«

. .»

.

_____/ . .

_____01.02_____

_____

_____

_____15.02.14_____

_____(_____)

«___» _____2019   ,   ____
_____/ . .

, 2019 .

1.
2.
3.
4.
5.
6.   -

7.   (   )

12.
13.

–

.

–

,

,

.

–

.

,

–

,

. «   »

,   ,

15.02.14

(   ).   –

–

,   .

–   ,   –

. –

,   –

.

:

—

;

—   ;

—

;

—   ,   -
                              ;
—   ,   ,   -
                        ;
—   .

1.

·

15

·

,

—   01.02 «   -

-

»

:

	-
1.1.	- .
1.2.	.
1.3.	.
1.4.	- .

1	, - .
2	, , .
3	.
4	, , , .
5	.
6	- , .

7	, , - .
8	- - .
9	.
10	- .
11	.

:

	- ; ; - ; ;
	- - ; - ; - ; ; ; (CAD/CAM –) - - ; ; - - ; (CAD/CAM –) ; - , ; ;

;

-

;
;

;
-

;

;

;

-
-

, CAD/CAM/CAE ;

;

;

;

, -

-

(CALS-);

, ,

;

- -

;

;

2.

        ,   -

        ,   .   -

        .   -

        . (   ).   -

        .

        .   -

        (,   ) -

        ,

        .

3.

:

1.   ;
2.   -   ;

:

-                     ;
-                 ;
-                     ;
-          -   ;
-                ;
-                              ;
-                    .

-

,   .(   )

:   ,

,   ,   .

(   )   -

,   .   -

.

,   .

    –   .   -

,   .   -

,   -

.

:

1.   .

-

:   ;   -

;   -

.   -

,   -

,   -

,   .

,   ,   -

9

,   ,   -

.

2.   -

.

.   :

,   ,   -

;   ,   -

,   -

.

4,   2-D.   ,

.

3.   .

-

.   -

:

- ●   ;
- ●   ;
- ●   .

-   :

1.   -

.

1.1

,

,   -

.

$P(l)$,   -

(1.1):

$$P(l) = \frac{N_0 - r(l)}{N_0} = 1 - \frac{r(l)}{N_0},$$

N_0 –   ; $r(l)$ –

.   , N_0,

$P(l)$.

10

1.2

,

,

.

$Q(l),$ -

(1.2):

$$Q(l) = 1 - P(l) = \frac{r(l)}{N_0}.$$

1.3

–

. -

,

-

.

$a(\Delta l)$ (1.3):

$$a(\Delta l) = \frac{r(\Delta l)}{N_0 \cdot \Delta l}, \frac{1}{\text{км}}$$

– $r(\Delta l)$ Δl .

1.4

-

,

,   . -

–

-

.

$\lambda(\Delta l)$ (1.4):

$$\lambda(\Delta l) = \frac{r(\Delta l)}{N_{CP} \cdot \Delta l}, \frac{1}{\text{км}}$$

$$N_{CP} = \frac{N(l) + N(l + \Delta l)}{2}.$$

$\lambda(\Delta l)$

,

.

.

1.5

–

.

L_1 -

(1.5):

$$L_1 = \frac{\sum\limits_{i=1}^{N} l_i}{\sum\limits_{i=1}^{N} r_i},$$

l_i –   ; r_i –   .

.

1.6

,   -

.

w   -

(1.6):

$$\omega_{\text{ф}} = \frac{1}{L_1}.$$

(. 1.1.).

1.1.

Δl	0 - 100				
$r(\Delta l)$					
$\sum r(l)$					
$P(l)$					
$Q(l)$					
$a(\Delta l)$					
$\lambda(\Delta l)$					

:

-
-
-

•

.

0   600   .   .,

.   -

N0 = 180   .

r(600000) = 60.   -

100   .   .   -

: 2, 12, 16, 10, 14, 6.

.

.

,

. 1.2.

Δl , .	0 - 100	100 - 200	200 - 300	300 - 400	400 - 500	500 - 600
$r(\Delta l)$	2	12	16	10	14	6
$\sum r(l)$	2	14	30	40	54	60

(1.1)   -

.   ,   0   100   100

200   .   .   :

$$P(0 \div 100) = 1 - \frac{r(l)}{N_0} = 1 - \frac{2}{180} = 0,989,$$

$$P(100 \div 200) = 1 - \frac{r(l)}{N_0} = 1 - \frac{14}{180} = 0,922.$$

,   (1.2)   .

$$Q(0 \div 100) = 1 - P(l) = 1 - 0,989 = 0,011,$$

$$Q(100 \div 200) = 1 - P(l) = 1 - 0,922 = 0,078.$$

(1.3).

