52857.8 —
2007

27   2002 .   184-   «   »,
                        —   1.0—2004 «   . -
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                                        » (   );
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      2   260 «   -
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      3   -
                            27   2007 .   503-

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                            :   97/23   29   1997 .
                                                    -          ,   ,   -
        ;   13445-3:2002 «   ,   .   3.   » (EN   13445-3:2002 «Unfired
pressure vessel — Part 3: Design»)

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Vessels and apparatus.
Norms and methods of strength calculation.
Jacketed vessels and apparatus

— 01—04—08

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52857.1 —2007 . .

52857.2—2007 . . -
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52857.6—2007 . . -

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fcj — , ;

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, — , ;

D_3 — , :

— (Dj = , + s,). ;

Oj — (D$_4$ - + s$_2$). :

D_K , :

D_p — , : D_0-D_x, Dp = D,;

d$_0$ — , ;

d,» , ;

, d, :

£, — . :

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F— . :

F, — . ;

f,. f$_2$, l$_3$, f$_t$ — :

U, U— ;

G, — . ;

G$_2$ — . ;

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ho — , :

hop — , ;

l?, — , ;

hi — [h$_2$ - $_3$(1 - cos)], ;

l, — . ‘;

». ,. $_2$ — ;

$_3$. $_4$. *, . . $_8$ — ;

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L — , ;

1$_3$ — , ;

{} — , , ;

{ — 52857.2;

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f$_R$ — *

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. . $_3$ — ;

m — ;

N — ;

[N], — , 2.6.3 (l = 0:1:2;... 6);

, — ;

$_2$ — ;

$_3$ — ;

— . .

, — . .

( ), ,>0;

( ), ,< 0;

j — . ;

[$_2$) — . :

— :

$R,$ — , ;

R_3 — , ;

$_0$ — , :

, — . ;

$_2$ — , :

— $(r_3 - _2 - 0.SSj).$;

s_0 — , ;

s_{0p} — , :

$s,$ — , :

s_{lp} — , ;

s_2 — , ;

s_{2p} — , ;

s_3 — , :

s_4 — , ;

s_p — , ; $s_p = s_2.$ *

$Sp = s_4;$

— ." ;

, — 20 " ;

$_2$ — 20 " ;

$^{\wedge}$ — , ;

,- — , ;

f_p — $l_p s(R_1 + R_2) ski^{\wedge}_>$;

, : «

$f, = 0.5(D, + D_2) sin^{-\wedge}.$

$£, = (l?, + R_2) \sin ^{\wedge};$

$l,$ — , :

$^{\wedge}$ —

$[, = 0.5 (, D_2) \sin],$;

$f,$ — , :

V — ;

$IV,$ — , -*;

W_2 — , 2;

$X,_{2,3}$ — :

— ....

, — .1/" ;

otj — .1/" ;

*? — ;

% — :

— .... ;

— ....*;

S_0 — ...." :

5 — ,...." ;

, — $\{l = 0; 1; 2:... 6),$;

$£$ — ;

$[ ]$ — ;

$£,$ — :

$£$ — , ;

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[— -
. . :
[ ],— . :
[ ],— . :
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[ ),— (; = 0:1; 2;.... 6). ;
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< .< ₄— ;
<P_{di}< - *. 5< ** — :
₀— ;
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₂— ;
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,2— ;
X— ;
— .....°.

4

4.1
4.1.1 , (, 20).
4.1.2 (. 5—8) ,
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( ). ,
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380 * — :
420 — :
525 ® — .
4.1.3 [ ] , -
, (₀, „),
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4.1.4 -
. , -
52857.6.
4.1.5 ,
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15 " . 52857.6.
4.2 U-
4.2.1 :
-

$$\frac{D_2}{D_1} \leq 1,2;$$

•

$$0,001 \leq \frac{s_1}{D_1} \leq 0,5\left(\frac{D_2}{D_1}-1\right);$$

4

•

52.51.2.
«1

4.2.2   - 30%   - 45 *

$$r_0S \quad \frac{-O.Ssg}{1}$$

4.2.3

, $N > 10^*$ —

(.   .1.   ).

4.2.4
% a 1,5s$_2$ —   U-   .

0.5^0,5, > $_0$2Sj —   .

4.2.5

(.   .2,   ).

4.2.6.

<7,50.402.

,   . .

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4.3   ,   *

4.3.1   ,

5 s30 min jl; 4^|j^ J"

4.3.2   no 4.3—4.5

0.85^<1.25.

4.3.3   30   45° (.
.4.   )   .
4.3.4

aS0.7min{s$_Q$; s$_2$}.

4.3.5   4.6

*i

4.4
4.4.1   5   :
-                  ^ . ;:
• h_2 z s$_2$:
•   20* 5 5 90 *.
4.4.2   V-   ,
.

4.4.3   8.6

^2-6 0,5.

5   U-

5.1
5.1.1
   52857.1.   pj   — ,.
,>0.
5.1.2   52857.2.
, < 0 | ,|.

   pj+| ,|.
      , > 0   2⁻ ,.   -
         L   ’   2·   52857.2.
5.1.3   52857.2.
                                                    ,
   :
) t_f 0.30,.   ,   1.
                           ;
) l_2
   (.   .5.   )   ,   -
                         .   ,   ,
            l_2 52857.2;
)   ./,   1,,   52857.2   :

                  =   {**- ,;/ -0.5£>,},   (1)

                                                                                 (2)

                  =   {1₈: , +1.1^0, (s,-)};   (3)

)   (.   .6.   )   -
      ^<8,   ;
)   -

                                                                                 (4)
                              &01
                  < ₀
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                  ,,   .   .
5.2
5.2.1
   52857.2.   5.1.1   5.1.2.   ,   -
                  2,   ,   -
            $d_,$.

