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Layout

Input values:	*1.234*	or	1.234
Calculated values:	***1.234***	or	**1.234**
Critical values:	*1.234*	or	1.234
Estimated values:	*1.234*	or	1.234

7 EQU
Form for equations

Tables

with comment every three lines

ASME example E4.18.10 :2013 .
Arrangement in 3 lines. Line 3 calculates the difference between line 1:LV
and 2:ASME in % with the maximum in the last column. Maximum LV-ASME<0.3%.

:	psi÷MPa:							
1	145							
2	145							
3	0	0	0	0	0	0	0	0

Stat. tubesheet:

-----	Sig 1 -:	-Sig 2 -:	-Sig 3 -:	-Tau 1 -:	-Tau 2 -:	-Tau 3 -:	----:MaxDiff%	
4	21873	18749	3125	0	0	0		
5	21900	18800	3130					
6	0.1213	0.2731	0.1668				0	0.1668

Stat. tubesheet:

-----	Sigto1-:	Sigto2-:	-Sigto3-:	-Stb 1 -:	-Stb 2 -:	-Stb 3 -:	--------:MaxDiff%	
7	-4646	3832	-813.6	10544	10544	10544		
8	-4650	3833	-814	10550	10550	10550		
9	0.09559	0.02758	0.04756	0.05829	0.05829	0.05829	0	0.09559

Float. tubesheet:

-----	Sig 1 -:	-Sig 2 -:	-Sig 3 -	:----------:MaxDiff%				
10	11421	9789	1632	0				
11	11400	9780	1630					
12	0.1846	0.09672	0.09681	0	0	0	0	0.1846

Line 13: Max diff% 2009, Line 14: actual calculation

13	0.2731	0.09559	0.1846					
14		0.09559	0.1846					
15		0	0	0	0	0	0	

Links

1 7 EQU: psi÷MPa=145
2 7 EQU: 145
3
4 1 UHXc: #138(1)*psi÷MPa: #138(2)*psi÷MPa: #138(3)*psi÷MPa: |#140(1)|*psi÷MPa: |#140(2)|*psi÷MPa: |#140(3)|*psi÷MPa
5 7 EQU: 21900: 18800: 3130: 3120: 2670: 445
6
7 1 UHXc: #263(1)*psi÷MPa: #263(2)*psi÷MPa: #263(3)*psi÷MPa: #269(1)*psi÷MPa: #269(2)*psi÷MPa : #269(3)*psi÷MPa
8 7 EQU: -4650: 3833: -814: 10550:10550 : 10550
9
10 1 UHXc: #138(4)*psi÷MPa: #138(5)*psi÷MPa: #138(6)*psi÷MPa:
11 7 EQU: 11400: 9780: 1630
12
13 '7 EQU: #187: #211: #235 (Result 2009)
14 7 EQU: #187: #211: #235
15

Stat 1
ASME UHX-14 Floating Tubesheets ASME BPVC Edition 2017

Floating tubesheet according to ASME-UHX-14

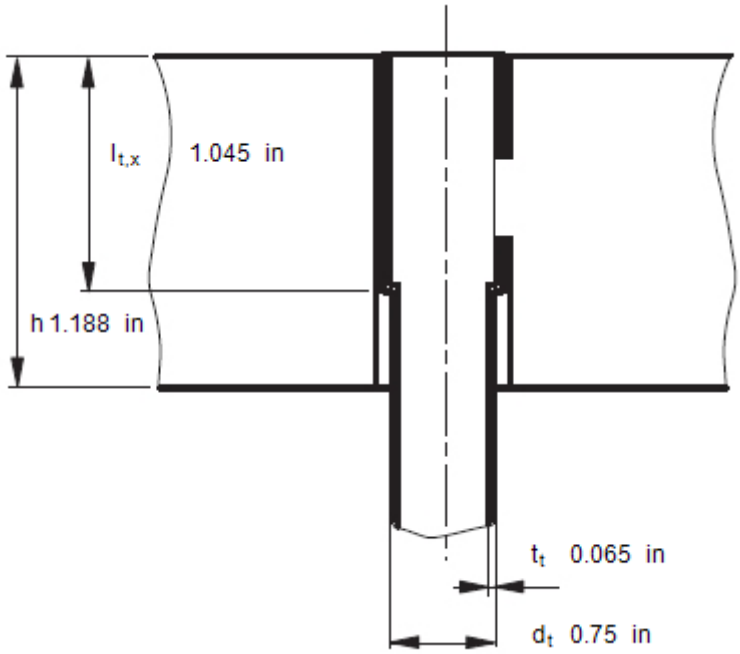
Type of heat exchanger (a,b,c)	WArt	*c*		a,b,c
Heat Exchanger With an Internally Sealed Floating Head (D)				
Configuration of the tubesheet (a-f,A-D)	Type	d		a-f,A-D
Stationary tubesheet gasketed with shell and channel				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure	P_s		*150*	psi
Tube side internal operation pressure	P_t		*175*	psi
Shell side internal test pressure	P_{sp}			psi
Tube side internal test pressure	P_{tp}			psi
Load case (1=operation, 2+3=test at 20°C, 4=other)			*1*	
load case: operation				
Calculation case acc. UHX-14.4(a): (1), (2) ... (7)			1	(1-7)
Tube side pressure only (Ps=0) without thermal expansion				

Tubesheet material									
Shell material (Type abc)									
Tube material									
Channel material(Type aefA)									
Operation	**Tubesheet**		**Shell**		**Tubes**		**Channel**		
Temperature		°F		°F		°F			°F
Thickness	*1.188*	in		in	*0.065*	in			in
Outsidediameter	39.88	in		in	*0.75*	in			in
Poiss.-rat.	*0.31*		0.3		*0.31*		0.3		
Allow. c1	*0*	in		in	*0*	in			in
Corr.all.c2	*0*	in		in	*0*	in			in
Figure									
Strength for the selected load case temperature									
Strength		psi		psi		psi			psi
Safety									
E-module	*2.65e+7*	psi		psi	*2.65e+7*	psi			psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F			1E-6/°F
Yield str.	17500	psi		psi	*17500*	psi			psi
Limit temperature		°F		°F		°F			°F
All.stress	*15800*	psi	**0**	psi	*15800*	psi		**0**	psi
Pr.+sec.st	*47400*	psi	**0**	psi	*47400*	psi			psi
Properties for testing at 20°C									
Strength	0	psi	0	psi	0	psi		0	psi
Safety									
Yield str.		psi		psi		psi			psi
Tensile str.		psi		psi		psi			psi

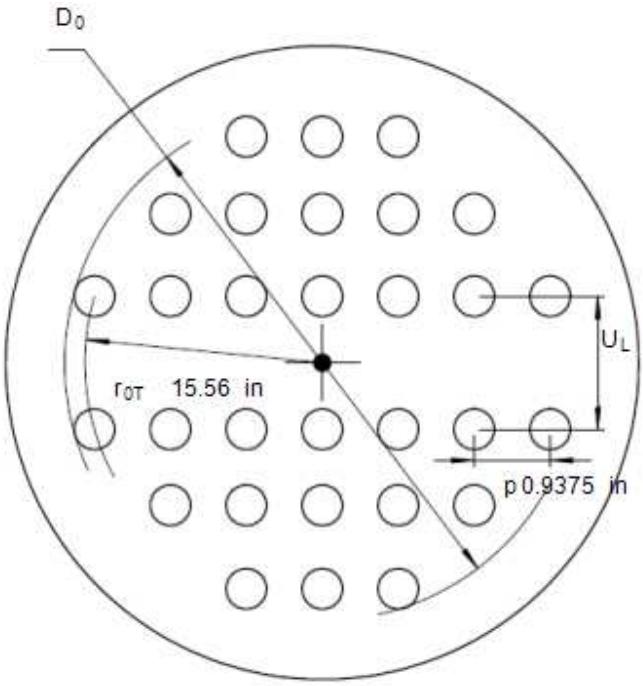
Additional specifications for the geometry and loading

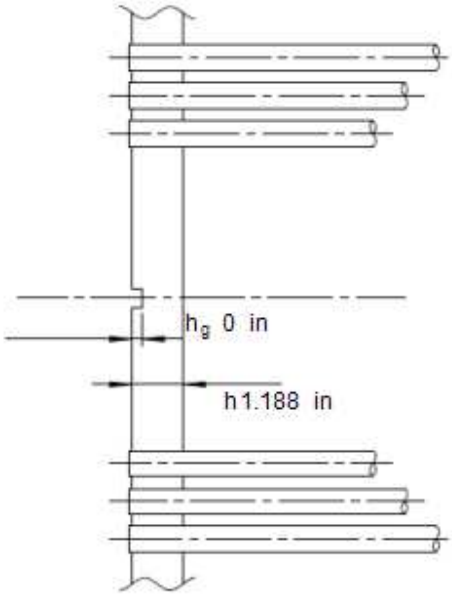
Tubesheet

Tube-tubesheet joint (1=expanded, 2=welded)		*1*	(1, 2)
Tube pattern (1=Triangle, 2=Square)		*1*	(1, 2)
Number of tubes	N_t	*1066*	



