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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

5 EQU
Form for equations

Tables

with comment every three lines

ASME:2017 Example E4.18.8 and LV-calculation Add 2013
Results are arranged in 3 lines, line1: LV calculation, line 2: ASME,
line 3: difference in %.

:Stationary tubesheet, calculation case 1 ----------:-------

:	Conversion :	Sig :	SigAll :	|Tau| :	Tau	Sigto :	Stb	:MaxDiff%	
1	145	16416	28493		15196	2563	10662		
2	145	16400	28500		15200	2560	10700		
3	0	0.09598	-0.0254		-0.02539	0.1358	-0.3511		0.3511

:Stationary tubesheet, calculation case 2 ----------:-------

:	Case 2:	Sig :	SigAll :	|Tau| :	TauAll :	Sigto :	Stb	: MaxDiff%	
4	2	27360	28493		15196	-4522	10662		
5	2	27400	28500		15200	-4520	10700		
6	0	-0.1477	-0.0254		-0.02539	0.05299	-0.3511		0.3511

:Stationary tubesheet, calculation case 3 ----------:-------

:	Case 3:	Sig :	SigAll :	|Tau| :	TauAll :	Sigto :	Stb	: MaxDiff%	
7	3	10944	28493		15196	-1959	10662		
8	3	10900	28500		15200	-1959	10700		
9	0	0.4019	-0.0254		-0.02539	-4.08e-3	-0.3511		0.3511

:Floating tubesheet, |Sig| for calculation case 1-3 ----------:-------

:	Case 1 :	Case 2 :	Case 3 :----------:MaxDiff%					
10	9493	15822	6329					
11	9500	15800	6330					
12	-0.07055	0.1403	-0.01791	0	0	0	0	0.1403

Maximum % difference between LV and ASME for tube and tubesheeet stresses:

13	100							
14								
15								

Maximum 2009:

16	0.4582							

Links

1 1 UHXc: psi÷MPa=145: #138*psi÷MPa: #156*psi÷MPa: |#140*psi÷MPa|: #157*psi÷MPa: #263*psi÷MPa: #269*psi÷MPa
2 5 EQU: 145: 16400: 28500: 2210: 15200: 2560:10700
3
4 2 UHXc: 2: #138*psi÷MPa: #156*psi÷MPa: |#140*psi÷MPa|: #157*psi÷MPa: #263*psi÷MPa: #269*psi÷MPa
5 5 EQU: 2: 27400: 28500: 3680: 15200: -4520: 10700
6
7 4 UHXc: 3: #138*psi÷MPa: #156*psi÷MPa: |#140|*psi÷MPa: #157*psi÷MPa: #263*psi÷MPa: #269*psi÷MPa
8 5 EQU: 3: 10900: 28500: 1470: 15200: -1959: 10700
9
10 3 UHXc: #138(3)*psi÷MPa: #138(9)*psi÷MPa: #138(10)*psi÷MPa
11 5 EQU: 9500: 15800: 6330
12
13 5 EQU: Max(#163;#187;#211;#235)

16 '5 EQU: Max(#163;#187;#211;#235)

Additional comments

Units		**Value**	**Unit**		**Selected Unit**
Conversion	#121=	1	MPa	= #123 =	**145** psi

Stat

ASME UHX-14 Floating Tubesheets ASME BPVC Edition 2017

Floating tubesheet according to ASME-UHX-14

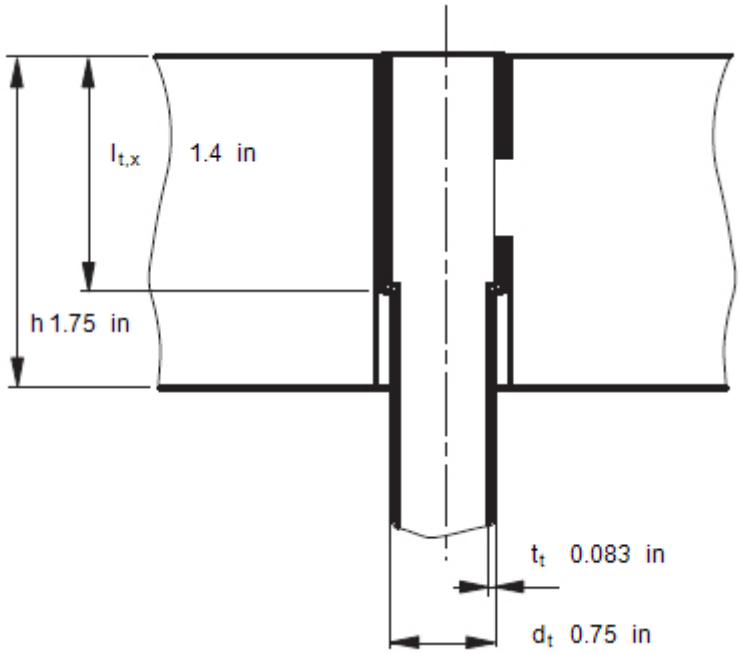
Type of heat exchanger (a,b,c)		WArt	*a*	a,b,c
Heat Exchanger With an Immersed Floating Head				
Configuration of the tubesheet (a-f,A-D)		Type	*d*	a-f,A-D
Stationary tubesheet gasketed with shell and channel				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure		P_s	*250*	psi
Tube side internal operation pressure		P_t	*150*	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	*1.75*	in		in	*0.083*	in	in
Outsidediameter	*33.07*	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	*2.7e+7*	psi		psi	*2.7e+7*	psi	psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F	1E-6/°F
Yield str.		psi		psi	*20550*	psi	psi
Limit temperature		°F		°F		°F	°F
All.stress	*19000*	psi	***0***	psi	*13350*	psi	***0*** psi
Pr.+sec.st	*57000*	psi	***0***	psi		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