$$a(0 \div 100) = \frac{r(\Delta l)}{N_0 \cdot \Delta l} = \frac{2}{180 \cdot 100 \cdot 10^3} = 1,111 \cdot 10^{-7} \frac{1}{\text{км}}$$

$$a(100 \div 200) = \frac{r(\Delta l)}{N_0 \cdot \Delta l} = \frac{12}{180 \cdot 100 \cdot 10^3} = 6,667 \cdot 10^{-7} \frac{1}{\text{км}}$$

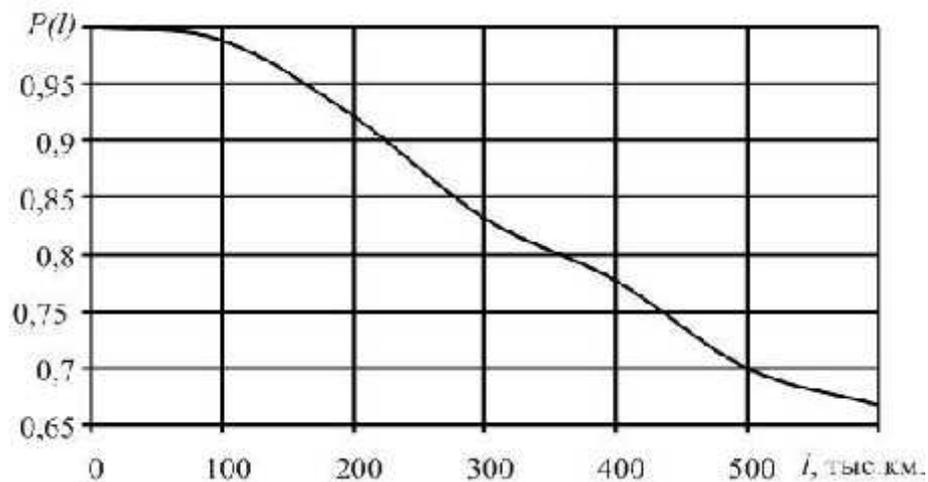(1.4)   -

.

-

0   100   .   .   :

$$N_{CP} = \frac{N(0) + N(0 + 100)}{2} = \frac{180 + (180 - 2)}{2} = 179.$$

0-100   .   .   :

$$\lambda(0 \div 100) = \frac{r(\Delta l)}{N_{CP} \cdot \Delta l} = \frac{2}{179 \cdot 100 \cdot 10^3} = 1{,}117 \cdot 10^{-7} \frac{1}{\text{км}}.$$

-

100-200   .   .

$$N_{CP} = \frac{N(100) + N(100 + 200)}{2} = \frac{178 + (178 - 12)}{2} = 172,$$

$$\lambda(100 \div 200) = \frac{r(\Delta l)}{N_{CP} \cdot \Delta l} = \frac{12}{172 \cdot 100 \cdot 10^3} = 6{,}977 \cdot 10^{-7} \frac{1}{\text{км}}.$$

(1.5   1.6)

.

$$L_1 = \frac{\sum\limits_{i=1}^{N} l_i}{\sum\limits_{i=1}^{N} r_i} = \frac{600000}{60} = 100 \cdot 10^3 \ \text{км}.$$

$$\omega_{\Phi} = \frac{1}{L_1} = \frac{1}{100 \cdot 10^3} = 0{,}01 \cdot 10^{-3} \ \frac{1}{\text{км}}$$