Expanded length of tube in tubesheet		$l_{t,x}$	***1.045***	in
Expanded length ratio $l_{t,x}/h$		ρ	0.88	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*15.56*	in
Perimeter of the outermost tubes	UHX-12.2	C_p		in
Total area enclosed by C_p	UHX-12.2	A_p		in²





Tube pitch (center distance)	p	*0.9375*	in
Total untubed area UL1·LL1+UL2·LL2.. UHX-11.2	A_L	0	in²
Depth of tube side pass partition groove	h_g	0	in
Expanded length ratio ltx/h	ρ	0.88	
Tube length between inner tubesheet faces	L	*153.5*	in
Unsupported tube span for buckling	l		in
Type of tube support (0.6=tubesheet-tubesheet, 0.8=tubesheet - support plate, 1=plate-plate)	k		
Equivalent free buckling length k · l	l_t	*20.75*	in

Flange

Bolt number	n		-
Bolt root diameter	d_B		in
Total bolt area	A_b	0	in²
Bolt material			
Strength operation	K_s		psi
Strength test	K_{sp}		psi
Safety operation	S_s		-
Safety test	S_{sp}		-
Stress increase factor (1.5 acc. App.S)	F_s	1.5	-

Gasket		**Shell Type d,e,f**		**Channel Type B,b,c,d**	
Contact outside diameter	G_a		in		in
Contact inside diameter	G_i		in		in
Theoretical seating width	b_0		in		in
Gasket factor (Table 2-5.1)	m				
Gasket seating pressure	Y		psi	0	psi
Diameter of gasket force	G	39.44	in	39.44	in
Poisson's ratio	v	0.3		0.3	

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W		lbf		lbf
Gasket operating force	W		lbf	290720	lbf
Total required bolt area	A_m		in²		in²
Flange thickness	h_r		in		in

Maximum bolt force for all calculation casese	W_{max}	0	lbf

Bolt root area 0 in² :

Results acc. to UHX-14

Gasket seating force = 0.5(A_m+A_b)·K_{sp}/S_{sp}, App.2-5	W	290720	lbf
Channel thickness without allowances	t_c		in
Shell thickness without allowances	t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear	μ	**0.2**	
Effective ligament efficiency for shear	μ*	**0.322**	
Effective depth of pass partition groove	h_g'	**0**	in
Equivalent radius of outer tube limit circle	a_0	**15.94**	in
Radial channel dimension	a_c	**19.72**	in
Radial shell dimension	a_s	**19.72**	in
Ratio = a_c/a_0	$ρ_C$	**1.237**	
Ratio = a_s/a_0	$ρ_S$	**1.237**	
Parameter = 1-N_t·(0.5·d_aTUBE/a_0)²	x_s	**0.4099**	
Parameter = 1-N_t·(0.5·d_iTUBE/a_0)²	x_t	**0.5967**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E^*	**8946987**	psi
Ratio of elasticity tubesheet								E^*/E	**0.3376**	
Effective Poisson's ratio tubesheet								v^*	**0.3161**	
Effective pitch								p^*	**0.9375**	in
Effective tube hole diameter								d^*	**0.6356**	in
Parameter for table UHX-13.1								X_a	**7.399**	
Z_d	**0.003691**	Z_v	**0.01864**	Z_m	**0.1967**	Z_a	**482.2**	Z_w	**0.01864**	

Step 4

Diameter ratio = A/D0							K	**1.251**	
F	**0.4535**	Φ		**0.5969**			Q_1	**0.2024**	

UHX-14.5.5 Step 5: Coefficients

			ω_S	**0**	in²		ω_S^*	**8.002**	in²
ω_C	**0**	in²	ω_C^*	**8.002**	in²		γ_b	**0**	

Results acc. to UHX-14.6 and step 6

T_r =	**68**	°F	T_s^* =	**68**	°F		T_c^*	**68**	°F
P_s^* =	**0**	psi	P_c^* =	**0**	psi		P_e	**92.92**	psi

UHX-14.5.7 Step 7

Q_2	**-1253**	lbf	Q_3	**0.09623**			F_m	**0.07021**	
Strength condition for the tubesheet bending stress, case								1	:
σ =	**21879**	psi	$<1.5\cdot\sigma_B$ =	**23700**	psi			case 1-3	
			$< S_{PS}$ =	*47400*	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:

τ =	**0**	psi	$<0.8\cdot\sigma_B$ =	**12640**	psi

Strength condition of step 7-8 are satisfied

Step 9, as examples UHX-20.3:2009 (old N)

F_q	**8.22**	F_s	**1.25**				
Strength condition for the tube stress with cacluation case						1	:
S_{To} =	**-4647**	psi	$\le \sigma_T$ =	*15800*	psi	for calculation case 1-3	
S_{To}			$\le 2\cdot\sigma_T$ =	**31600**	psi	for calculation case 4-7	
$\lvert S_{To}\rvert$			$\le S_{tb}$ =	**10547**	psi	(for $S_{To} < 0$, Buckling)	
r_t	**0.2433**	in	F_t	**85.3**		C_t	**172.9**

Buckling stability acc. UHX-14.5.9 satisfied

Step 10: Stress σ_S in the shell and σ_C in the channel

$\sigma_S = \lvert\sigma_{Sm}\rvert + \lvert\sigma_{Sb}\rvert$ =			**0**	psi	< 1.5 · σ_{allS}, S_{PSs} or S_{PSs1}					
σ_S =	**0**	psi	+	**0**	psi	<	**0**	psi		
$\sigma_C = \lvert\sigma_{Cm}\rvert + \lvert\sigma_{Cb}\rvert$ =			**0**	psi	< 1.5 · σ_{allC} or S_{PSc}					
σ_C =	**0**	psi	+	**0**	psi	<	**0**	psi		

Condition UHX-14.5.10 not required for configurations dBCD

Geometric conditions:

valid

Strength condition for linked modules (Connection activated: Yes):

2 Stat-2
ASME UHX-14 Floating Tubesheets ASME BPVC Edition 2017

Floating tubesheet according to ASME-UHX-14

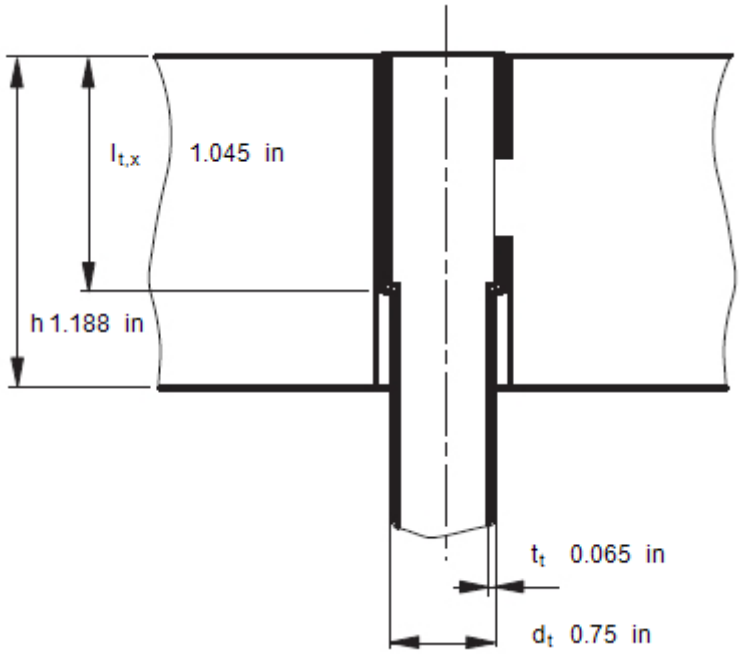
Type of heat exchanger (a,b,c)	WArt	c		a,b,c
Heat Exchanger With an Internally Sealed Floating Head (D)				
Configuration of the tubesheet (a-f,A-D)	Type	d		a-f,A-D
Stationary tubesheet gasketed with shell and channel				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure	P_s		150	psi
Tube side internal operation pressure	P_t		175	psi
Shell side internal test pressure	P_{sp}			psi
Tube side internal test pressure	P_{tp}			psi
Load case (1=operation, 2+3=test at 20°C, 4=other)			1	
load case: operation				
Calculation case acc. UHX-14.4(a): (1), (2) ... (7)			2	(1-7)
Shell side pressure only (Pt=0) without thermal expansion				
Tubesheet material				
Shell material (Type abc)				
Tube material				
Channel material(Type aefA)				

Operation	**Tubesheet**		**Shell**		**Tubes**		**Channel**	
Temperature		°F		°F		°F		°F
Thickness	1.188	in		in	0.065	in		in
Outsidediameter	39.88	in		in	0.75	in		in
Poiss.-rat.	0.31		0.3		0.31		0.3	
Allow. c1	0	in		in	0	in		in
Corr.all.c2	0	in		in	0	in		in
Figure								
Strength for the selected load case temperature								
Strength		psi		psi		psi		psi
Safety								
E-module	2.65e+7	psi		psi	2.65e+7	psi		psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F		1E-6/°F
Yield str.	17500	psi		psi	17500	psi		psi
Limit temperature		°F		°F		°F		°F
All.stress	15800	psi	**0**	psi	15800	psi	**0**	psi
Pr.+sec.st	47400	psi	**0**	psi	47400	psi		psi
Properties for testing at 20°C								
Strength	0	psi	0	psi	0	psi	0	psi
Safety								
Yield str.		psi		psi		psi		psi
Tensile str.		psi		psi		psi		psi