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5.2.2 4, .

5.3 (. .1.)

5.3.1 :

) :

$$(5)$$

?

) , :

$$= \overline{\quad} \qquad (6)$$

) :

- = 0 , .1 . ( )

- = $\dfrac{+0.5\$}{'-)^{\wedge} \quad 7 \quad '}$ .1 . ( ) $\qquad (7)$

) :

$$*2 +0,25 \quad *30°$$
$$\ll \,^{\wedge}2 +0.45 \quad =45 \qquad (8)$$

) :

$$X\text{«t25} \quad [\quad ,-\underline{-c)_N /0,(a,-c)} \quad j.....................ftO, L$$
$$1°fe \,(\text{s}2 \quad -\,)[\quad 2[oW^*;-c)^{\wedge}V \; 2Mb- \qquad (9)$$

(, < 0). (9) , = 0;

) :

$$\underline{m\ln([_0),:H_2).}_{(\lt\text{J})2} \qquad (\;)$$

- , .1 . ( ).
< |»2 < »2.
- , .1 , 6 ( ).

$$\%2 \sim \quad 2' \quad / \; S0.5^{\wedge}Oj(sj -) \qquad (11)$$

|» = 1.0, > 0.5 (-)

)

$$(12)$$

5.3.2

$$1 \; ?,\_ \quad *- \;) \quad ' \qquad (13)$$

5.3.3

$$mia\{X,; \quad _2; X, \tag{14}$$

$$X, \text{««(<* *»}_{+1} \tag{15}$$

$$\text{* ^1 + <} \quad \text{I} \tag{16}$$

$$\text{* ^ +[}_{4(1} \quad +)\text{^.} \tag{17}$$

f_v, f_2, f_3 f_4
            f_t:

-

-   $xd^{\wedge}$

$$f, = X. \quad \min(1; x).$$

            f_2:
• $= 30®$

$$f_2 - 1.22(1 \quad 0.51p \quad 2ez).$$

• $« = 45®$

$$f_2 = 0.71 + 0.52p \quad £2.$$

$$z = \backslash_2 \begin{array}{l} 2(£_0/£) \quad £S£_0; \\ 1+(e_0/e) \quad £<e_0; \end{array}$$

$$_0 = 0.38^{\wedge}14 \; 0.54 \; +0.15 \; ^2 \qquad 0=30^*;$$

$$£_0 = 0{,}60^{\wedge}1+0.83 \; +0.37 \; ^2 \qquad =45.$$

            f_3
• $= 30$

$$^W4¥)^4$$

W3-

24e+p^z max Jo

• -45°

$$f_3 = 1 + \dfrac{12\rho^3 \left(\dfrac{0.2}{\varepsilon}\right)^4}{12\varepsilon + \rho^2 \max\left\{0; \left(\dfrac{0.5}{\varepsilon}\right)^3 - 1\right\}}.$$

f_t

• = 30*

$f_4 -- JZmax$ +§ $\dfrac{.4}{3}$

$1 + {}^5[1 + {>}/3\{1^*\text{-}9.5\ )]$

« = 45*

$f_A = \max \left| 1; \min[\text{l}; 0.8 + {}^\wedge]_+ \text{fmin} \right| \left| 1 - \dfrac{41}{"1 + «(1 + \{1 + 5.5\ ))} \right|$

5.3.4

-

.

,

$\dot{0.7}\, Ju_2\, \tilde{\,}\, [s_2 - \ )$, .1 .6.

$- \dfrac{7}{0.5\, JD_2\,(s_2 - \ )}\backslash$, .1 . . .

:

S?D- _____ ; (18)

21]₂

«2 * S* . (19)

(5), — (14).

Sj .

5.4 (. .2.).

5.4.1 :

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• , = 1.0 , .2 .6. .

$/\, \text{l}^2$ (20)

•< , = ^ ^ l | , .2 .

•< ₂ = < ₂ , .2 . . .

• ₂ = 0 , .2 . .; (21)

)

- / -) (22)

- £2 (oloPnO' (23)

-• ʷ 2609» ' (24)

)

(25)

^

$$\frac{*-4_2 \text{ if.}}{} f \quad 4eloWb[\ 2[2(\quad «1\ C)J\ 2^\wedge \quad ,\{\ ,\ c)J\ J^* \tag{26}$$

p, > p₂ > 0,   (26)   p,.   0:
)

$$w\frac{(^-)\quad 2\ 0\ (\$ -).}{2^{"}} \qquad -)^* \tag{27}$$

)

$$A\#j=mm\{Q \quad ;(1+2 \quad)\ \}. \tag{28}$$

5.4.2

$$[p_2]=(H^2_{+}iW_{2+}W_3)^\wedge j^\wedge. \tag{29}$$

5.4.3

"*W^D.(s,-◇^a   - '}   ( )

$$ft_oSft_{0p} + C. \tag{31}$$

(30)
.   -
.   **4.2.4.**
5.4.4
                                                        (.   .2 , .   .   -
)

,   "   (3   2   )
~ 2   min{M);(ol,)