-

(. 1.1).   ,
, . .   0,
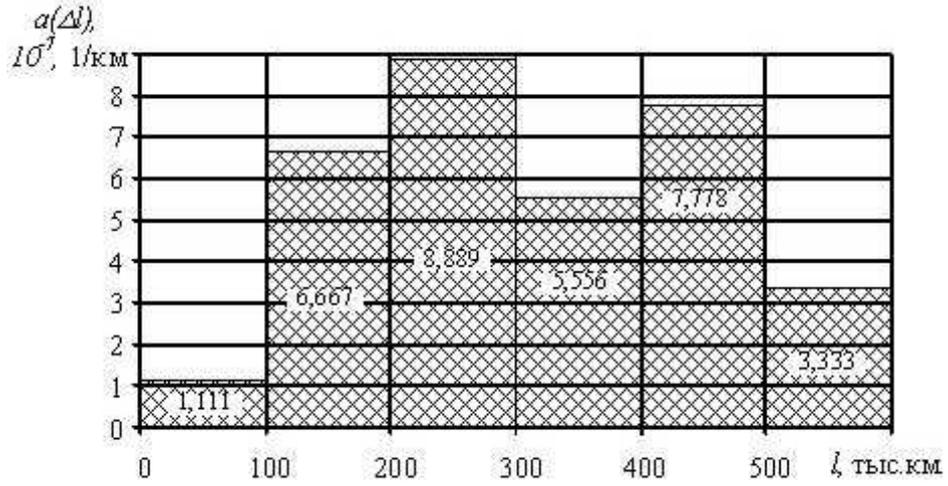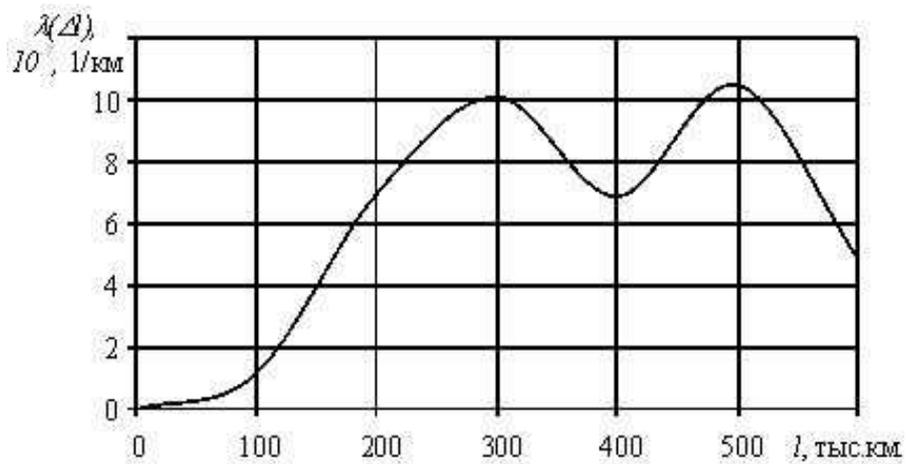   – 1.

. 1.1

(. 1.2).   ,   , . .

              0,

– 0.
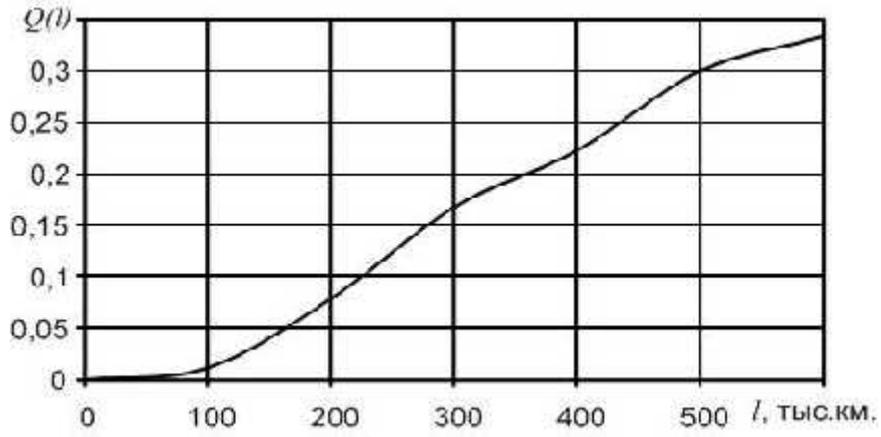
. 1.2

(. 1.3).

. 1.3

     . 1.4
       .

. 1.4

2.

•

,   ,   ,

.   -

                                                                                    -

.   ,   ,

                                                                                    -

.   -

                                                                                    -

-

,   .

                                                                                    -

.

.

                                                                                    -

,   ,   ,   -

:

$$P_{_3}(t) = e^{-\lambda t},$$

: -   ,   ;

-   –   2, 718281;

t -   ,   .

                                                             ,   -

                                                                                    -

16

:

$$f_{Э}(t) = -dP_{Э}(t)/dt = \lambda e^{-\lambda t}$$

.

: 400, 440, 500, 600, 670, 700, 800, 1200, 1600, 1800 . -

.

: , -

500 .

800 900 . .

- , -

:

$$L_1 = \frac{1}{N}\sum_{1}^{10} l_i = \frac{400 + 440 + 500 + 600 + 670 + 700 + 800 + 1200 + 1600 + 1800}{10} = 871 \text{ ч.}$$

:

$$\lambda = \frac{1}{L_1} = \frac{1}{871} = 1{,}15 \cdot 10^{-3}\ \frac{1}{\text{ч}}.$$

$f_{Э}(t)$, -

.