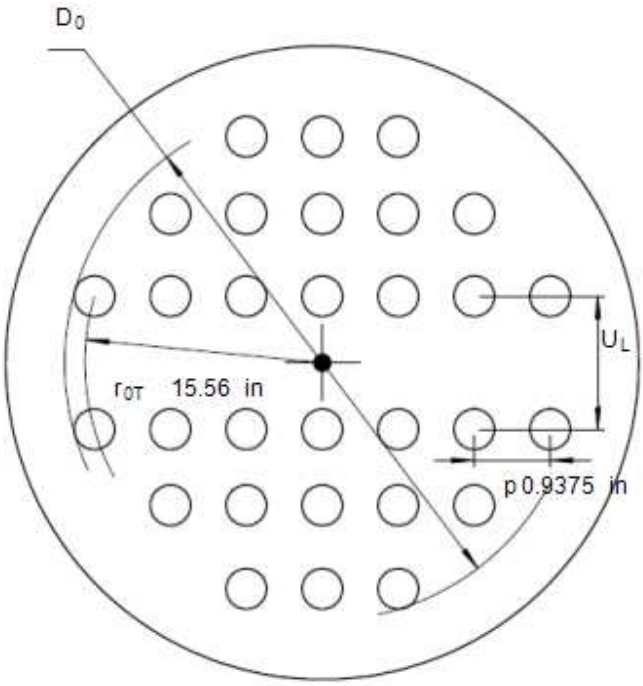
Additional specifications for the geometry and loading

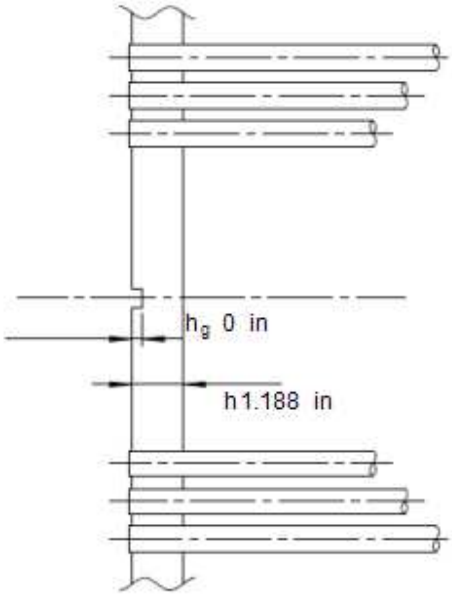
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)	1	(1, 2)
Tube pattern	(1=Triangle, 2=Square)	1	(1, 2)
Number of tubes	N_t	1066	



Expanded length of tube in tubesheet		$l_{t,x}$	**1.045**	in
Expanded length ratio $l_{t,x}/h$		ρ	0.88	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	15.56	in
Perimeter of the outermost tubes	UHX-12.2	C_p		in
Total area enclosed by C_p	UHX-12.2	A_p		in²





Tube pitch (center distance)			p	0.9375	in
Total untubed area UL1·LL1+UL2·LL2..	UHX-11.2		A_L	0	in²
Depth of tube side pass partition groove			h_g	0	in
Expanded length ratio ltx/h			ρ	0.88	
Tube length between inner tubesheet faces			L	153.5	in
Unsupported tube span for buckling			l		in
Type of tube support (0.6=tubesheet-tubesheet, 0.8=tubesheet - support plate, 1=plate-plate)			k		
Equivalent free buckling length k · l			l_t	20.75	in

Flange

Bolt number			n		-
Bolt root diameter			d_B		in
Total bolt area			A_b	0	in²
Bolt material					
Strength operation			K_s		psi
Strength test			K_{sp}		psi
Safety operation			S_s		-
Safety test			S_{sp}		-
Stress increase factor (1.5 acc. App.S)			F_s	1.5	-

Gasket		**Shell Type d,e,f**		**Channel Type B,b,c,d**	
Contact outside diameter	G_a		in		in
Contact inside diameter	G_i		in		in
Theoretical seating width	b_0		in		in
Gasket factor (Table 2-5.1)	m				
Gasket seating pressure	Y		psi	0	psi
Diameter of gasket force	G	39.44	in	39.44	in
Poisson's ratio	v	0.3		0.3	

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W		lbf		lbf
Gasket operating force	W		lbf	290720	lbf
Total required bolt area	A_m		in²		in²
Flange thickness	h_r		in		in

Maximum bolt force for all calculation casese		W_{max}	0	lbf
Bolt root area	0 in² :			

Results acc. to UHX-14

Gasket seating force = $0.5(A_m+A_b)\cdot K_{sp}/S_{sp}$, App.2-5		W	290720	lbf
Channel thickness without allowances		t_c		in
Shell thickness without allowances		t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear		μ	**0.2**	
Effective ligament efficiency for shear		μ*	**0.322**	
Effective depth of pass partition groove		h_g'	**0**	in
Equivalent radius of outer tube limit circle		a_0	**15.94**	in
Radial channel dimension		a_c	**19.72**	in
Radial shell dimension		a_s	**19.72**	in
Ratio = a_c/a_0		ρ_C	**1.237**	
Ratio = a_s/a_0		ρ_S	**1.237**	
Parameter = $1-N_t\cdot(0.5\cdot d_a TUBE/a_0)^2$		x_s	**0.4099**	
Parameter = $1-N_t\cdot(0.5\cdot d_i TUBE/a_0)^2$		x_t	**0.5967**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E*	**8946987**	psi
Ratio of elasticity tubesheet								E*/E	**0.3376**	
Effective Poisson's ratio tubesheet								v*	**0.3161**	
Effective pitch								p*	**0.9375**	in
Effective tube hole diameter								d*	**0.6356**	in
Parameter for table UHX-13.1								X_a	**7.399**	
Z_d	**0.003691**	Z_v	**0.01864**	Z_m	**0.1967**	Z_a	**482.2**	Z_w	**0.01864**	

Step 4

Diameter ratio = A/D0							K	**1.251**	
F	**0.4535**	Φ		**0.5969**			Q_1	**0.2024**	

UHX-14.5.5 Step 5: Coefficients

		ω_S		**0**	in²		ω_S*	**8.002**	in²
ω_C	**0**	in²	ω_C*	**8.002**	in²		γ_b	**0**	

Results acc. to UHX-14.6 and step 6

T_r =	**68**	°F	T_s* =	**68**	°F		T_c*	**68**	°F
P_s* =	**0**	psi	P_c* =	**0**	psi		P_e	**-79.65**	psi

UHX-14.5.7 Step 7

Q_2	**1074**	lbf	Q_3	**0.09623**			F_m	**0.07021**	
Strength condition for the tubesheet bending stress, case								2	:
σ =	**18753**	psi	<1.5· σ_B =	**23700**	psi			case 1-3	
			< S_{PS} =	47400	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:

τ =	**0**	psi	<0.8· σ_B =	**12640**	psi

Strength condition of step 7-8 are satisfied

Step 9, as examples UHX-20.3:2009 (old N)

F_q	**8.22**	F_s	**1.25**				
Strength condition for the tube stress with cacluation case						2	:
S_{To} =	**3833**	psi	≤ σ_T =	15800	psi	for calculation case 1-3	
S_{To}			≤ 2·σ_T =	**31600**	psi	for calculation case 4-7	
$\lvert S_{To} \rvert$			≤ S_{tb} =	**10547**	psi	(for S_{To} < 0, Buckling)	
r_t	**0.2433**	in	F_t	**85.3**		C_t	**172.9**

Strength acc. UHX-14.5.9 satisfied

Step 10: Stress σ_S in the shell and σ_C in the channel

σ_S = $\lvert \sigma_{Sm} \rvert$ + $\lvert \sigma_{Sb} \rvert$ =			**0**	psi	< 1.5 · σ_{allS}, S_{PSs} or S_{PSs1}					
σ_S =	**0**	psi	+	**0**	psi	<	**0**	psi		
σ_C = $\lvert \sigma_{Cm} \rvert$ + $\lvert \sigma_{Cb} \rvert$ =			**0**	psi	< 1.5 · σ_{allC} or S_{PSc}					
σ_C =	**0**	psi	+	**0**	psi	<	**0**	psi		

Condition UHX-14.5.10 not required for configurations dBCD

Geometric conditions:

valid

Strength condition for linked modules (Connection activated: Yes):