5.5
G, G₂

$$\begin{cases} 4 & . \quad . \\ G. & . \end{cases}$$

$$\frac{ft,}{[ft] \cdot [\quad 2]0|} \qquad \frac{4\,F}{} \qquad S1. \tag{33}$$

[p₂] —   (13)
(29)
5.6

$$0 = \frac{[\sigma]_2\, \gamma_r}{[p_2]} \qquad\qquad ,L<J_e \qquad\qquad \quad IVZ \tag{34}$$

$$\int$$

$d_e = \max\{d_{,}: 0.7\,{}^{\wedge}R, s_3;\ 0.7\,{}^{\wedge}R_2 s_4\];$

[p₂] —   no   (13)   ,
(29) —   .
5.6.1

$$= (\quad , \quad , \text{-}\ _2\ _2). \tag{35}$$

                                                                    ”

.
5.6.2   ,   1.

1 —

			.	,
U- .5.	.1 . .16. .1 . .1 .	— — — —	— — — —	4.0
	2 . .26, .2 . 2 .	— — —	— — — —	3.5 3.5 3.0 5.5
- .6.	.1 . .16. .1 . .1 .	2.0	1.6	2.5 2.5 2.0 2.0
	2 . .26. .2 . 2 ,	2.0 1.6 2.0 2.0	1.6 1.6 1.2 2.0	2.5 2.5 2.0 3.5
,	.4,	2.0	—	—
.8.	. 10.	2.0	—	—
.9.	.11.	2.0		

5.6.3

$$_0 £[\quad N \quad [W]o- \tag{36}$$

[ ]₉

$$[ ]_0 = 2[\quad). \tag{37}$$

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52857.6.

$[\quad ^,$

$$<^* \quad \frac{\Delta \sigma_0}{2}. \tag{38}$$

6   (.   .7,   )

6.1

5.1.1 — 5.1.3.

6.2   (.   .1.   )

,   -
4.2.2

$$_0 £1.8^\wedge \quad (s_2-c). \tag{39}$$

6.3   (.   .2.   )
6.3.1   :

$$' \_ \tag{40}$$

$$+ \}. \tag{41}$$

6.3.2

,   .2 . 6.   ,
.

$$>0, \quad \frac{max \quad \min Mo;2N, \left(\frac{s_1}{h_0}\right)^2}{"HMotfcrM}; \tag{42}$$

•   ,   2 .   .

$$- _0 \cdot \tag{43}$$

6.4   -

(. 6.6.3),   [₂]

(13)   (29).   -

$$-(\%?)^2-£' <^*>$$

2

6.5

$$>]^{*\bullet} \tag{45}$$

$[\ _2]$ —
(13)

(29)

(45)

.

6.6

6.6.1 (. .1, -

)

$$\tag{46}$$

, 5.6.1;

$$\sqrt{\dfrac{D_4}{s_2}} \qquad 0.5tg^2a(l+0.6\text{-}fj)$$

$$2'$$

$$\sqrt{1+\dfrac{0.5tg^2a(l^*Q.6\S j)}{\varepsilon\left(\varepsilon+0,32\left(\dfrac{s_2}{s_1}\right)^2\right)}} \tag{47}$$

£ (6).

$$\left[\varepsilon_p\right]=\dfrac{[\sigma]_2}{E_2}\varphi_{p3}\dfrac{D_3}{D_4}. \tag{48}$$

$$\begin{array}{c} 1.0 \qquad ,\ >0 \\ ,\qquad ,<0 \end{array} \tag{49}$$

>, —
52857.2.

$$|= \qquad \qquad ' \tag{50}$$

.1.— . 1;

$$^\wedge \qquad ^\wedge \dfrac{\ \ \_)}{^{2s<}\ \ ^*ju(Zr,CtQ<l)^4}\left[1-\dfrac{\varepsilon}{\varepsilon_1}\left(1-\dfrac{1}{2}\left(\dfrac{s_2}{s_1}\right)^2\right)\right]. \tag{51}$$

$$,=\left(\dfrac{V?^4+0.41 \qquad 30'}{^\wedge\ \ +6.0 \qquad 45}\right) \tag{52}$$

,   .1 ,   .

.   :

$_2$ +   *   (53)

$$K_2 \text{«i+|2.,3i} \quad \frac{2-\dfrac{0,1}{\varepsilon}\left[1-\left(\dfrac{s_2}{s_1}\right)^2\right]}{\sqrt[4]{1+(2\varepsilon \text{ctg}\alpha)^4}}$$ (54)

                    2S, S*

                                          (55).   —   1 .   .

,—   (56)

                    ,£( ], N£(/),.   (55)

                    $_2$£ [ok N£ [W)$_2$.   (56)

                    [ ],   [0)   [/],   [/];

2.6.3.   1

,   2   .

6.6.2   (.   .2.   -

)

$$\varepsilon_\rho = \frac{|\varepsilon_T|}{1+\dfrac{D_4 s_2}{D_3 s_1}+\dfrac{D_4}{L}\left(\dfrac{3b_0}{3b_0-\sqrt{D_3 s_1}}\right)\left(\dfrac{\theta_0 s_2}{s_1^2+0,5s_2^2}\right)}.$$ (57)

—   .5.6.3.

                    £[ ]=1.5^$_{<4}$.   (58)

                    4>d4 = $_2$-   £ >0; |
                                                            .   {59)
                    $_\varepsilon$,4* 1-   ,<0 |

< ,—   52857.2.