, -

Excel. 2 -

.

. , -

.

-

, , , -

, , -

. -

, .

(, -

), ,

.

17

4.

☐

☐
☐
☐

« ».

5.

(   ).

.

.

.

.

4

(210 297   ).   .

1.   :

☐   – 14   ;

☐   – Times New Roman;

☐   –   ;

–   – 1,25   ;

☐   –   ;

☐   –

2.   :

☐   – 14   ;

☐   – Times New Roman;

☐   –   ;

☐   –   ;

☐   –   .

3.   :   – 2   ,   – 2   ,   – 2,5   ,

– 1,5   .

_

.   ,   -

,

.

-

.

-

.   -

«   ».

-

,   -   ,   . .

.

21

6. -

7.   -

                          (   )   -

                                                                                                                 -

     -                    .

                                                                                                                 ,   ,   -

                                            .

                         10-15   .

                                                                                                              :   ,

          ,   ,   ,   (-

     ),   (   ).

                                                                                                                                                      .

                                            .

                                    (–   –   ).   -

                                                            ,   .

     ,   .

                                    –   ,   -

                                        40.

                                                                                                    ,

               .   ,   ,

                                    .   ,   -

                                        .

8.

	«5»	«4»	«3»	«2»
- -		2	1	-
, ,	2- , ,	2- , , -	, , -
, , -	2 , ,	2 , , -	, , -
, , ,	-, , , ,	, , , ,	-
(,)	5 . . . -	5 . . . -	. 5 . . 5	- - . - . .
	3	2	1	

:

«
. .» (. .)

15.02.14   _____

.

_____   . .
«____»_____20__ .

01.02.

: _____

:
«____»_____2020 .
_____

( )   (   ):
_____

, 20___ .

, . .   :   /
. .   .-   :   , 2009. - 231 .
, . .   :
(   ):   /   . .   ,
. .   ;   .   .   .   .   . -   :   -
, 2009. - 218 .
, . .   :   -
/ . .   . - 3-   .,   .   . -   .:   -
:   , 2008. - 508 .
, . .   :   4 . /   ;
[. .   ]. -   .:   -   .   , 2009. - 4 .   -
:   . -   :   -   -
, 2009. - 243 .
, . .   /   . .   ,
. .   , . .   . -   :   , 2009. - 195 .
:
"   " /   . .   ,   . .   ,
. .   , . .   . -   .:   , 2005. -
59 .

7.0.53-2007   ,   -
.   .   .   -
. -   .:   , 2007. - 5 .

:   .   . -   .:   , 2001. - 39 .

, . .   -
[   ] /   . .   //   . -
2003. - N 4. -   : http://vestnik.fa.ru/4(28)2003/4.html.

.

( )	- - , N_0			,	.
1	120			0-1500 $\Delta l=250$	7; 12; 14; 16; 10; 15.
2	170		-	0-1200 $\Delta l=150$	2; 3; 7; 9; 10; 12; 13; 10.
3	156		-	300-1600 $\Delta l=130$	7; 16; 10; 10; 11; 2; 19; 15; 14; 17.
4	130			600-1200 $\Delta l=100$	7; 16; 18; 2; 5; 10.
5	300			300-1500 $\Delta l=120$	2; 7; 10; 6; 10; 8; 10; 7; 12; 14.
6	178			0-1280 $\Delta l=160$	2; 10; 7; 6; 8; 10; 7; 16.
7	106			0-1500 $\Delta l=250$	1; 9; 14; 16; 10; 15;
8	196		-	0-1200 $\Delta l=150$	1; 3; 6; 9; 10; 11; 13; 10;
9	175		-	300-1600 $\Delta l=130$	3; 7; 10; 10; 11; 19; 15; 14; 17, 10.
10	232			600-1200 $\Delta l=100$	7; 15; 17; 2; 5; 12.
11	225			0-1500 $\Delta l=250$	5; 10; 10; 11; 19;17.
12	405			0-1200 $\Delta l=150$	7; 16; 18; 2; 3; 5; 10; 15.
13	168			600-1200 $\Delta l=100$	2; 10; 7; 6; 9; 10.
14	157		-	0-1500 $\Delta l=250$	2; 7; 12; 8; 10; 6;
15	163		-	0-1600 $\Delta l=160$	2; 3; 6; 9; 10; 12; 13; 11; 8; 15.
16	267			0-1800 $\Delta l=300$	5; 16; 19; 2; 10; 9.
17	312			300-1500 $\Delta l=120$	7; 16; 10; 11; 2; 4; 8; 15; 14; 17.
18	245			100-1200 $\Delta l=110$	2; 10; 5; 6; 8; 10; 7; 10; 12; 15.
19	305			0-600 $\Delta l=100$	8; 10; 9; 11; 2; 19;
20	248		-	200-1200 $\Delta l=150$	3; 16; 13; 10; 11; 2; 19; 15; 14.
21	315		-	100-1200 $\Delta l=110$	5; 16; 10; 10; 11; 2; 19; 15; 14; 17.
22	176			0-1200 $\Delta l=150$	4; 16; 15; 2; 3; 5; 10; 13.
23	172			200-1400 $\Delta l=120$	5; 16; 19; 2; 10; 9; 8; 12; 14; 10.
24	274			600-1200 $\Delta l=100$	5; 12; 8; 6; 10; 9.
25	222			300-1600 $\Delta l=130$	2; 7; 10; 4; 10; 8; 11; 7; 12; 14.
26	344		-	300-1500 $\Delta l=120$	7; 6; 10; 15; 18; 2; 7; 5; 13; 11.
27	185		-	300-1600 $\Delta l=130$	2; 4; 7; 9; 10; 8; 15; 11; 13; 10;
28	202			0-1800 $\Delta l=300$	7; 3; 16; 18; 5; 12.
29	215			0-1200 $\Delta l=150$	5; 18; 20; 2; 4; 7; 11; 13.