3 Stat-3
ASME UHX-14 Floating Tubesheets ASME BPVC Edition 2017

Floating tubesheet according to ASME-UHX-14

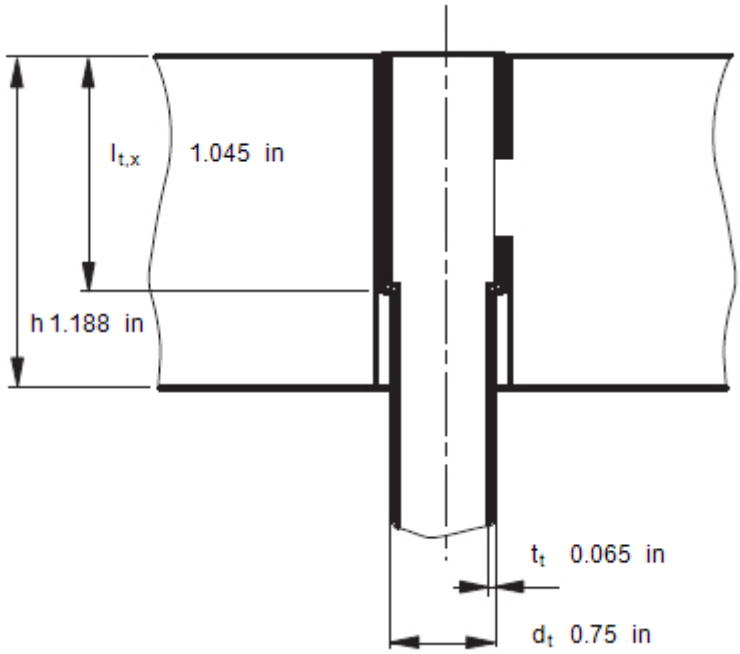
Type of heat exchanger (a,b,c)	WArt	c		a,b,c
Heat Exchanger With an Internally Sealed Floating Head (D)				
Configuration of the tubesheet (a-f,A-D)	Type	d		a-f,A-D
Stationary tubesheet gasketed with shell and channel				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure	P_s		150	psi
Tube side internal operation pressure	P_t		175	psi
Shell side internal test pressure	P_{sp}			psi
Tube side internal test pressure	P_{tp}			psi
Load case (1=operation, 2+3=test at 20°C, 4=other)			1	
load case: operation				
Calculation case acc. UHX-14.4(a): (1), (2) ... (7)			3	(1-7)
Tube and shell side pressure acting without thermal expansion				

Tubesheet material								
Shell material (Type abc)								
Tube material								
Channel material(Type aefA)								
Operation	**Tubesheet**		**Shell**		**Tubes**		**Channel**	
Temperature		°F		°F		°F		°F
Thickness	1.188	in		in	0.065	in		in
Outsidediameter	39.88	in		in	0.75	in		in
Poiss.-rat.	0.31		0.3		0.31		0.3	
Allow. c1	0	in		in	0	in		in
Corr.all.c2	0	in		in	0	in		in
Figure								
Strength for the selected load case temperature								
Strength		psi		psi		psi		psi
Safety								
E-module	2.65e+7	psi		psi	2.65e+7	psi		psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F		1E-6/°F
Yield str.	17500	psi		psi	17500	psi		psi
Limit temperature		°F		°F		°F		°F
All.stress	15800	psi	**0**	psi	15800	psi	**0**	psi
Pr.+sec.st	47400	psi	**0**	psi	47400	psi		psi
Properties for testing at 20°C								
Strength	0	psi	0	psi	0	psi	0	psi
Safety								
Yield str.		psi		psi		psi		psi
Tensile str.		psi		psi		psi		psi

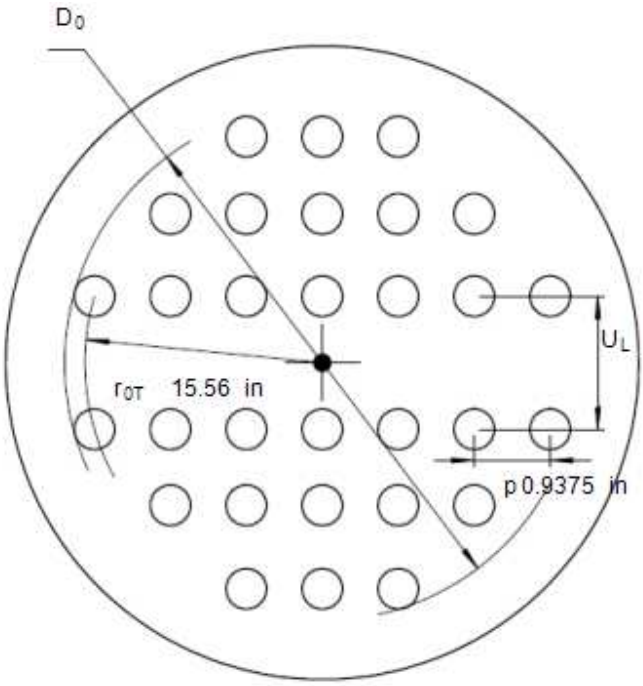
Additional specifications for the geometry and loading

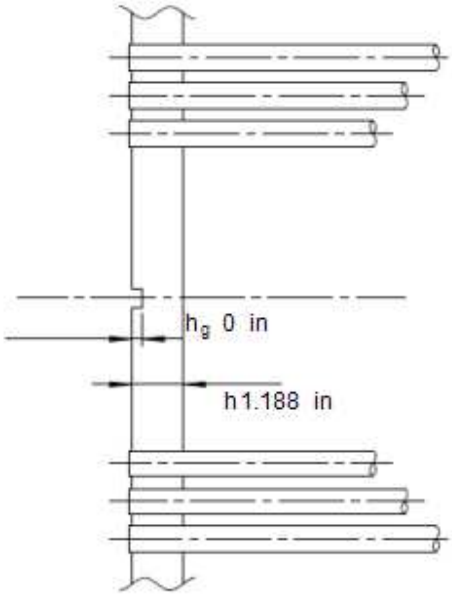
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)	1	(1, 2)
Tube pattern	(1=Triangle, 2=Square)	1	(1, 2)
Number of tubes	N_t	1066	



Expanded length of tube in tubesheet		$l_{t,x}$	**1.045**	in
Expanded length ratio $l_{t,x}/h$		ρ	0.88	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	15.56	in
Perimeter of the outermost tubes	UHX-12.2	C_p		in
Total area enclosed by C_p	UHX-12.2	A_p		in²





Tube pitch (center distance)			p	0.9375	in
Total untubed area UL1·LL1+UL2·LL2..	UHX-11.2		A_L	0	in²
Depth of tube side pass partition groove			h_g	0	in
Expanded length ratio ltx/h			ρ	0.88	
Tube length between inner tubesheet faces			L	153.5	in
Unsupported tube span for buckling			l		in
Type of tube support (0.6=tubesheet-tubesheet, 0.8=tubesheet - support plate, 1=plate-plate)			k		
Equivalent free buckling length k · l			l_t	20.75	in

Flange

Bolt number			n		-
Bolt root diameter			d_B		in
Total bolt area			A_b	0	in²
Bolt material					
Strength operation			K_s		psi
Strength test			K_{sp}		psi
Safety operation			S_s		-
Safety test			S_{sp}		-
Stress increase factor (1.5 acc. App.S)			F_s	1.5	-

Gasket		**Shell Type d,e,f**		**Channel Type B,b,c,d**	
Contact outside diameter	G_a		in		in
Contact inside diameter	G_i		in		in
Theoretical seating width	b_0		in		in
Gasket factor (Table 2-5.1)	m				
Gasket seating pressure	Y		psi	0	psi
Diameter of gasket force	G	39.44	in	39.44	in
Poisson's ratio	v	0.3		0.3	

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W		lbf		lbf
Gasket operating force	W		lbf	290720	lbf
Total required bolt area	A_m		in²		in²
Flange thickness	h_r		in		in

Maximum bolt force for all calculation casese			W_{max}	0	lbf
Bolt root area	0 in²	:			

Results acc. to UHX-14

Gasket seating force = $0.5(A_m+A_b)\cdot K_{sp}/S_{sp}$, App.2-5		W	290720	lbf
Channel thickness without allowances		t_c		in
Shell thickness without allowances		t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear		μ	**0.2**	
Effective ligament efficiency for shear		μ*	**0.322**	
Effective depth of pass partition groove		h_g'	**0**	in
Equivalent radius of outer tube limit circle		a_0	**15.94**	in
Radial channel dimension		a_c	**19.72**	in
Radial shell dimension		a_s	**19.72**	in
Ratio = a_c/a_0		ρ_C	**1.237**	
Ratio = a_s/a_0		ρ_S	**1.237**	
Parameter = $1-N_t\cdot(0.5\cdot d_a TUBE/a_0)^2$		x_s	**0.4099**	
Parameter = $1-N_t\cdot(0.5\cdot d_i TUBE/a_0)^2$		x_t	**0.5967**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E^*	**8946987**	psi
Ratio of elasticity tubesheet								E^*/E	**0.3376**	
Effective Poisson's ratio tubesheet								v^*	**0.3161**	
Effective pitch								p^*	**0.9375**	in
Effective tube hole diameter								d^*	**0.6356**	in
Parameter for table UHX-13.1								X_a	**7.399**	
Z_d	**0.003691**	Z_v	**0.01864**	Z_m	**0.1967**	Z_a	**482.2**	Z_w	**0.01864**	

Step 4

Diameter ratio = A/D0							K	**1.251**
F	**0.4535**	Φ	**0.5969**				Q_1	**0.2024**

UHX-14.5.5 Step 5: Coefficients

		ω_S	**0**	in²		ω_S^*	**8.002**	in²
ω_C	**0**	in²	ω_C^*	**8.002**	in²	γ_b	**0**	

Results acc. to UHX-14.6 and step 6

T_r =	**68**	°F	T_s^* =	**68**	°F	T_c^*	**68**	°F		
P_s^* =	**0**	psi	P_c^* =	**0**	psi	P_e	**13.27**	psi		

