000100000100,

- 221) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

- 222) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

223) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

- 224) $n_m = 8$, w = 73, $L_{min} = 351$, $n_b = 8$, $n_d = 1$,

- 225) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

b = 10010010010010010010010010000000100000,

- 226) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

b = 10010010010000010010010000000100000100,

- 227) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

b = 10010010000010010010000000100000100100,

- 228) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

- 229) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

b = 10010010000000100000100100100100100000,

- 230) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

b = 10010000000100000100100100100100000100

- 231) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

232) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

b = 10010010010010010000000100100000100000

- 233) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

b = 10010010010010000000100100000100000100

- 234) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

b = 10010010010000000100100000100000100100,

235) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

236) $n_m = 8$, w = 74, $L_{min} = 354$, $n_b = 8$, $n_d = 4$,

237) $n_m = 8$, w = 75, $L_{min} = 357$, $n_b = 8$, $n_d = 7$,

b = 10010010010010000010010010000000100000

238) $n_m = 8$, w = 75, $L_{min} = 357$, $n_b = 8$, $n_d = 7$,

b = 10010010010000010010010000000100000100,

239) $n_m = 8$, w = 75, $L_{min} = 357$, $n_b = 8$, $n_d = 7$,

b = 10010010000010010010000000100000100100,

240) $n_m = 8$, w = 75, $L_{min} = 357$, $n_b = 8$, $n_d = 7$,

b = 10010010000000100000100100100100100000

241) $n_m = 8$, w = 75, $L_{min} = 357$, $n_b = 8$, $n_d = 7$,

b = 10010010010010010000000100100000100000

- 242) $n_m = 8$, w = 75, $L_{min} = 357$, $n_b = 8$, $n_d = 7$,

b = 10010010010010000000100100000100000100

- 243) $n_m = 8$, w = 75, $L_{min} = 357$, $n_b = 8$, $n_d = 7$,

- 244) $n_m = 8$, w = 75, $L_{min} = 357$, $n_b = 8$, $n_d = 7$,

- 245) $n_m = 8$, w = 76, $L_{min} = 360$, $n_b = 8$, $n_d = 10$,

b = 100100100100100000100100100000000100000

- 246) $n_m = 8$, w = 76, $L_{min} = 360$, $n_b = 8$, $n_d = 10$,

b = 10010010010000010010010000000100000100

- 247) $n_m = 8$, w = 76, $L_{min} = 360$, $n_b = 8$, $n_d = 10$,

b = 10010010010010010000000100100000100000,

- 248) $n_m = 8$, w = 76, $L_{min} = 360$, $n_b = 8$, $n_d = 10$,

b = 10010010010010000000100100000100000100

- 249) $n_m = 8$, w = 76, $L_{min} = 360$, $n_b = 8$, $n_d = 10$,

b = 10010010010000000100100000100000100100

250) $n_m = 8$, w = 77, $L_{min} = 363$, $n_b = 8$, $n_d = 13$,

b = 10010010010010010010010010000000100000

- 251) $n_m = 8$, w = 77, $L_{min} = 363$, $n_b = 8$, $n_d = 13$,

- 252) $n_m = 8$, w = 77, $L_{min} = 363$, $n_b = 8$, $n_d = 13$,

b = 10010010010010000000100100000100000100,

- 253) $n_m = 8$, w = 78, $L_{min} = 366$, $n_b = 8$, $n_d = 16$,

b = 10010010010010010000000100100000100000

- 254) $n_m = 8$, w = 79, $L_{min} = 372$, $n_b = 8$, $n_d = 22$,

b = 10010010010010010010010010000000100000

- 255) $n_m = 8$, w = 79, $L_{min} = 372$, $n_b = 8$, $n_d = 22$,

b = 10010010010000010010010000000100000100

- 256) $n_m = 8$, w = 79, $L_{min} = 372$, $n_b = 8$, $n_d = 22$,

b = 10000010010010010010010000000100100000,

- 257) $n_m = 8$, w = 80, $L_{min} = 375$, $n_b = 8$, $n_d = 25$,

b = 10010010010010010010010010000000100000

- 258) $n_m = 8$, w = 81, $L_{min} = 381$, $n_b = 8$, $n_d = 31$,

259) $n_m = 8$, w = 81, $L_{min} = 381$, $n_b = 8$, $n_d = 31$,

- 260) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

261) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10010010010010010010010010000000100000

262) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10010010010000010010010000000100000100,

263) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10010010000010010010000000100000100100,

264) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

265) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

266) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10010010000000100000100100100100100000

267) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10010000000100000100100100100100000100

268) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10000000100000100100100100100000100100

- 269) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

- 270) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 100000100000100100100100100100000000100

- 271) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10000010010010010010010000000100100000

- 272) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10010010010010010000000100100000100000

- 273) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10010010010010000000100100000100000100

- 274) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

b = 10010010010000000100100000100000100100,

- 275) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

- 276) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

277) $n_m = 8$, w = 82, $L_{min} = 390$, $n_b = 9$, $n_d = 1$,

- 278) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

b = 100100100100100000100100100000000100000

- 279) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

b = 10010010010000010010010000000100000100

- 280) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

b = 10010010000010010010000000100000100100,

- 281) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

- 282) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

b = 10010010000000100000100100100100100000

- 283) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

b = 10010000000100000100100100100100000100,

- 284) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

- 285) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

b = 10010010010010010000000100100000100000

286) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

b = 10010010010010000000100100000100000100

- 287) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

288) $n_m = 8$, w = 83, $L_{min} = 393$, $n_h = 9$, $n_d = 4$,

289) $n_m = 8$, w = 83, $L_{min} = 393$, $n_b = 9$, $n_d = 4$,

290) $n_m = 8$, w = 84, $L_{min} = 396$, $n_b = 9$, $n_d = 7$,

b = 10010010010010010010010010000000100000

291) $n_m = 8$, w = 84, $L_{min} = 396$, $n_b = 9$, $n_d = 7$,

b = 10010010010000010010010000000100000100

292) $n_m = 8$, w = 84, $L_{min} = 396$, $n_b = 9$, $n_d = 7$,

b = 10010010000010010010000000100000100100,

293) $n_m = 8$, w = 84, $L_{min} = 396$, $n_b = 9$, $n_d = 7$,

b = 10010010000000100000100100100100100000

294) $n_m = 8$, w = 84, $L_{min} = 396$, $n_b = 9$, $n_d = 7$,

b = 10010010010010010000000100100000100000

295) $n_m = 8$, w = 84, $L_{min} = 396$, $n_b = 9$, $n_d = 7$,

b = 10010010010010000000100100000100000100

- 296) $n_m = 8$, w = 84, $L_{min} = 396$, $n_b = 9$, $n_d = 7$,

297) $n_m = 8$, w = 84, $L_{min} = 396$, $n_h = 9$, $n_d = 7$,

298) $n_m = 8$, w = 85, $L_{min} = 399$, $n_b = 9$, $n_d = 10$,

b = 10010010010010010010010010000000100000

299) $n_m = 8$, w = 85, $L_{min} = 399$, $n_b = 9$, $n_d = 10$,

b = 10010010010000010010010000000100000100

300) $n_m = 8$, w = 85, $L_{min} = 399$, $n_b = 9$, $n_d = 10$,

b = 10010010010010010000000100100000100000

301) $n_m = 8$, w = 85, $L_{min} = 399$, $n_b = 9$, $n_d = 10$,

b = 10010010010010000000100100000100000100,

302) $n_m = 8$, w = 85, $L_{min} = 399$, $n_b = 9$, $n_d = 10$,