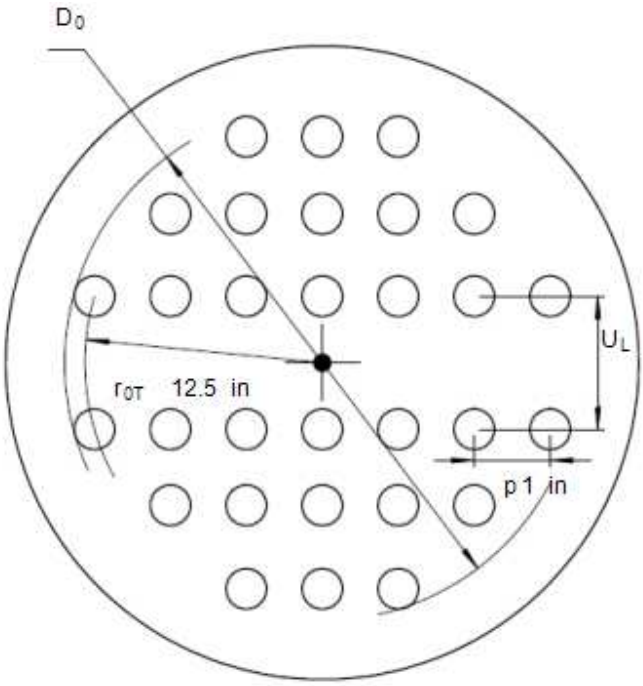
Additional specifications for the geometry and loading

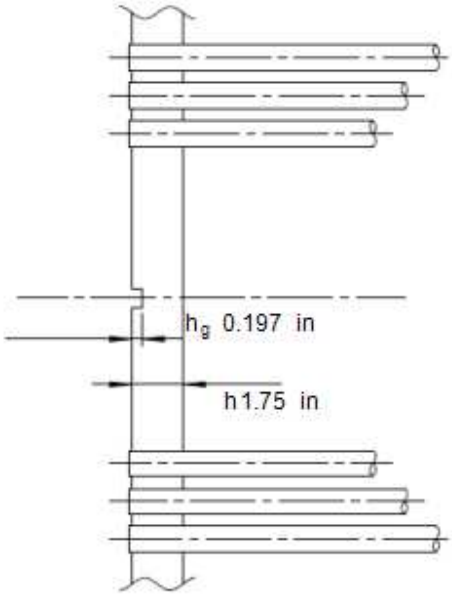
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)		*1*	(1, 2)
Tube pattern	(1=Triangle, 2=Square)		*1*	(1, 2)
Number of tubes		N_t	*466*	



Expanded length of tube in tubesheet		$l_{t,x}$	***1.4***	in
Expanded length ratio $l_{t,x}/h$		ρ	0.8	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*12.5*	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	*1*	in
Total untubed area UL1·LL1+UL2·LL2..	UHX-11.2		A_L	*64.4*	in²
Depth of tube side pass partition groove			h_g	*0.197*	in
Expanded length ratio ltx/h			ρ	0.8	
Tube length between inner tubesheet faces			L	*252.5*	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	*15.38*	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	*29.38*	in	*29.38*	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	*211426*	lbf
Total required bolt area	A_m		in²		in²
Flange thickness	h_r		in		in

Maximum bolt force for all calculation casese		W_{max}	211426	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	211426	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	**0.25**	
Effective ligament efficiency for shear	μ*	**0.3853**	
Effective depth of pass partition groove	h_g'	**0.197**	in
Equivalent radius of outer tube limit circle	a_0	**12.87**	in
Radial channel dimension	a_c	**14.69**	in
Radial shell dimension	a_s	**14.69**	in
Ratio = a_c/a_0	ρ_C	**1.141**	
Ratio = a_s/a_0	ρ_S	**1.141**	
Parameter = $1-N_t\cdot(0.5\cdot d_a TUBE/a_0)^2$	x_s	**0.6047**	
Parameter = $1-N_t\cdot(0.5\cdot d_i TUBE/a_0)^2$	x_t	**0.7603**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E*	**1.091e+7**	psi
Ratio of elasticity tubesheet								E*/E	**0.4039**	
Effective Poisson's ratio tubesheet								v*	**0.3084**	
Effective pitch								p*	**1.068**	in
Effective tube hole diameter								d*	**0.6567**	in
Parameter for table UHX-13.1								X_a	**3.61**	
Z_d	**0.03276**	Z_v	**0.07874**	Z_m	**0.4213**	Z_a	**4.21**	Z_w	**0.07874**	

Step 4

Diameter ratio = A/D0							K	**1.284**	
F	**0.4284**	Φ		**0.5605**			Q_1	**0.07818**	

UHX-14.5.5 Step 5: Coefficients

			ω_S	**0**	in²		ω_S*	**1.758**	in²
ω_C	**0**	in²	ω_C*	**1.758**	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	**-150**	psi

UHX-14.5.7 Step 7

Q_2	**-213.4**	lbf	Q_3	**0.09534**			F_m	**0.1023**	
Strength condition for the tubesheet bending stress, case								1	:
σ =	**16420**	psi	<1.5· σ_B =	**28500**	psi			case 1-3	
			< S_{PS} =	*57000*	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:									
τ =	**0**	psi	<0.8· σ_B =	**15200**	psi				

Strength condition of step 7-8 are satisfied

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

F_q	**3.421**		F_s	**1.54**					
Strength condition for the tube stress with cacluation case								1	:
S_{To} =	**2564**	psi	≤ σ_T =	*13350*	psi		for calculation case 1-3		
S_{To}			≤ 2·σ_T =	**26700**	psi		for calculation case 4-7		
$\lvert S_{To} \rvert$			≤ S_{tb} =	**10665**	psi		(for S_{To} < 0, Buckling)		
r_t	**0.2376**	in	F_t	**64.72**			C_t	**161**	

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):