UHX-14.5.7 Step 7

Q_2	**-179**	lbf	Q_3	**0.09623**		F_m	**0.07021**	
Strength condition for the tubesheet bending stress, case							3	:
σ =	**3126**	psi	$<1.5\cdot\sigma_B$ =	**23700**	psi		case 1-3	
			$< S_{PS}$ =	47400	psi		case 4-7	

Step 8

Strength condition for the tubesheet shear stress:

τ =	**0**	psi	$<0.8\cdot\sigma_B$ =	**12640**	psi

Strength condition of step 7-8 are satisfied

Step 9, as examples UHX-20.3:2009 (old N)

F_q	**8.22**	F_s	**1.25**			
Strength condition for the tube stress with cacluation case						3 :
S_{To} =	**-813.8**	psi	$\le \sigma_T$ =	15800	psi	for calculation case 1-3
S_{To}			$\le 2\cdot\sigma_T$ =	**31600**	psi	for calculation case 4-7
$\lvert S_{To} \rvert$			$\le S_{tb}$ =	**10547**	psi	(for $S_{To} < 0$, Buckling)
r_t	**0.2433**	in	F_t	**85.3**		C_t **172.9**

Buckling stability acc. UHX-14.5.9 satisfied

Step 10: Stress σ_S in the shell and σ_C in the channel

σ_S = $\lvert\sigma_{Sm}\rvert$ + $\lvert\sigma_{Sb}\rvert$ =			**0**	psi		$< 1.5 \cdot \sigma_{allS}$, S_{PSs} or S_{PSs1}				
σ_S =	**0**	psi	+	**0**	psi	<	**0**	psi		
σ_C = $\lvert\sigma_{Cm}\rvert$ + $\lvert\sigma_{Cb}\rvert$ =			**0**	psi		$< 1.5 \cdot \sigma_{allC}$ or S_{PSc}				
σ_C =	**0**	psi	+	**0**	psi	<	**0**	psi		

Condition UHX-14.5.10 not required for configurations dBCD

Geometric conditions:

valid

Strength condition for linked modules (Connection activated: Yes):

4 Float-1
ASME UHX-14 Floating Tubesheets ASME BPVC Edition 2017

Floating tubesheet according to ASME-UHX-14

Type of heat exchanger (a,b,c)	WArt	c		a,b,c
Heat Exchanger With an Internally Sealed Floating Head (D)				
Configuration of the tubesheet (a-f,A-D)	Type	D		a-f,A-D
Floating tubesheet internally sealed				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure	P_s		150	psi
Tube side internal operation pressure	P_t		175	psi
Shell side internal test pressure	P_{sp}			psi
Tube side internal test pressure	P_{tp}			psi
Load case (1=operation, 2+3=test at 20°C, 4=other)			1	
load case: operation				
Calculation case acc. UHX-14.4(a): (1), (2) ... (7)			1	(1-7)
Tube side pressure only (Ps=0) without thermal expansion				

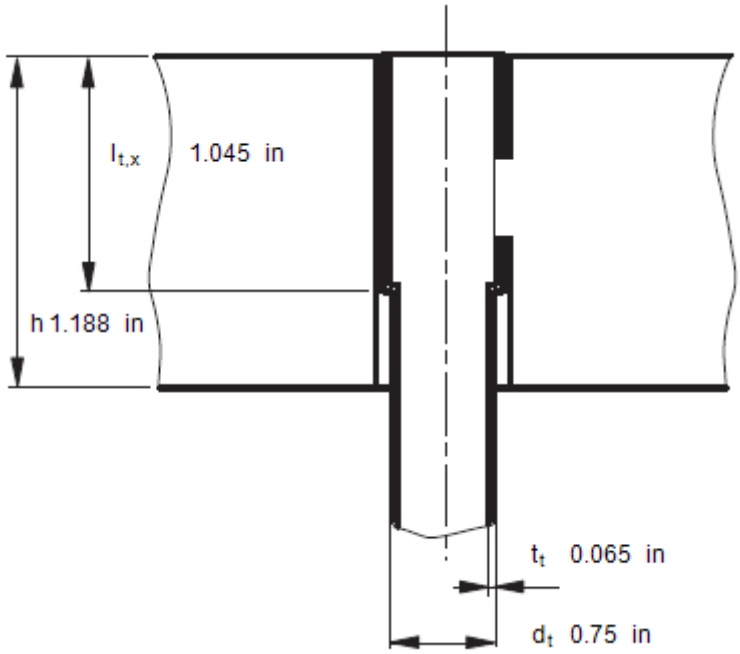
Tubesheet material
Shell material (Type abc)
Tube material
Channel material(Type aefA)

Operation	**Tubesheet**		**Shell**		**Tubes**		**Channel**	
Temperature		°F		°F		°F		°F
Thickness	1.188	in		in	0.065	in		in
Outsidediameter	36.88	in		in	0.75	in		in
Poiss.-rat.	0.31		0.3		0.31		0.3	
Allow. c1	0	in		in	0	in		in
Corr.all.c2	0	in		in	0	in		in
Figure								
Strength for the selected load case temperature								
Strength		psi		psi		psi		psi
Safety								
E-module	2.65e+7	psi		psi	2.65e+7	psi		psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F		1E-6/°F
Yield str.	17500	psi		psi	17500	psi		psi
Limit temperature		°F		°F		°F		°F
All.stress	15800	psi	**0**	psi	15800	psi	**0**	psi
Pr.+sec.st	47400	psi	**0**	psi	47400	psi		psi
Properties for testing at 20°C								
Strength	0	psi	0	psi	0	psi	0	psi
Safety								
Yield str.		psi		psi		psi		psi
Tensile str.		psi		psi		psi		psi

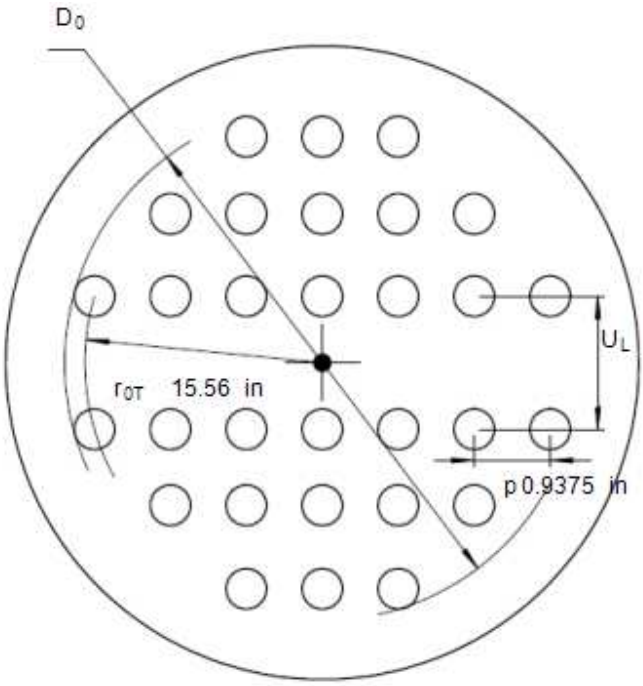
Additional specifications for the geometry and loading

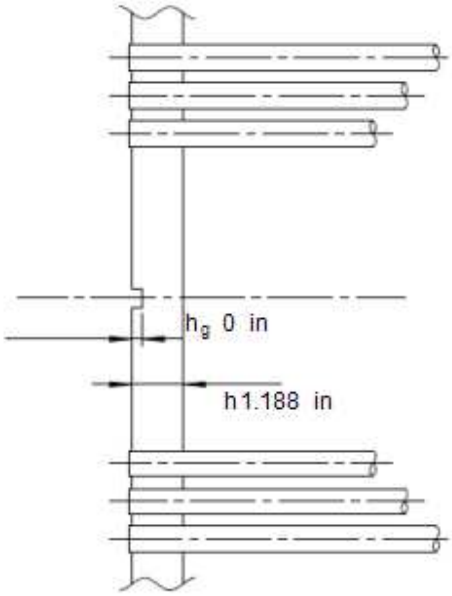
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)	1	(1, 2)
Tube pattern	(1=Triangle, 2=Square)	1	(1, 2)
Number of tubes	N_t	1066	



Expanded length of tube in tubesheet		$l_{t,x}$	1.045	in
Expanded length ratio $l_{t,x}$/h		ρ	**0.88**	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	15.56	in
Perimeter of the outermost tubes	UHX-12.2	C_p		in
Total area enclosed by C_p	UHX-12.2	A_p		in²





Tube pitch (center distance)	p	0.9375	in
Total untubed area UL1·LL1+UL2·LL2.. UHX-11.2	A_L	0	in²
Depth of tube side pass partition groove	h_g	0	in
Expanded length ratio ltx/h	ρ	**0.88**	
Tube length between inner tubesheet faces	L	153.5	in
Unsupported tube span for buckling	l		in
Type of tube support (0.6=tubesheet-tubesheet, 0.8=tubesheet - support plate, 1=plate-plate)	k		
Equivalent free buckling length k · l	l_t	20.75	in