                                    :

>2—   2.

2—

.2.			
. 2 .	,2	.	* 2
. 2 .	· »-	fi 6	
. .2 ,		& 6	* 2
. .2 .	(-)² eV-TSi-	f£ 12	0.5

$$\Delta\sigma_1 = \varepsilon_p E_1 \beta_{x1} \frac{2e_0 s_2}{W_1 \left[2+\left(\frac{s_2}{s_1}\right)^2\right]} \frac{D_4}{D_3} + \frac{p_2 D_1}{(s_1-c)}.$$ (60)

$$\Delta\sigma_2 = \varepsilon_p E_2 \beta_{x2} \frac{e_0 s_2}{W_2 \left[1+2\left(\frac{s_1}{s_2}\right)^2\right]} \frac{3h_0+\sqrt{D_4 s_2}}{3h_0+\sqrt{D_3 s_1}} + \frac{p_2 D_2}{2(s_2-c)} \gamma_k.$$ (61)

(55)   (56).   *

( ),   (^   [/],   [W]_2

5.6.3.   1   ,   2

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6.6.3   6.6.1   6.6.2.

,   .

,   Lc,

.   6.4.

6.6.4   ,   *

52857.6.

7   ,   ,

(.   .8,   )

7.1

7.1.1   52857.2

,   , > 0.

7.1.2   , < 0.   52857.2

| ,|.

7.1.3   ,   ,   *

2   7.4.3.   .

, < 0,   (62)   7.3.1.

$$\frac{s_1-c}{D_1} \ge \sqrt[3]{4,5\frac{p_1}{E_1}\left(\frac{\delta_T}{360'}\right)^2}.$$ (62)

7.2

7.2.1   52857.2   *

,   , > 0. $|p_1|$, < 0.

7.2.2   ,   ,

7.3.   .

s, s_3 *

s_2 s_4.

7.3

7.3.1

•   :

$$[p_2] = [\sigma]_1 \frac{(s_1-c)^2}{t_p t_T} f_s \left[1-\left(\frac{p_1 D_p}{2[\sigma]_1(s_1-c)}\right)^2\right],$$ (63)

•   :

(64)

f₅ fₑ d_0ft_0
,   (66).

$$t_0 = \sqrt{t_\rho\, t_\tau}\,.$$ {65}

10   fₛ   f₆   :

'(s^]| ^   h   .

$$\#_{5\sim}\quad 1+\ \frac{t8+2.3??'l}{5>}$$

, *

(66)

$$\frac{13+?4(1.1.3\ )^{\wedge}}{2\,{}^{*}0}$$

$^{ln}d_{t0}$

7.3.2
                    :

/,-($,~) $\dfrac{[\sigma]_1}{\rho_2}f_5$ 1. ^{2} (67)
                    2((^*)

$f_2=(S_a-C)\quad \dfrac{\overline{[\sigma]_2}}{\rho_2}f_6$:   (68)

$f_0 a min\{f,;f_2\}.$ (69)

d_0t f_b I_6.
d_0.   t, ^   .   ^   ,   (69)   (65)
4.3.2.
                    :

$$5''''0|\quad \wedge\quad).$$ (70)

$S,{}^{*}s_{\eta p}+c.$ (71)

(72)

$Sj\, 2Sj_{p+}c.$ (73)

%

?   .

7.3.3   ,   -

                                                                            6.2   -

—   6.3.

    :

$$*_t^{\wedge} \min(l; 0.5_+^{\wedge}), \tag{74}$$

$$ts^{\wedge} \min[l: 0.5 + {}^{\wedge}kj, \tag{75}$$

f_6   **(66).**

7.4   **(.   .4.   )**

$$0{,}7x(d_0 - s_2)\min j(o)_|;(ol_2|' \tag{76}$$

$s_2 = a\,a\,s^*, \quad . \tag{77}$

$$\eta = 1 - \frac{\pi}{4}\left(\frac{d_0}{t_0}\right)^2. \tag{78}$$

to   **(65).**

7.5   **(.   .4.   )**

$$\$\; \frac{\rule{4cm}{0.4pt}}{*\,\text{«}(^{tf}O - \quad {}^{\wedge} \quad\quad {}^{\wedge}\ ;:\ )'} \tag{79}$$

        (78).

s_0 **.** **(80)**

            :

$* 1.41$. **(81)**

        (80)   (81)

        4.3.4.

7.6

7.6.1   **:**

)

(82)

)

$$\bullet\; V\text{»}\; (<^* \quad ?^{\wedge} \\ * \sim {}_R tf_o 0{,}7 \;^{TM}(\quad _3 + \quad _4 \quad _4 J^* \tag{83}$$

•   **:**

(84)

(85)

•   :

          -             (86)

$$4?$$

                   (87)

•   :

$$x = \frac{d_0}{l_0}\sqrt{\frac{x}{4}}; \quad y = 1.1\left(\frac{s_p}{s_0}\right)^3 \sqrt{\frac{s_0}{d_0}}.$$

$$_6 = 9 \frac{1-x^2 i - y(0.7i - t3x^2)}{*(4)-4| \quad -3}$$

7.6.2

               $_4 =$ (88)

$$<5 = 4.2 - \frac{1-x^2 + y(0.7 + t3x^2)}{:^4 + y(0.7 + 3.3x^4) - 4x^2(y + (t3y-1)\ln x)^T}$$

$$; = 1 + \left(\frac{V}{1.180^*} \cdot \frac{\sin 2\psi}{x}\right) - \left(\frac{D_4 s_2}{D_3 s_1}\right)^2 \frac{2\left(\frac{\sin\psi}{\pi}\right)^2}{\frac{V_-}{180'}}$$

           , = ,   ,

                                                                 (89)
                 .