Strength conditions are valid for all calculation cases

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

Floating tubesheet according to ASME-UHX-14

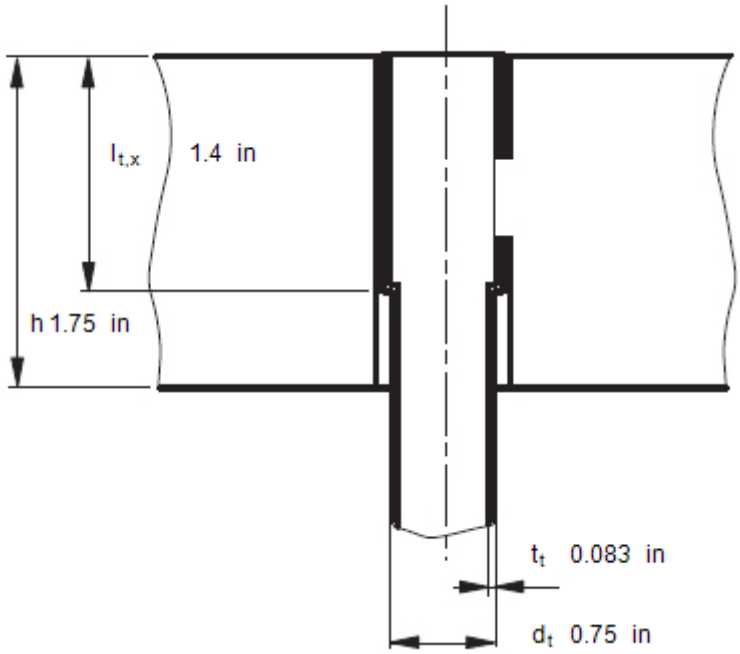
Type of heat exchanger (a,b,c)	WArt	*a*		a,b,c
Heat Exchanger With an Immersed Floating Head				
Configuration of the tubesheet (a-f,A-D)	Type	*d*		a-f,A-D
Stationary tubesheet gasketed with shell and channel				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure	P_s		*250*	psi
Tube side internal operation pressure	P_t		*150*	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	*1.75*	in		in	*0.083*	in		in
Outsidediameter	*33.07*	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	*2.7e+7*	psi		psi	*2.7e+7*	psi		psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F		1E-6/°F
Yield str.		psi		psi	*20550*	psi		psi
Limit temperature		°F		°F		°F		°F
All.stress	*19000*	psi	***0***	psi	*13350*	psi	***0***	psi
Pr.+sec.st	*57000*	psi	***0***	psi		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

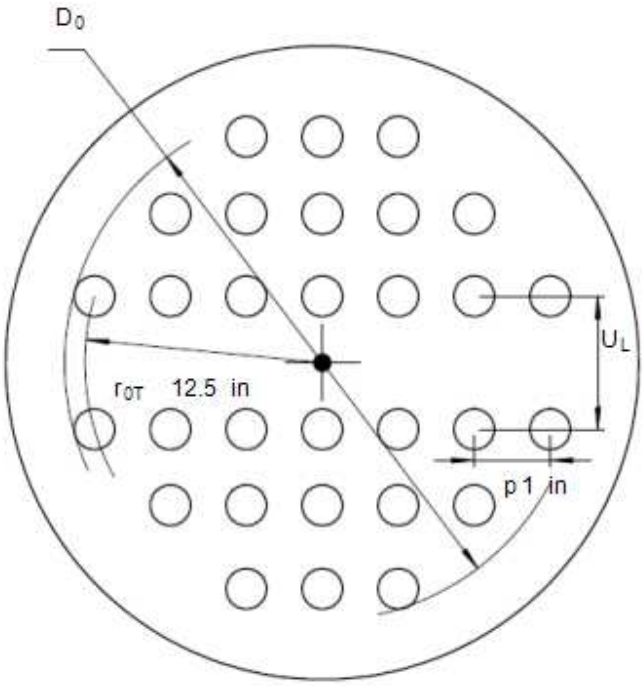
Additional specifications for the geometry and loading

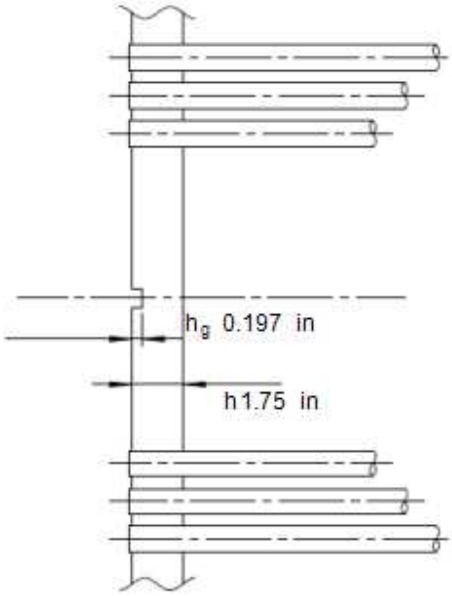
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)	*1*	(1, 2)
Tube pattern	(1=Triangle, 2=Square)	*1*	(1, 2)
Number of tubes	N_t	*466*	



Expanded length of tube in tubesheet		$l_{t,x}$	*1.4*	in
Expanded length ratio $l_{t,x}/h$		ρ	**0.8**	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*12.5*	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	*1*	in
Total untubed area UL1·LL1+UL2·LL2..	UHX-11.2			A_L	*64.4*	in²
Depth of tube side pass partition groove				h_g	*0.197*	in
Expanded length ratio ltx/h				ρ	**0.8**	
Tube length between inner tubesheet faces				L	*252.5*	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	*15.38*	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	*29.38*	in	*29.38*	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	*211426*	lbf
Total required bolt area	A_m		in²		in²
Flange thickness	h_r		in		in

Maximum bolt force for all calculation casese		W_{max}	211426	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	211426	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	**0.25**	
Effective ligament efficiency for shear	μ*	**0.3853**	
Effective depth of pass partition groove	h_g'	**0.197**	in
Equivalent radius of outer tube limit circle	a_0	**12.87**	in
Radial channel dimension	a_c	**14.69**	in
Radial shell dimension	a_s	**14.69**	in
Ratio = a_c/a_0	ρ_C	**1.141**	
Ratio = a_s/a_0	ρ_S	**1.141**	
Parameter = $1-N_t\cdot(0.5\cdot d_a TUBE/a_0)^2$	x_s	**0.6047**	
Parameter = $1-N_t\cdot(0.5\cdot d_i TUBE/a_0)^2$	x_t	**0.7603**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E*	**1.091e+7**	psi
Ratio of elasticity tubesheet								E*/E	**0.4039**	
Effective Poisson's ratio tubesheet								v*	**0.3084**	
Effective pitch								p*	**1.068**	in
Effective tube hole diameter								d*	**0.6567**	in
Parameter for table UHX-13.1								X_a	**3.61**	
Z_d	**0.03276**	Z_v	**0.07874**	Z_m	**0.4213**	Z_a	**4.21**	Z_w	**0.07874**	