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W	**0**	lbf	**0**	lbf
Gasket operating force	W	**0**	lbf	**0**	lbf
Total required bolt area	A_m	**0**	in²	**0**	in²
Flange thickness	h_r	**0**	in	**0**	in

Maximum bolt force for all calculation casese	W_{max}	0	lbf

Bolt root area 0 in² : **sufficient**

Results acc. to UHX-14

Gasket seating force = 0.5(A_m+A_b)·K_{sp}/S_{sp}, App.2-5	W	0	lbf
Channel thickness without allowances	t_c		in
Shell thickness without allowances	t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear	μ	**0.2**	
Effective ligament efficiency for shear	μ*	**0.322**	
Effective depth of pass partition groove	h_g'	**0**	in
Equivalent radius of outer tube limit circle	a_0	**15.94**	in
Radial channel dimension	a_c	**18.44**	in
Radial shell dimension	a_s	**18.44**	in
Ratio = a_c/a_0	$ρ_C$	**1.157**	
Ratio = a_s/a_0	$ρ_S$	**1.157**	
Parameter = 1-N_t·(0.5·d_aTUBE/a_0)²	x_s	**0.4099**	
Parameter = 1-N_t·(0.5·d_iTUBE/a_0)²	x_t	**0.5967**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E^*	**8946968**	psi
Ratio of elasticity tubesheet								E^*/E	**0.3376**	
Effective Poisson's ratio tubesheet								v^*	**0.3161**	
Effective pitch								p^*	**0.9375**	in
Effective tube hole diameter								d^*	**0.6356**	in
Parameter for table UHX-13.1								X_a	**7.399**	
Z_d	**0.003691**	Z_v	**0.01864**	Z_m	**0.1967**	Z_a	**482.2**	Z_w	**0.01864**	

Step 4

Diameter ratio = A/D0							K	**1.157**	
F	**0.2951**	Φ		**0.3884**			Q_1	**0.139**	

UHX-14.5.5 Step 5: Coefficients

		ω_S		**0**	in²		ω_S^*	**3.369**	in²
ω_C	**0**	in²	ω_C^*	**3.369**	in²		γ_b	**0**	

Results acc. to UHX-14.6 and step 6

T_r =	**68**	°F	T_s^* =	**68**	°F		T_c^*	**68**	°F
P_s^* =	**0**	psi	P_c^* =	**0**	psi		P_e	**59.19**	psi

UHX-14.5.7 Step 7

Q_2	**-547.7**	lbf	Q_3	**0.06612**			F_m	**0.05755**	
Strength condition for the tubesheet bending stress, case								1	:
σ =	**11424**	psi	<1.5· σ_B =	**23700**	psi		case 1-3		
			< S_{PS} =	47400	psi		case 4-7		

Step 8

Strength condition for the tubesheet shear stress:

τ =	**0**	psi	<0.8· σ_B =	**12640**	psi

Strength condition of step 7-8 are satisfied

Step 9, as examples UHX-20.3:2009 (old N)

F_q	**7.379**		F_s	**1.25**					
Strength condition for the tube stress with cacluation case								1	:
S_{To} =	**-2896**	psi	≤ σ_T =	15800	psi		for calculation case 1-3		
S_{To}			≤ 2·σ_T =	**31600**	psi		for calculation case 4-7		
$\lvert S_{To} \rvert$			≤ S_{tb} =	**10547**	psi		(for S_{To} < 0, Buckling)		
r_t	**0.2433**	in	F_t	**85.3**			C_t	**172.9**	

Condition UHX-14.5.9 not required for configuration ABCD

Step 10: Stress σ_S in the shell and σ_C in the channel

σ_S = $\lvert\sigma_{Sm}\rvert$ + $\lvert\sigma_{Sb}\rvert$ =			**0**	psi	< 1.5 · σ_{allS}, S_{PSs} or S_{PSs1}						
σ_S =	**0**	psi	+	**0**	psi	<	**0**	psi			
σ_C = $\lvert\sigma_{Cm}\rvert$ + $\lvert\sigma_{Cb}\rvert$ =			**0**	psi	< 1.5 · σ_{allC} or S_{PSc}						
σ_C =	**0**	psi	+	**0**	psi	<	**0**	psi			

Condition UHX-14.5.10 not required for configurations dBCD

Geometric conditions:

valid

Strength condition for linked modules (Connection activated: Yes):

5 Float-2
ASME UHX-14 Floating Tubesheets ASME BPVC Edition 2017

Floating tubesheet according to ASME-UHX-14

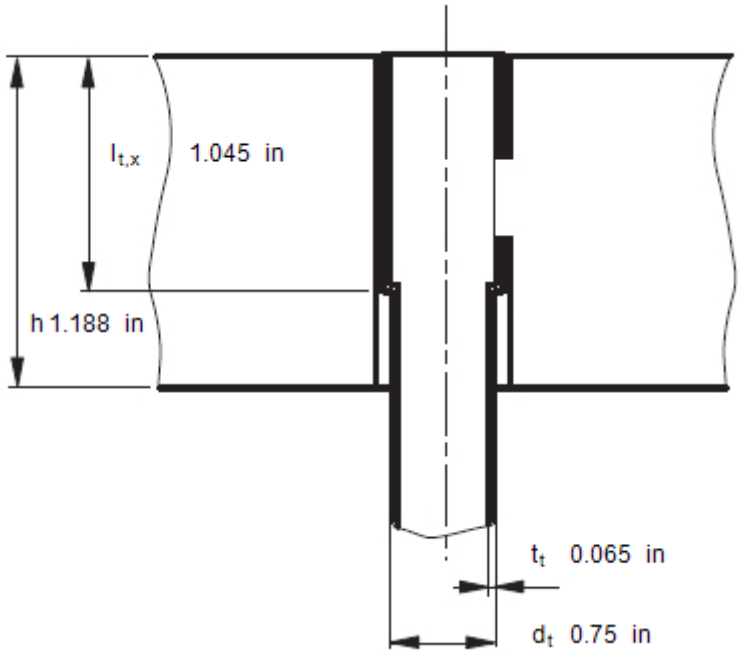
Type of heat exchanger (a,b,c)	WArt	*c*		a,b,c
Heat Exchanger With an Internally Sealed Floating Head (D)				
Configuration of the tubesheet (a-f,A-D)	Type	*D*		a-f,A-D
Floating tubesheet internally sealed				
Type of channel (1=Cylinder, 2=Hemispherical)			*1*	(1,2)
Shell side internal operation pressure	P_s		*150*	psi
Tube side internal operation pressure	P_t		*175*	psi
Shell side internal test pressure	P_{sp}			psi
Tube side internal test pressure	P_{tp}			psi
Load case (1=operation, 2+3=test at 20°C, 4=other)			*1*	
load case: operation				
Calculation case acc. UHX-14.4(a): (1), (2) ... (7)			2	(1-7)
Shell side pressure only (Pt=0) without thermal expansion				

Tubesheet material								
Shell material (Type abc)								
Tube material								
Channel material(Type aefA)								
Operation	**Tubesheet**		**Shell**		**Tubes**		**Channel**	
Temperature		°F		°F		°F		°F
Thickness	*1.188*	in		in	*0.065*	in		in
Outsidediameter	*36.88*	in		in	*0.75*	in		in
Poiss.-rat.	*0.31*		*0.3*		*0.31*		*0.3*	
Allow. c1	*0*	in		in	*0*	in		in
Corr.all.c2	*0*	in		in	*0*	in		in
Figure								
Strength for the selected load case temperature								
Strength		psi		psi		psi		psi
Safety								
E-module	*2.65e+7*	psi		psi	*2.65e+7*	psi		psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F		1E-6/°F
Yield str.		psi		psi	*17500*	psi		psi
Limit temperature		°F		°F		°F		°F
All.stress	*15800*	psi	***0***	psi	*15800*	psi	***0***	psi
Pr.+sec.st	*47400*	psi	***0***	psi	*47400*	psi		psi
Properties for testing at 20°C								
Strength	*0*	psi	0	psi	0	psi	0	psi
Safety								
Yield str.		psi		psi		psi		psi
Tensile str.		psi		psi		psi		psi

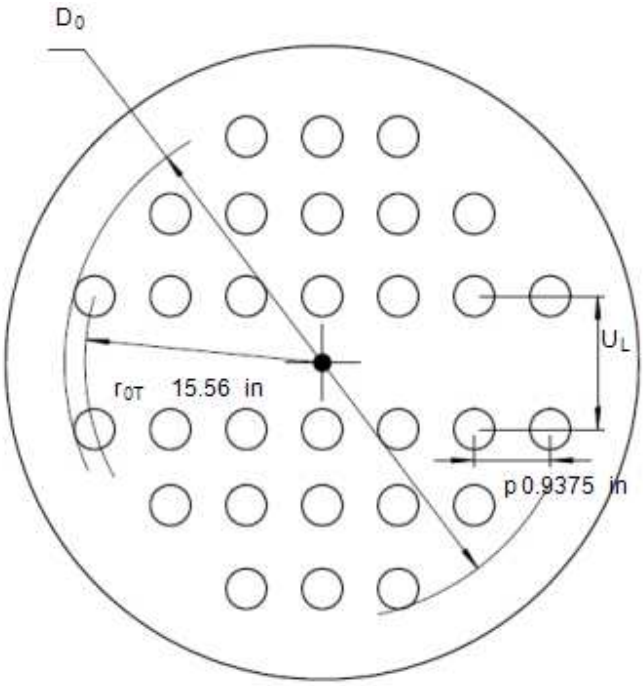
Additional specifications for the geometry and loading