(-)	,	, , .
1	440, 510, 770, 800, 950, 1110.	0-1500, Δl=250
2	430, 510, 750, 805, 950, 1110, 1115, 1180.	0-1200, Δl=150
3	400, 513, 760, 800, 950, 1110, 1121, 1190, 1450, 1650.	300-1600, Δl=130
4	410, 510, 775, 810, 950, 1115.	600-1200, Δl=100
5	540, 610, 770, 800, 850, 1110, 1115, 1290, 1450, 1600.	300-1500, Δl=120
6	430, 510, 760, 790, 955, 1130, 1145, 1180.	0-1280, Δl=160
7	390, 410, 750, 800, 950, 1110, 1215, 1280, 1290, 1600.	0-1500, Δl=250
8	442, 510, 773, 806, 950, 1115, 1117, 1180, 1450, 1570.	0-1200, Δl=150
9	490, 610, 670, 800, 950, 1110,1225, 1390, 1490, 1607.	300-1600, Δl=130
10	425, 526, 768, 800, 950, 1110,1115, 1250, 1450, 1600.	600-1200, Δl=100
11	440, 520, 750, 825, 936, 1110,1147, 1190, 1430, 1580.	0-1500, Δl=250
12	430, 560, 765, 808, 950, 1110,1126, 1190, 1430, 1630.	0-1200, Δl=150
13	423, 510, 760, 790, 950, 1110, 1115, 1178, 1450, 1510.	600-1200, Δl=100
14	500, 510, 690, 800, 970, 1150.	0-1500, Δl=250
15	440, 510, 770, 800, 950, 1110, 1115, 1190, 1450, 1600.	0-1600, Δl=160
16	510, 610, 870, 900, 950, 1110.	0-1800, Δl=300
17	540, 565, 772, 800, 940, 1110, 1120, 1190, 1452, 1610.	300-1500, Δl=120
18	400, 540, 750, 800, 850, 1110, 1145, 1390, 1450, 1610.	100-1200, Δl=110
19	510, 625, 770, 834, 950, 1110.	0-600, Δl=100
20	412, 550, 770, 856, 950, 1106, 1115, 1180, 1450, 1590.	200-1200, Δl=100
21	605, 610, 870, 900, 950, 1210, 1315, 1412, 1450, 1600.	100-1200, Δl=110
22	564, 570, 773, 840, 950, 1110, 1117, 1190.	0-1200, Δl=150
23	441, 530, 735, 800, 950, 1110, 1234,1290, 1450, 1593.	200-1400, Δl=120
24	560, 565, 670, 762, 950, 1110, 1115, 1190, 1290, 1520.	600-1200, Δl=100
25	540, 584, 770, 790, 850, 1010, 1115, 1230, 1450, 1600.	300-1600, Δl=130
26	406, 516, 764, 804, 950, 1110, 1115, 1390, 1410, 1500.	300-1500, Δl=120
27	443, 510, 730, 840, 953, 1110, 1135, 1190, 1450, 1650.	300-1600, Δl=130
28	423, 532, 706, 864, 950, 1110, 1215, 1250, 1650, 1910.	0-1800, Δl=300
29	554, 560, 770, 842, 947, 1106, 1121, 1192.	0-1200, Δl=150