Step 4

Diameter ratio = A/D0							K	**1.284**	
F	**0.4284**	Φ		**0.5605**			Q_1	**0.07818**	

UHX-14.5.5 Step 5: Coefficients

			ω_S	**0**	in²		ω_S*	**1.758**	in²
ω_C	**0**	in²	ω_C*	**1.758**	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	**250**	psi

UHX-14.5.7 Step 7

Q_2	**355.6**	lbf	Q_3	**0.09534**			F_m	**0.1023**	
Strength condition for the tubesheet bending stress, case								2	:
σ =	**27367**	psi	<1.5· σ_B =	**28500**	psi			case 1-3	
			< S_{PS} =	*57000*	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:									
τ =	**0**	psi	<0.8· σ_B =	**15200**	psi				

Strength condition of step 7-8 are satisfied

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

F_q	**3.421**		F_s	**1.54**					
Strength condition for the tube stress with cacluation case									2 :
S_{To} =	**-4524**	psi	≤ σ_T =	*13350*	psi		for calculation case 1-3		
S_{To}			≤ 2·σ_T =	**26700**	psi		for calculation case 4-7		
$\lvert S_{To} \rvert$			≤ S_{tb} =	**10665**	psi		(for S_{To} < 0, Buckling)		
r_t	**0.2376**	in	F_t	**64.72**			C_t	**161**	

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 · 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):

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

Floating tubesheet according to ASME-UHX-14

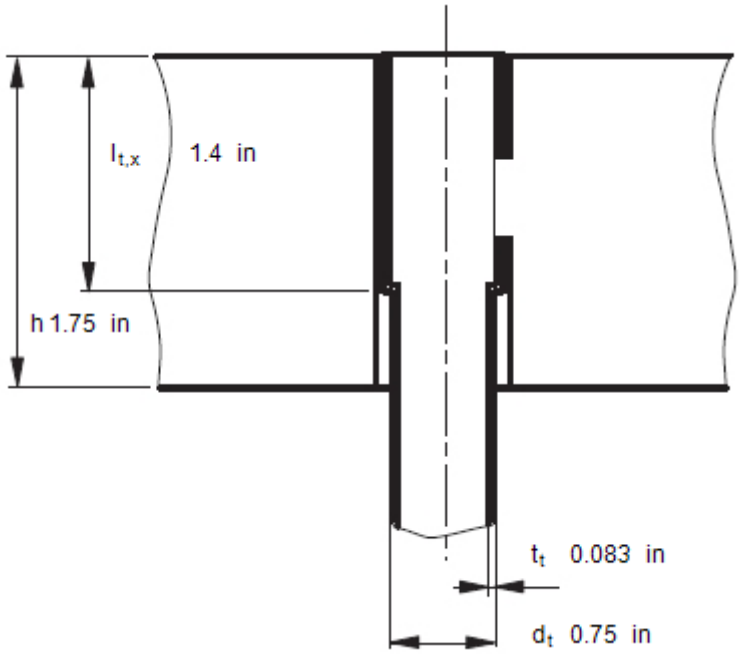
Type of heat exchanger (a,b,c)	WArt	*a*		a,b,c
Heat Exchanger With an Immersed Floating Head				
Configuration of the tubesheet (a-f,A-D)	Type	*d*		a-f,A-D
Stationary tubesheet gasketed with shell and channel				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure	P_s		*250*	psi
Tube side internal operation pressure	P_t		*150*	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	*1.75*	in		in	*0.083*	in		in
Outsidediameter	*33.07*	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	*2.7e+7*	psi		psi	*2.7e+7*	psi		psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F		1E-6/°F
Yield str.		psi		psi	*20550*	psi		psi
Limit temperature		°F		°F		°F		°F
All.stress	*19000*	psi	***0***	psi	*13350*	psi	***0***	psi
Pr.+sec.st	*57000*	psi	***0***	psi		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

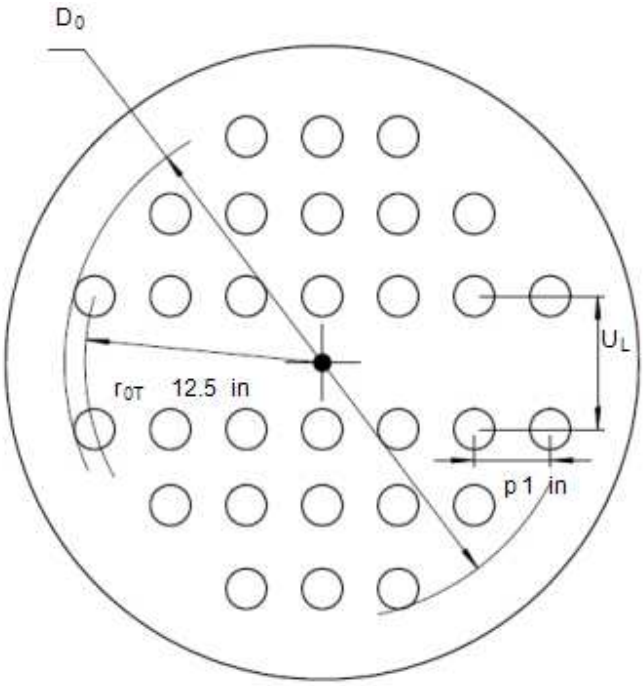
Additional specifications for the geometry and loading