7.6.3   :

                         $_3$ [ ], N [l_3.   (90)

                     $<_4$ [61* $N£(W)_4$.   (91)

                 [ ]$_3$ (el*   [l_3 [l^*

          5.6.3.   **3**   ,   **4**   .

7.7   ,   **7.**   ,
              .

8

8.1
8.1.1   52857.2
                  ,.   , >0.
8.1.2   , < 0,   52857.2   -

              1 ,|.

8.1.3   (.9,   )
,
52857.2.   ,   :

) t_t 0.30,. $_2$£ $_3$ + 1,
,   ;

) f_2 52857.2   ,
(.   .9 .   )   -
,   ;

)   £>./,   52857.2   :

$$=\max k - bj; \ t_2 - 0.5 \, 0^*; \ b_2\}. \tag{92}$$

$$/, = -- \, £ -- 7 , \tag{93}$$

$/_2$ $2(s_2 -c)+P_2 +1.1 \ ^\wedge D_i (s, -c); \ t_t \sim \ +1.1 \ Jo,(s,-c); \ 2(s_2 \sim c)+1,1$ (94)

r)   P 52857.2   ./   ,   :

$$= \ =^\wedge+0{,}65 \ _2; \tag{95}$$

$$/ =/ \ | (s2-c)0.3^\wedge-; \tag{96}$$

$$r_3(s_2-) \ ^\wedge- \ \ \ ^\wedge \ . $$
,-   ,>0   (97)

8.1.4 $_2$,
b_2 8.3.

8.2
8.2.1   52857.2   -
,-   ,>0.   ,-   ,<0.
8.2.2   pj   ,
b_2 8.3.2.
8.3
8.3.1   :

$$\frac{4Mi(s_i-cf}{+4r_3(s,-c)\cos y} \left(1+ \frac{6f}{20,(3,-)} \right) \tag{98}$$

,< 0.   :

$$\frac{-\&-1U}{[} \left| \frac{\circ}{|\_4|e|,(s, \sim c)} \ \frac{o,(s, c)+e|}{O,(s,-c)+0.5b\S} \right| \tag{99}$$

$_2$> ,>0.   :

$$' U«M*i- / \tag{100}$$

8.3.2

$$\sim \$[\text{“}1 \quad *\text{-}*)J \tag{101}$$

8.4
8.4.1

$$V$$

52857.3. , -
V

$$V = \frac{1}{0.9 + Je(s_2^3 - c)} \tag{102}$$

:

- $V-$ (. .9 . .):

$$\% \ ^{ss} 4> - \tag{( )}$$

- (. .96.):

$$(p_b 5 = mtnjo.4{:}0.7^s^J{:} \tag{104}$$

$$= 0.4. \tag{105}$$

, 4 :

$$>_3 \quad \min\{v; \ \} {:} \tag{106}$$

$$_4 \quad \{ \ ; \ \}. \tag{107}$$

8.4.2

$$[\ '\ ] = \frac{\ }{\ } < \ _3{}^{-} \tag{108}$$

8.4.3 :

$$2[\ \frac{-2}{]_2 \ »_4} + \ 2' \tag{109}$$

$$s_2 \ a \ s_{2p} + \ . \tag{110}$$

$$2 \ 0.6 s_{2p}. \tag{111}$$

8.5 (. .96. -
).
8.4. $V, <pj. <_4$ -
:

$$V = 1 - \frac{b_2}{l_\mathfrak{s}} \tag{112}$$

$\bullet$ *. (113)

$=$ * - (114)

8.6

8.6.1

$+$)+£ 9] - (115)

=' 1[¹ ¹-1 ⁸]' (116)

$_{10}$ - 1 V- .11 , . . I (117)

$_{,0}$=3+3.5^ .116, .[

$_{,,}$ = 1 V- .11 . . .i (118)

K_n«^j .116. A.]

8.6.2

$$_6 = \frac{|^{4+£} 1 \, {}^*1}{1{}^*3\% \, J{}^*L \,{}^`}_{\Gamma^{*\text{«j}}}$$ (119)

8.6.3 :

$_5$ ( )$_5$ **N** (AOs. (120)

$_6$**5** . (121)

[

5.6.3. 5 ,

6 — .