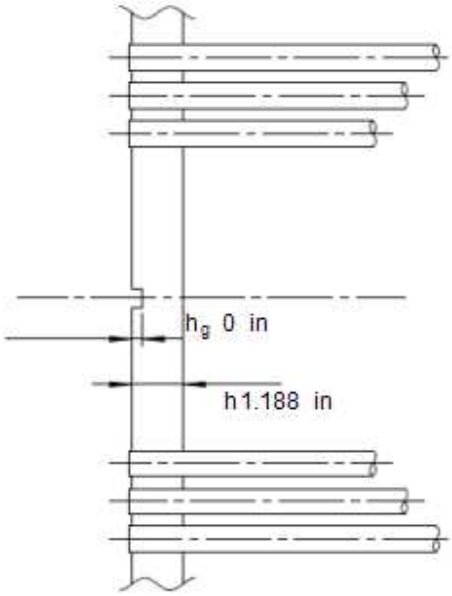
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)	*1*	(1, 2)
Tube pattern	(1=Triangle, 2=Square)	*1*	(1, 2)
Number of tubes	N_t	*1066*	



Expanded length of tube in tubesheet		$l_{t,x}$	*1.045*	in
Expanded length ratio $l_{t,x}/h$		ρ	**0.88**	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*15.56*	in
Perimeter of the outermost tubes	UHX-12.2	C_p		in
Total area enclosed by C_p	UHX-12.2	A_p		in²





Tube pitch (center distance)	p	*0.9375*	in
Total untubed area UL1·LL1+UL2·LL2.. UHX-11.2	A_L	*0*	in²
Depth of tube side pass partition groove	h_g	*0*	in
Expanded length ratio ltx/h	ρ	**0.88**	
Tube length between inner tubesheet faces	L	*153.5*	in
Unsupported tube span for buckling	l		in
Type of tube support (0.6=tubesheet-tubesheet, 0.8=tubesheet - support plate, 1=plate-plate)	k		
Equivalent free buckling length k · l	l_t	*20.75*	in

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W	**0**	lbf	**0**	lbf
Gasket operating force	W	**0**	lbf	**0**	lbf
Total required bolt area	A_m	**0**	in²	**0**	in²
Flange thickness	h_r	**0**	in	**0**	in

Maximum bolt force for all calculation casese	W_{max}	0	lbf

Bolt root area in² :

Results acc. to UHX-14

Gasket seating force = 0.5(A_m+A_b)·K_{sp}/S_{sp}, App.2-5	W	**0**	lbf
Channel thickness without allowances	t_c		in
Shell thickness without allowances	t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear	μ	**0.2**	
Effective ligament efficiency for shear	μ*	**0.322**	
Effective depth of pass partition groove	h_g'	**0**	in
Equivalent radius of outer tube limit circle	a_0	**15.94**	in
Radial channel dimension	a_c	**18.44**	in
Radial shell dimension	a_s	**18.44**	in
Ratio = a_c/a_0	$ρ_C$	**1.157**	
Ratio = a_s/a_0	$ρ_S$	**1.157**	
Parameter = 1-N_t·(0.5·d_aTUBE/a_0)²	x_s	**0.4099**	
Parameter = 1-N_t·(0.5·d_iTUBE/a_0)²	x_t	**0.5967**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E^*	**8946968**	psi
Ratio of elasticity tubesheet								E^*/E	**0.3376**	
Effective Poisson's ratio tubesheet								v^*	**0.3161**	
Effective pitch								p^*	**0.9375**	in
Effective tube hole diameter								d^*	**0.6356**	in
Parameter for table UHX-13.1								X_a	**7.399**	
Z_d	**0.003691**	Z_v	**0.01864**	Z_m	**0.1967**	Z_a	**482.2**	Z_w	**0.01864**	

Step 4

Diameter ratio = A/D0							K	**1.157**
F	**0.2951**	Φ	**0.3884**				Q_1	**0.139**

UHX-14.5.5 Step 5: Coefficients

		ω_S	**0**	in²		ω_S^*	**3.369**	in²
ω_C	**0**	in²	ω_C^*	**3.369**	in²	γ_b	**0**	

Results acc. to UHX-14.6 and step 6

T_r	=	**68**	°F	T_s^*	=	**68**	°F	T_c^*	**68**	°F
P_s^*	=	**0**	psi	P_c^*	=	**0**	psi	P_e	**-50.74**	psi

UHX-14.5.7 Step 7

Q_2	**469.4**	lbf	Q_3	**0.06612**			F_m	**0.05755**	
Strength condition for the tubesheet bending stress, case								2	:
σ	= **9792**	psi	$<1.5\cdot\sigma_B$	= **23700**	psi		case 1-3		
			$< S_{PS}$	= *47400*	psi		case 4-7		

Step 8

Strength condition for the tubesheet shear stress:

τ	= **0**	psi	$<0.8\cdot\sigma_B$	= **12640**	psi

Strength condition of step 7-8 are satisfied

Step 9, as examples UHX-20.3:2009 (old N)

F_q	**7.379**		F_s	**1.25**			
Strength condition for the tube stress with cacluation case							2 :
S_{To}	= **2333**	psi	$\le \sigma_T$	= *15800*	psi	for calculation case 1-3	
S_{To}			$\le 2\cdot\sigma_T$	= **31600**	psi	for calculation case 4-7	
$\lvert S_{To}\rvert$			$\le S_{tb}$	= **10547**	psi	(for $S_{To} < 0$, Buckling)	
r_t	**0.2433**	in	F_t	**85.3**		C_t	**172.9**

Condition UHX-14.5.9 not required for configuration ABCD

Step 10: Stress σ_S in the shell and σ_C in the channel

$\sigma_S = \lvert\sigma_{Sm}\rvert + \lvert\sigma_{Sb}\rvert =$		**0**	psi	$< 1.5 \cdot \sigma_{allS}$, S_{PSs} or S_{PSs1}						
$\sigma_S =$	**0**	psi	$\lvert +\rvert$	**0**	psi	$\rvert <$	**0**	psi		
$\sigma_C = \lvert\sigma_{Cm}\rvert + \lvert\sigma_{Cb}\rvert =$		**0**	psi	$< 1.5 \cdot \sigma_{allC}$ or S_{PSc}						
$\sigma_C =$	**0**	psi	$\lvert +\rvert$	**0**	psi	$\rvert <$	**0**	psi		

Condition UHX-14.5.10 not required for configurations dBCD

Geometric conditions:

valid

Strength condition for linked modules (Connection activated: No):

6 Float-3
ASME UHX-14 Floating Tubesheets ASME BPVC Edition 2017

Floating tubesheet according to ASME-UHX-14

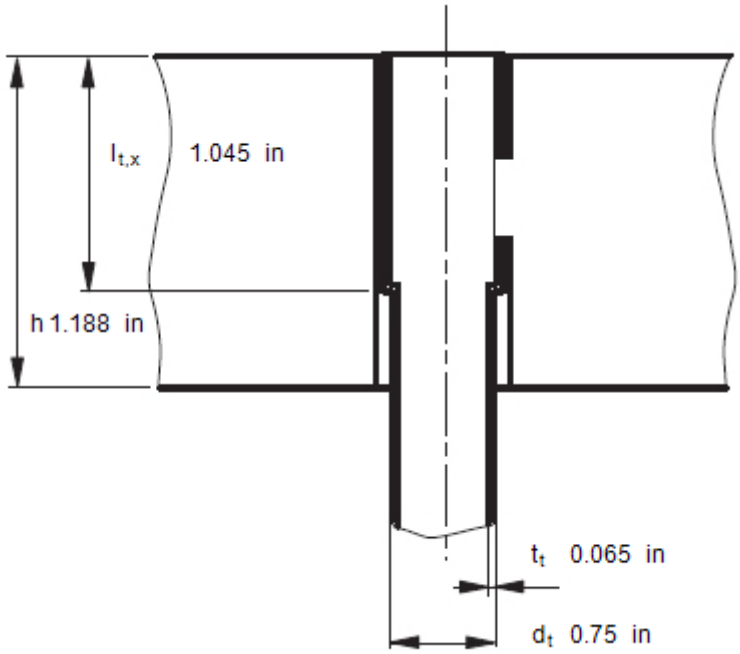
Type of heat exchanger (a,b,c)	WArt	*c*		a,b,c
Heat Exchanger With an Internally Sealed Floating Head (D)				
Configuration of the tubesheet (a-f,A-D)	Type	*D*		a-f,A-D
Floating tubesheet internally sealed				
Type of channel (1=Cylinder, 2=Hemispherical)			*1*	(1,2)
Shell side internal operation pressure	P_s		*150*	psi
Tube side internal operation pressure	P_t		*175*	psi
Shell side internal test pressure	P_{sp}			psi
Tube side internal test pressure	P_{tp}			psi
Load case (1=operation, 2+3=test at 20°C, 4=other)			*1*	
load case: operation				
Calculation case acc. UHX-14.4(a): (1), (2) ... (7)			3	(1-7)
Tube and shell side pressure acting without thermal expansion				