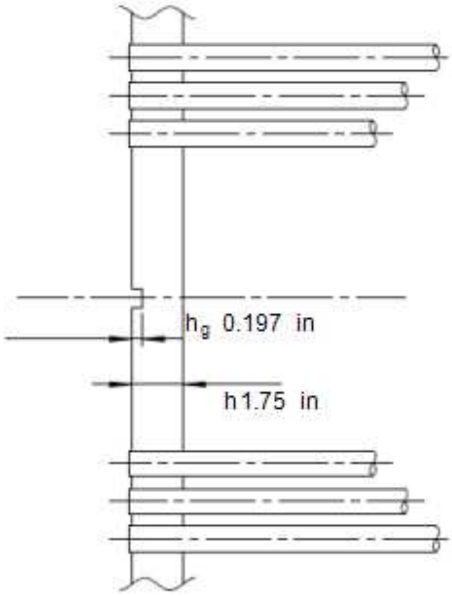
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)	*1*	(1, 2)
Tube pattern	(1=Triangle, 2=Square)	*1*	(1, 2)
Number of tubes	N_t	*466*	



Expanded length of tube in tubesheet		$l_{t,x}$	*1.4*	in
Expanded length ratio $l_{t,x}$/h		ρ	**0.8**	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*12.5*	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	*1*	in
Total untubed area UL1·LL1+UL2·LL2..	UHX-11.2		A_L	*64.4*	in²
Depth of tube side pass partition groove			h_g	*0.197*	in
Expanded length ratio ltx/h			ρ	**0.8**	
Tube length between inner tubesheet faces			L	*252.5*	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	*15.38*	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	*29.38*	in	*29.38*	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	*211426*	lbf
Total required bolt area	A_m		in²		in²
Flange thickness	h_r		in		in

Maximum bolt force for all calculation casese		W_{max}	211426	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	211426	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	**0.25**	
Effective ligament efficiency for shear	μ*	**0.3853**	
Effective depth of pass partition groove	h_g'	**0.197**	in
Equivalent radius of outer tube limit circle	a_0	**12.87**	in
Radial channel dimension	a_c	**14.69**	in
Radial shell dimension	a_s	**14.69**	in
Ratio = a_c/a_0	ρ_C	**1.141**	
Ratio = a_s/a_0	ρ_S	**1.141**	
Parameter = $1-N_t\cdot(0.5\cdot d_a TUBE/a_0)^2$	x_s	**0.6047**	
Parameter = $1-N_t\cdot(0.5\cdot d_i TUBE/a_0)^2$	x_t	**0.7603**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E*	**1.091e+7**	psi
Ratio of elasticity tubesheet								E*/E	**0.4039**	
Effective Poisson's ratio tubesheet								v*	**0.3084**	
Effective pitch								p*	**1.068**	in
Effective tube hole diameter								d*	**0.6567**	in
Parameter for table UHX-13.1								X_a	**3.61**	
Z_d	**0.03276**	Z_v	**0.07874**	Z_m	**0.4213**	Z_a	**4.21**	Z_w	**0.07874**	

Step 4

Diameter ratio = A/D0							K	**1.284**	
F	**0.4284**	Φ		**0.5605**			Q_1	**0.07818**	

UHX-14.5.5 Step 5: Coefficients

			ω_S	**0**	in²		ω_S*	**1.758**	in²
ω_C	**0**	in²	ω_C*	**1.758**	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	**100**	psi

UHX-14.5.7 Step 7

Q_2	**142.2**	lbf	Q_3	**0.09534**			F_m	**0.1023**	
Strength condition for the tubesheet bending stress, case								3	:
σ =	**10947**	psi	<1.5· σ_B =	**28500**	psi			case 1-3	
			< S_{PS} =	*57000*	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:									
τ =	**0**	psi	<0.8· σ_B =	**15200**	psi				

Strength condition of step 7-8 are satisfied

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

F_q	**3.421**		F_s	**1.54**					
Strength condition for the tube stress with cacluation case									3 :
S_{To} =	**-1959**	psi	≤ σ_T =	*13350*	psi		for calculation case 1-3		
S_{To}			≤ 2·σ_T =	**26700**	psi		for calculation case 4-7		
$\lvert S_{To} \rvert$			≤ S_{tb} =	**10665**	psi		(for S_{To} < 0, Buckling)		
r_t	**0.2376**	in	F_t	**64.72**			C_t	**161**	

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 · 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):

Float

ASME UHX-14 Floating Tubesheets ASME BPVC Edition 2017

Floating tubesheet according to ASME-UHX-14

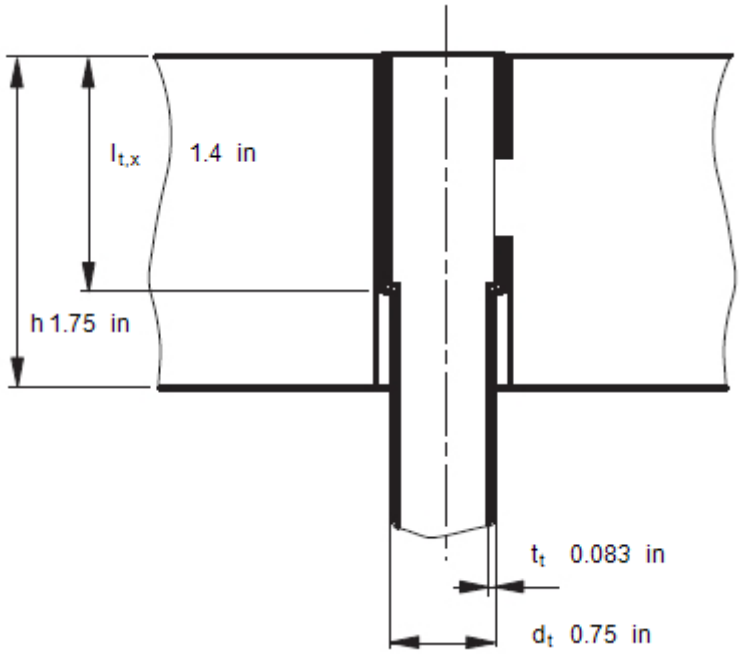
Type of heat exchanger (a,b,c)		WArt	*a*	a,b,c
Heat Exchanger With an Immersed Floating Head				
Configuration of the tubesheet (a-f,A-D)		Type	*C*	a-f,A-D
Floating tubesheet gasketed, without flange extension				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure		P_s	*250*	psi
Tube side internal operation pressure		P_t	*150*	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	*1.75*	in		in	*0.083*	in	*0.3125* in
Outsidediameter	*26.89*	in		in	*0.75*	in	*27.03* in
Poiss.-rat.	*0.31*		*0.3*		*0.31*		*0.32*
Allow. c1	*0*	in		in	*0*	in	*0* in
Corr.all.c2	*0*	in		in	*0*	in	*0* in
Figure							
Strength for the selected load case temperature							
Strength		psi		psi		psi	psi
Safety							
E-module	*2.7e+7*	psi		psi	*2.7e+7*	psi	*1.48e+7* psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F	*4.8* 1E-6/°F
Yield str.		psi		psi	*20550*	psi	*31600* psi
Limit temperature		°F		°F		°F	°F
All.stress	*19000*	psi	***0***	psi	*13350*	psi	*11300* psi
Pr.+sec.st	*57000*	psi	***0***	psi		psi	*33900* 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