( )

,
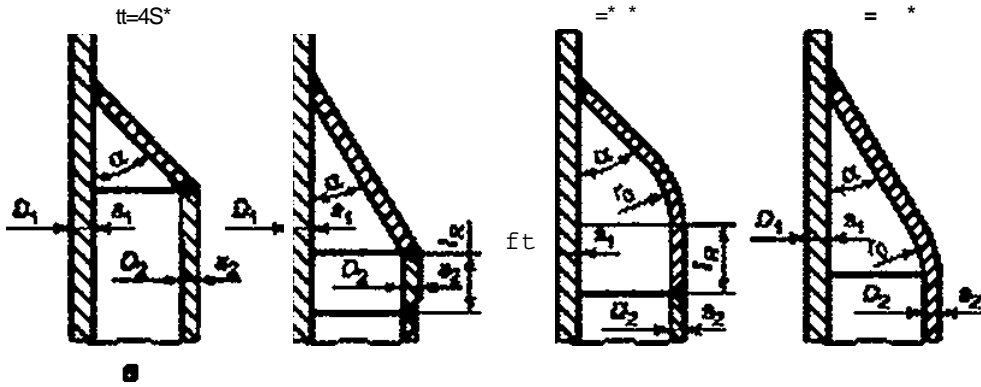
.1 —
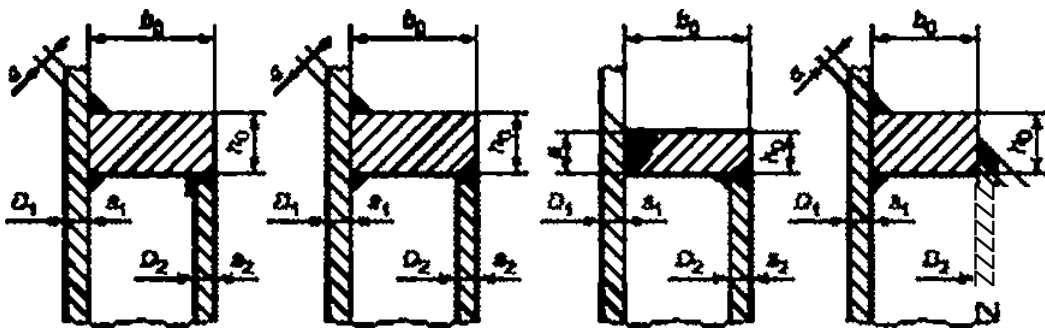
.2 —
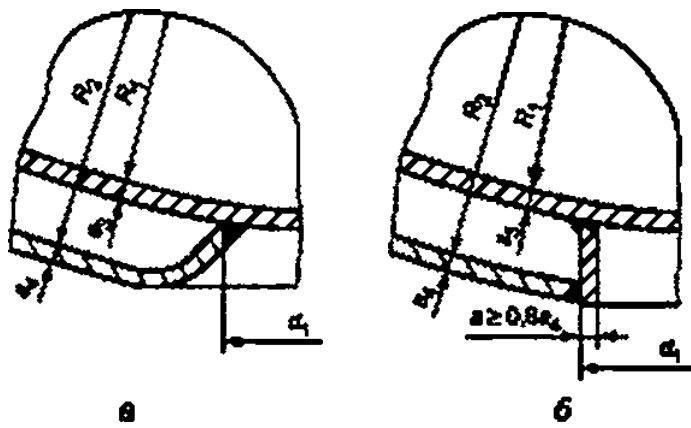
б — кольцевое

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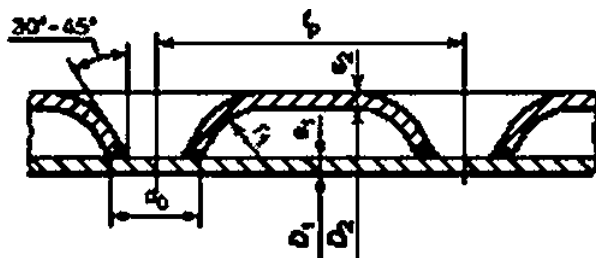
Рисунок А.4 — Сопряжение рубашки с корпусом сосуда отбортовкой