Tubesheet material								
Shell material (Type abc)								
Tube material								
Channel material(Type aefA)								
Operation	**Tubesheet**		**Shell**		**Tubes**		**Channel**	
Temperature		°F		°F		°F		°F
Thickness	*1.188*	in		in	*0.065*	in		in
Outsidediameter	*36.88*	in		in	*0.75*	in		in
Poiss.-rat.	*0.31*		*0.3*		*0.31*		*0.3*	
Allow. c1	*0*	in		in	*0*	in		in
Corr.all.c2	*0*	in		in	*0*	in		in
Figure								
Strength for the selected load case temperature								
Strength		psi		psi		psi		psi
Safety								
E-module	*2.65e+7*	psi		psi	*2.65e+7*	psi		psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F		1E-6/°F
Yield str.		psi		psi	*17500*	psi		psi
Limit temperature		°F		°F		°F		°F
All.stress	*15800*	psi	***0***	psi	*15800*	psi	***0***	psi
Pr.+sec.st	*47400*	psi	***0***	psi	*47400*	psi		psi
Properties for testing at 20°C								
Strength	*0*	psi	0	psi	0	psi	0	psi
Safety								
Yield str.		psi		psi		psi		psi
Tensile str.		psi		psi		psi		psi

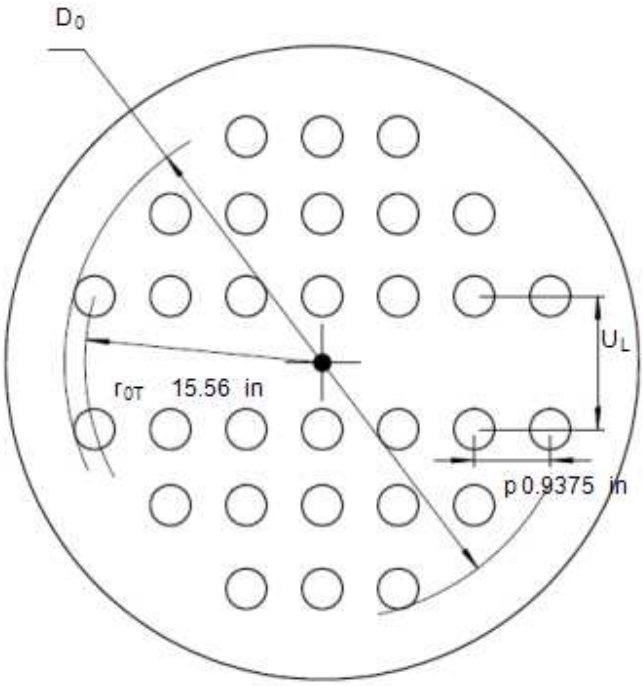
Additional specifications for the geometry and loading

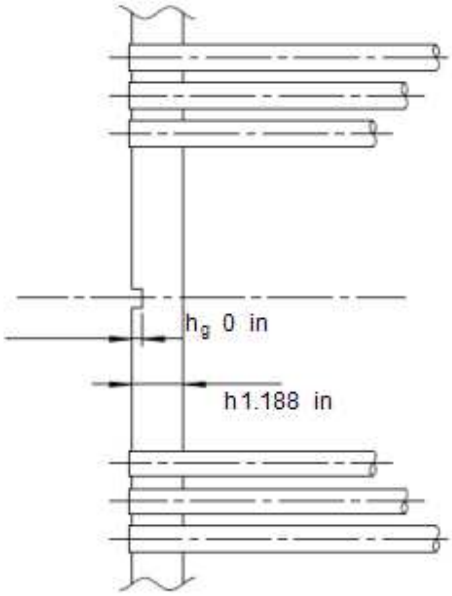
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)	*1*	(1, 2)
Tube pattern	(1=Triangle, 2=Square)	*1*	(1, 2)
Number of tubes	N_t	*1066*	



Expanded length of tube in tubesheet		$l_{t,x}$	*1.045*	in
Expanded length ratio $l_{t,x}/h$		ρ	**0.88**	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*15.56*	in
Perimeter of the outermost tubes	UHX-12.2	C_p		in
Total area enclosed by C_p	UHX-12.2	A_p		in²





Tube pitch (center distance)	p	*0.9375*	in
Total untubed area UL1·LL1+UL2·LL2.. UHX-11.2	A_L	*0*	in²
Depth of tube side pass partition groove	h_g	*0*	in
Expanded length ratio ltx/h	ρ	**0.88**	
Tube length between inner tubesheet faces	L	*153.5*	in
Unsupported tube span for buckling	l		in
Type of tube support (0.6=tubesheet-tubesheet, 0.8=tubesheet - support plate, 1=plate-plate)	k		
Equivalent free buckling length k · l	l_t	*20.75*	in

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W	**0**	lbf	**0**	lbf
Gasket operating force	W	**0**	lbf	**0**	lbf
Total required bolt area	A_m	**0**	in²	**0**	in²
Flange thickness	h_r	**0**	in	**0**	in

Maximum bolt force for all calculation casese	W_{max}	0	lbf

Bolt root area in² :

Results acc. to UHX-14

Gasket seating force = 0.5(A_m+A_b)·K_{sp}/S_{sp}, App.2-5	W	**0**	lbf
Channel thickness without allowances	t_c		in
Shell thickness without allowances	t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear	μ	**0.2**	
Effective ligament efficiency for shear	μ*	**0.322**	
Effective depth of pass partition groove	h_g'	**0**	in
Equivalent radius of outer tube limit circle	a_0	**15.94**	in
Radial channel dimension	a_c	**18.44**	in
Radial shell dimension	a_s	**18.44**	in
Ratio = a_c/a_0	$ρ_C$	**1.157**	
Ratio = a_s/a_0	$ρ_S$	**1.157**	
Parameter = 1-N_t·(0.5·d_aTUBE/a_0)²	x_s	**0.4099**	
Parameter = 1-N_t·(0.5·d_iTUBE/a_0)²	x_t	**0.5967**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E*	**8946968**	psi
Ratio of elasticity tubesheet								E*/E	**0.3376**	
Effective Poisson's ratio tubesheet								v*	**0.3161**	
Effective pitch								p*	**0.9375**	in
Effective tube hole diameter								d*	**0.6356**	in
Parameter for table UHX-13.1								X_a	**7.399**	
Z_d	**0.003691**	Z_v	**0.01864**	Z_m	**0.1967**	Z_a	**482.2**	Z_w	**0.01864**	

Step 4

Diameter ratio = A/D0							K	**1.157**	
F	**0.2951**	Φ		**0.3884**			Q_1	**0.139**	

UHX-14.5.5 Step 5: Coefficients

		ω_S		**0**	in²		ω_S*	**3.369**	in²
ω_C	**0**	in²	ω_C*	**3.369**	in²		γ_b	**0**	

Results acc. to UHX-14.6 and step 6

T_r =	**68**	°F	T_s* =	**68**	°F		T_c*	**68**	°F
P_s* =	**0**	psi	P_c* =	**0**	psi		P_e	**8.456**	psi

UHX-14.5.7 Step 7

Q_2	**-78.24**	lbf	Q_3	**0.06612**			F_m	**0.05755**	
Strength condition for the tubesheet bending stress, case								3	:
σ =	**1632**	psi	<1.5· σ_B =	**23700**	psi			case 1-3	
			< S_{PS} =	*47400*	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:									
τ =	**0**	psi	<0.8· σ_B =	**12640**	psi				

Strength condition of step 7-8 are satisfied

Step 9, as examples UHX-20.3:2009 (old N **)**

F_q	**7.379**		F_s	**1.25**					
Strength condition for the tube stress with cacluation case									3 :
S_{To} =	**-563.8**	psi	≤ σ_T =	*15800*	psi		for calculation case 1-3		
S_{To}			≤ 2·σ_T =	**31600**	psi		for calculation case 4-7		
$\lvert S_{To} \rvert$			≤ S_{tb} =	**10547**	psi		(for S_{To} < 0, Buckling)		
r_t	**0.2433**	in	F_t	**85.3**			C_t	**172.9**	

Condition UHX-14.5.9 not required for configuration ABCD

Step 10: Stress σ_S in the shell and σ_C in the channel

σ_S = $\lvert \sigma_{Sm} \rvert$ + $\lvert \sigma_{Sb} \rvert$ =			**0**	psi	< 1.5 · σ_{allS}, S_{PSs} or S_{PSs1}					
σ_S =	**0**	psi	+	**0**	psi	<	**0**	psi		
σ_C = $\lvert \sigma_{Cm} \rvert$ + $\lvert \sigma_{Cb} \rvert$ =			**0**	psi	< 1.5 · σ_{allC} or S_{PSc}					
σ_C =	**0**	psi	+	**0**	psi	<	**0**	psi		

Condition UHX-14.5.10 not required for configurations dBCD

Geometric conditions:

valid

Strength condition for linked modules (Connection activated: No):

Appendix: Material documentation

No materials for documentation