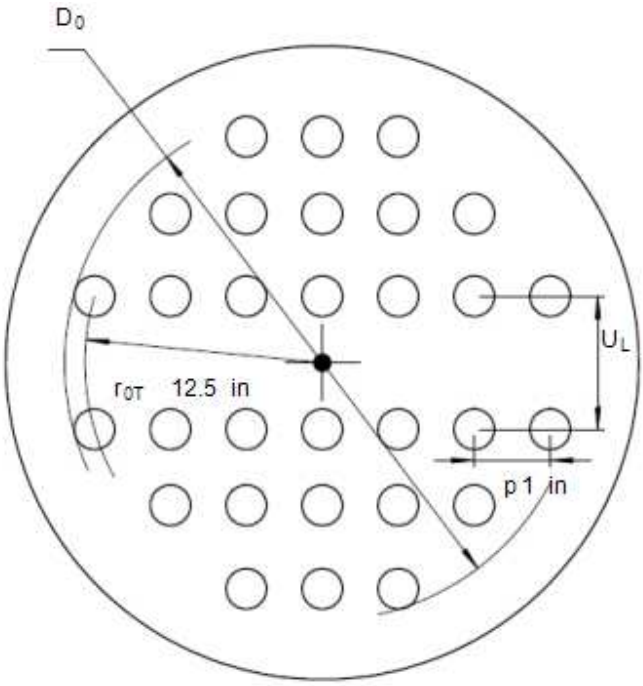
Additional specifications for the geometry and loading

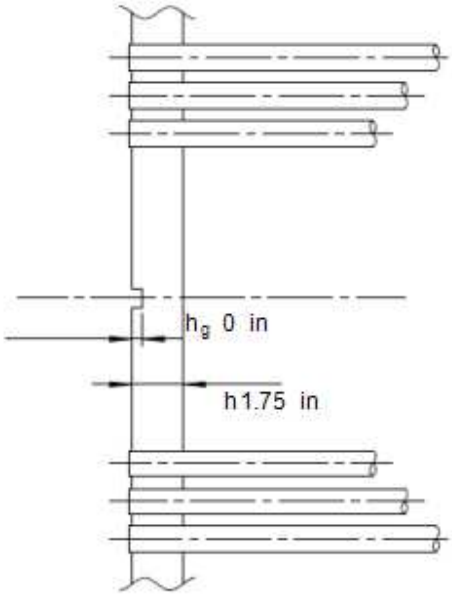
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)		*1* (1, 2)
Tube pattern	(1=Triangle, 2=Square)		*1* (1, 2)
Number of tubes		N_t	*466*



Expanded length of tube in tubesheet		$l_{t,x}$	*1.4*	in
Expanded length ratio $l_{t,x}$/h		ρ	**0.8**	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*12.5*	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	*1*	in
Total untubed area UL1·LL1+UL2·LL2.. UHX-11.2	A_L	*64.4*	in²
Depth of tube side pass partition groove	h_g	*0*	in
Expanded length ratio ltx/h	ρ	**0.8**	
Tube length between inner tubesheet faces	L	*252.5*	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	*15.38*	in

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W	***0***	lbf		lbf
Gasket operating force	W	**0**	lbf	*26225*	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	26225	lbf
Channel thickness without allowances	t_c	**0.3125**	in
Shell thickness without allowances	t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear	μ	**0.25**	
Effective ligament efficiency for shear	μ*	**0.3853**	
Effective depth of pass partition groove	h_g'	**0**	in
Equivalent radius of outer tube limit circle	a_0	**12.87**	in
Radial channel dimension	a_c	**13.25**	in
Radial shell dimension	a_s	**13.25**	in
Ratio = a_c/a_0	$ρ_C$	**1.029**	
Ratio = a_s/a_0	$ρ_S$	**1.029**	
Parameter = 1-N_t·(0.5·d_aTUBE/a_0)²	x_s	**0.6047**	
Parameter = 1-N_t·(0.5·d_iTUBE/a_0)²	x_t	**0.7603**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E*	**1.091e+7**	psi
Ratio of elasticity tubesheet								E*/E	**0.4039**	
Effective Poisson's ratio tubesheet								v*	**0.3084**	
Effective pitch								p*	**1.068**	in
Effective tube hole diameter								d*	**0.6567**	in
Parameter for table UHX-13.1								X_a	**3.61**	
Z_d	**0.03276**	Z_v	**0.07874**	Z_m	**0.4213**	Z_a	**4.21**	Z_w	**0.07874**	

Step 4

Diameter ratio = A/D0								K	**1.044**	
F	**0.07417**			Φ	**0.09705**			Q_1	**0.02049**	

UHX-14.5.5 Step 5: Coefficients

				ω_S	**0**	in²		ω_S*	**0.07057**	in²
ω_C	**0**	in²		ω_C*	**0.07057**	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	**-150**	psi

UHX-14.5.7 Step 7

Q_2	**-10.17**	lbf		Q_3	**0.02131**			F_m	**0.0751**	
Strength condition for the tubesheet bending stress, case									1	:
σ =	**9496**	psi		<1.5· σ_B =	**28500**	psi			case 1-3	
				< S_{PS} =	*57000*	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:										
τ =	**0**	psi		<0.8· σ_B =	**15200**	psi				