.6 —

а   , 6 —

.7 —
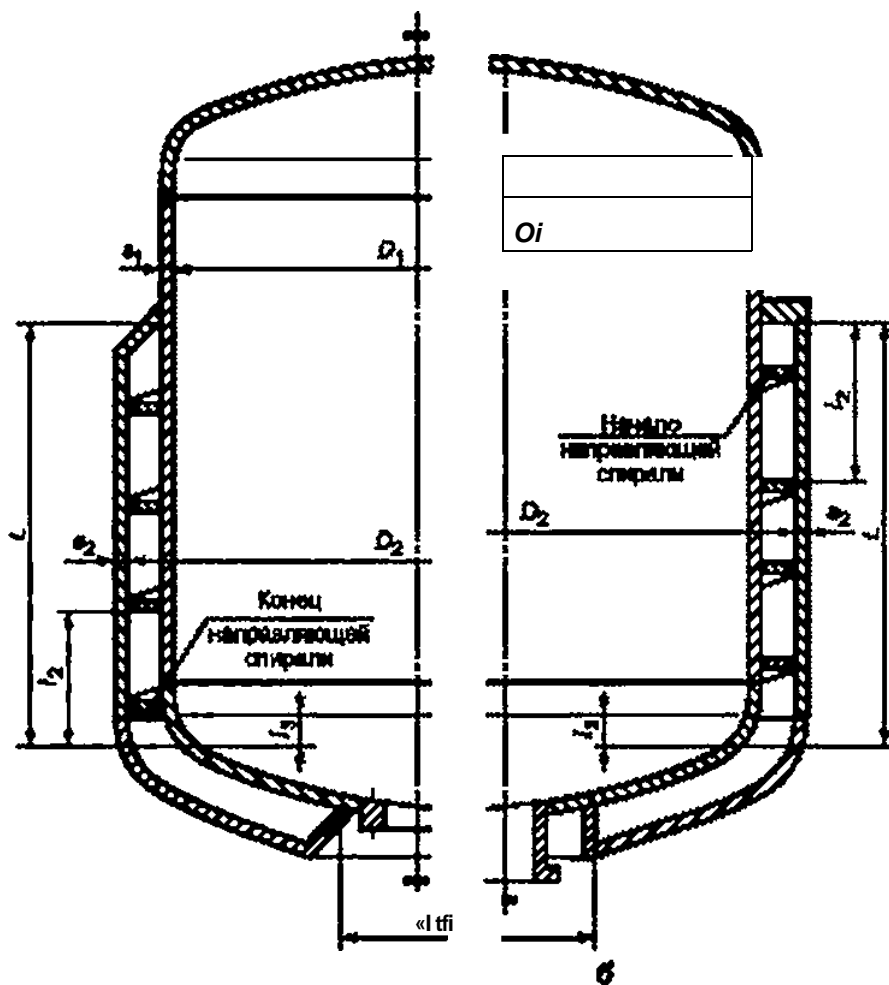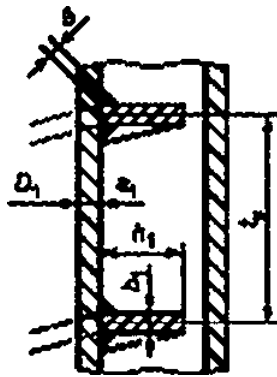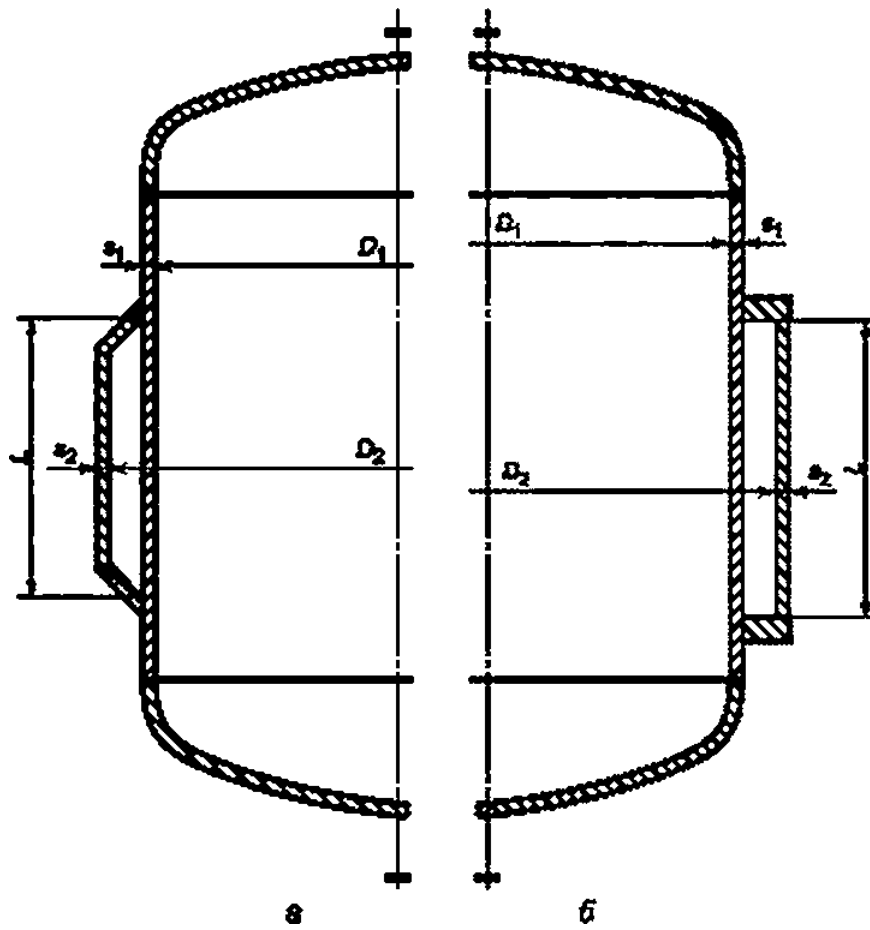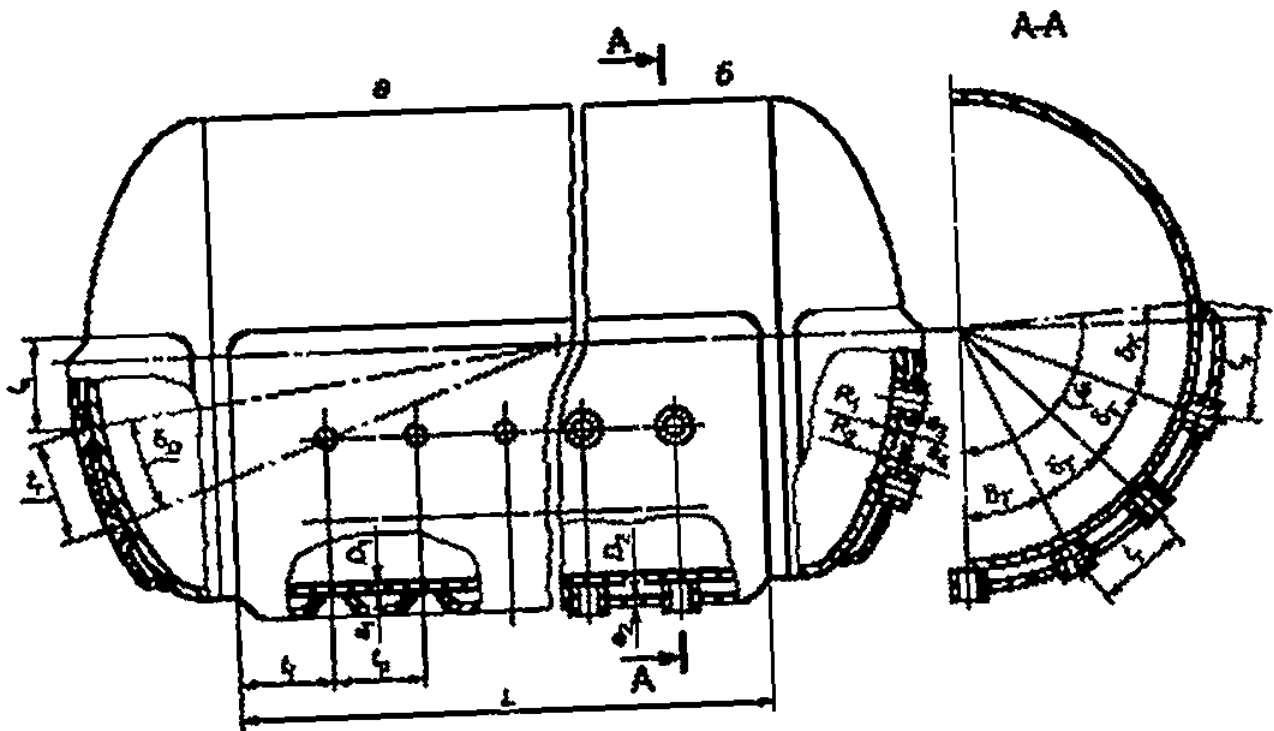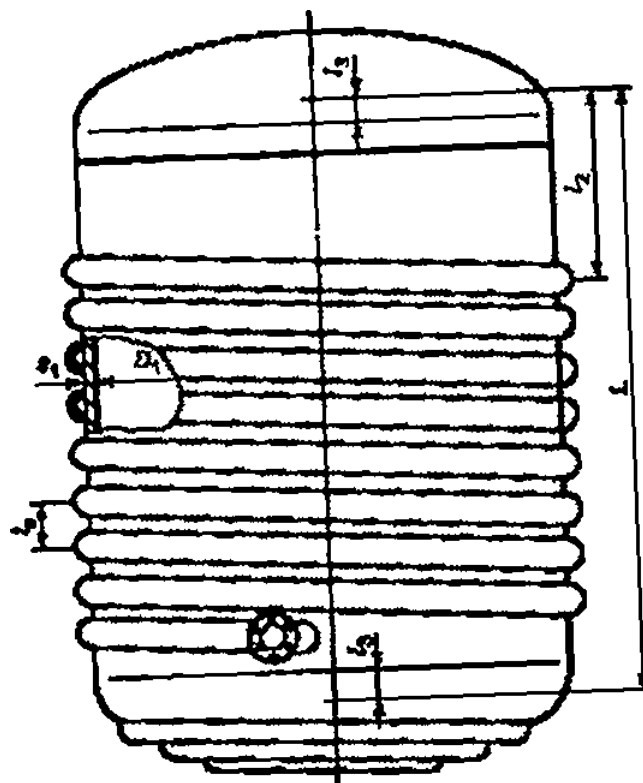