Strength condition of step 7-8 are satisfied

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

F_q	**2.925**			F_s	**1.787**					
Strength condition for the tube stress with cacluation case									1	:
S_{To} =	**2087**	psi		≤ σ_T =	*13350*	psi		for calculation case 1-3		
S_{To}				≤ 2·σ_T =	**26700**	psi		for calculation case 4-7		
$\lvert S_{To} \rvert$				≤ S_{tb} =	**9188**	psi		(for S_{To} < 0, Buckling)		
r_t	**0.2376**	in		F_t	**64.72**			C_t	**161**	

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	<	**16950**	psi		

Condition UHX-14.5.10 not required for configurations dBCD

Geometric conditions:

valid

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

Strength conditions are valid for all calculation cases

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

Floating tubesheet according to ASME-UHX-14

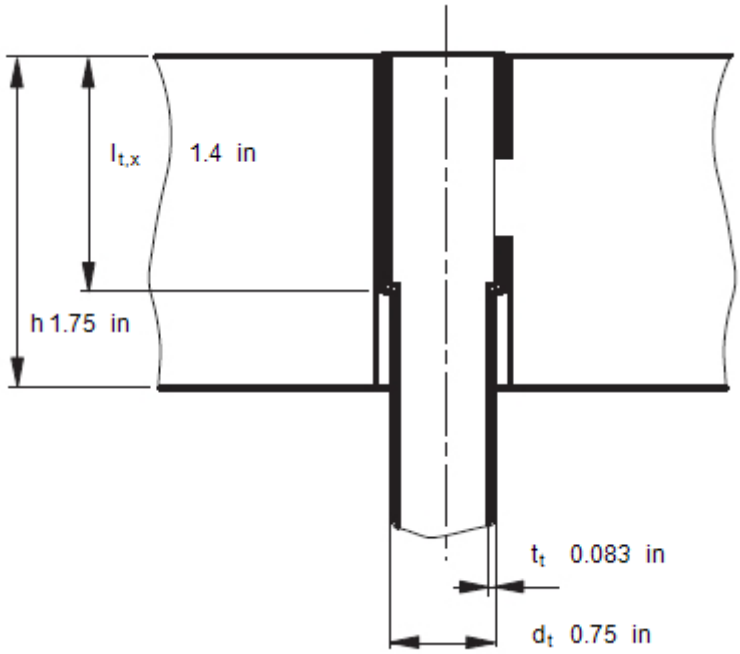
Type of heat exchanger (a,b,c)		WArt	*a*	a,b,c
Heat Exchanger With an Immersed Floating Head				
Configuration of the tubesheet (a-f,A-D)		Type	*C*	a-f,A-D
Floating tubesheet gasketed, without flange extension				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure		P_s	*250*	psi
Tube side internal operation pressure		P_t	*150*	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	*1.75*	in		in	*0.083*	in	*0.3125* in
Outsidediameter	*26.89*	in		in	*0.75*	in	*27.03* in
Poiss.-rat.	*0.31*		*0.3*		*0.31*		*0.32*
Allow. c1	*0*	in		in	*0*	in	*0* in
Corr.all.c2	*0*	in		in	*0*	in	*0* in
Figure							
Strength for the selected load case temperature							
Strength		psi		psi		psi	psi
Safety							
E-module	*2.7e+7*	psi		psi	*2.7e+7*	psi	*1.48e+7* psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F	*4.8* 1E-6/°F
Yield str.		psi		psi	*20550*	psi	*31600* psi
Limit temperature		°F		°F		°F	°F
All.stress	*19000*	psi	***0***	psi	*13350*	psi	*11300* psi
Pr.+sec.st	*57000*	psi	***0***	psi		psi	*33900* 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

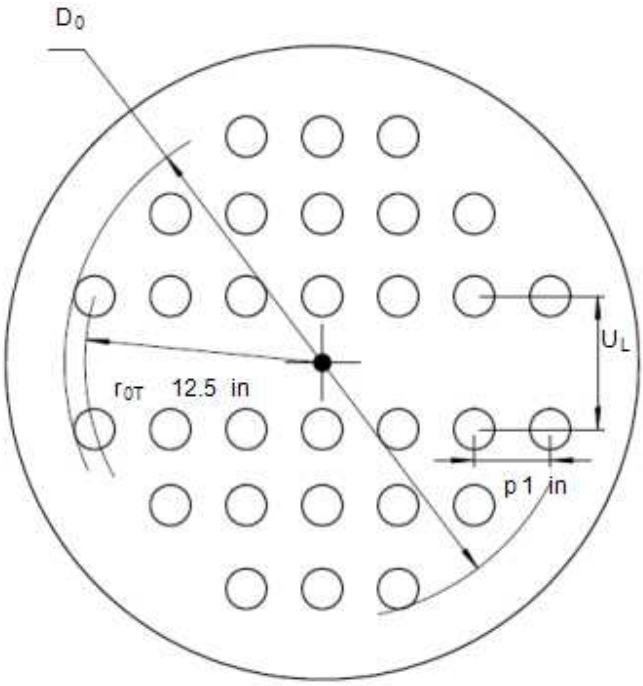
Additional specifications for the geometry and loading

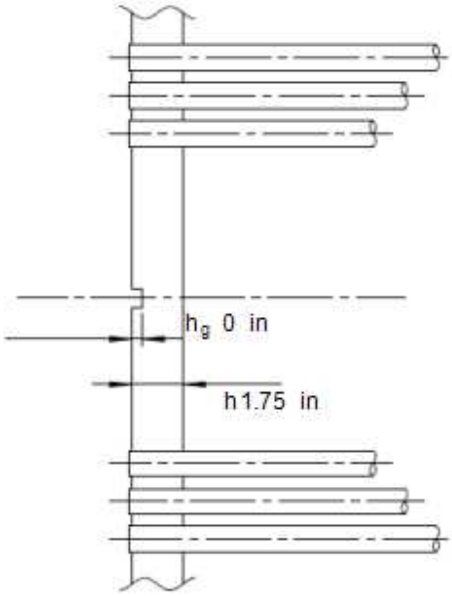
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)		*1*	(1, 2)
Tube pattern	(1=Triangle, 2=Square)		*1*	(1, 2)
Number of tubes		N_t	*466*	