Рисунок А.9а — Сосуды со змеевиковыми каналами
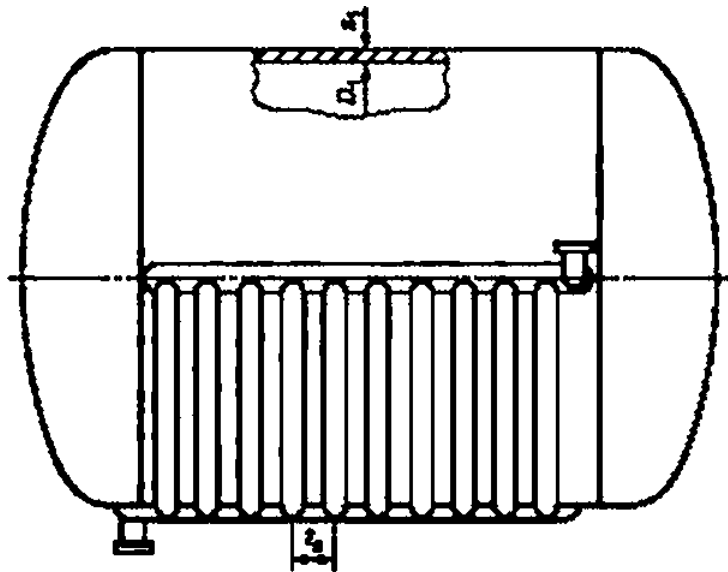
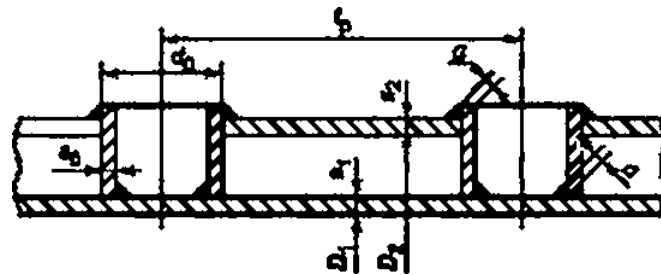Рисунок А.9б — Сосуды с регистровыми каналами

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