Expanded length of tube in tubesheet		$l_{t,x}$	*1.4*	in
Expanded length ratio $l_{t,x}$/h		ρ	**0.8**	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*12.5*	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	*1*	in
Total untubed area UL1·LL1+UL2·LL2.. UHX-11.2	A_L	*64.4*	in²
Depth of tube side pass partition groove	h_g	*0*	in
Expanded length ratio ltx/h	ρ	**0.8**	
Tube length between inner tubesheet faces	L	*252.5*	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	*15.38*	in

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W	***0***	lbf		lbf
Gasket operating force	W	**0**	lbf	*26225*	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 = $0.5(A_m+A_b)\cdot K_{sp}/S_{sp}$, App.2-5	W	26225	lbf
Channel thickness without allowances	t_c	**0.3125**	in
Shell thickness without allowances	t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear	μ	**0.25**	
Effective ligament efficiency for shear	μ*	**0.3853**	
Effective depth of pass partition groove	h_g'	**0**	in
Equivalent radius of outer tube limit circle	a_0	**12.87**	in
Radial channel dimension	a_c	**13.25**	in
Radial shell dimension	a_s	**13.25**	in
Ratio = a_c/a_0	ρ_C	**1.029**	
Ratio = a_s/a_0	ρ_S	**1.029**	
Parameter = $1-N_t\cdot(0.5\cdot d_a TUBE/a_0)^2$	x_s	**0.6047**	
Parameter = $1-N_t\cdot(0.5\cdot d_i TUBE/a_0)^2$	x_t	**0.7603**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E*	**1.091e+7**	psi
Ratio of elasticity tubesheet								E*/E	**0.4039**	
Effective Poisson's ratio tubesheet								v*	**0.3084**	
Effective pitch								p*	**1.068**	in
Effective tube hole diameter								d*	**0.6567**	in
Parameter for table UHX-13.1								X_a	**3.61**	
Z_d	**0.03276**	Z_v	**0.07874**	Z_m	**0.4213**	Z_a	**4.21**	Z_w	**0.07874**	

Step 4

Diameter ratio = A/D0								K	**1.044**	
F	**0.07417**			Φ	**0.09705**			Q_1	**0.02049**	

UHX-14.5.5 Step 5: Coefficients

				ω_S	**0**	in²		ω_S*	**0.07057**	in²
ω_C	**0**	in²		ω_C*	**0.07057**	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	**250**	psi

UHX-14.5.7 Step 7

Q_2	**16.95**	lbf		Q_3	**0.02131**			F_m	**0.0751**	
Strength condition for the tubesheet bending stress, case									2	:
σ =	**15826**	psi		<1.5· σ_B =	**28500**	psi			case 1-3	
				< S_{PS} =	*57000*	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:										
τ =	**0**	psi		<0.8· σ_B =	**15200**	psi				

Strength condition of step 7-8 are satisfied

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

F_q	**2.925**			F_s	**1.787**					
Strength condition for the tube stress with cacluation case									2	:
S_{To} =	**-3728**	psi		≤ σ_T =	*13350*	psi		for calculation case 1-3		
S_{To}				≤ 2·σ_T =	**26700**	psi		for calculation case 4-7		
$\lvert S_{To} \rvert$				≤ S_{tb} =	**9188**	psi		(for S_{To} < 0, Buckling)		
r_t	**0.2376**	in		F_t	**64.72**			C_t	**161**	

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	<	**16950**	psi		

Condition UHX-14.5.10 not required for configurations dBCD

Geometric conditions:

valid

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

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

Floating tubesheet according to ASME-UHX-14

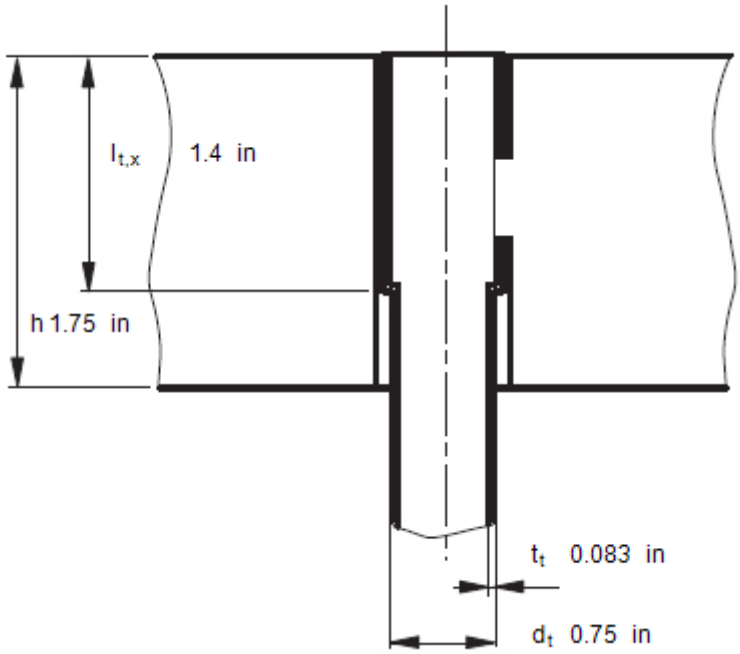
Type of heat exchanger (a,b,c)		WArt	*a*	a,b,c
Heat Exchanger With an Immersed Floating Head				
Configuration of the tubesheet (a-f,A-D)		Type	*C*	a-f,A-D
Floating tubesheet gasketed, without flange extension				
Type of channel (1=Cylinder, 2=Hemispherical)			1	(1,2)
Shell side internal operation pressure		P_s	*250*	psi
Tube side internal operation pressure		P_t	*150*	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	*1.75*	in		in	*0.083*	in	*0.3125* in
Outsidediameter	*26.89*	in		in	*0.75*	in	*27.03* in
Poiss.-rat.	*0.31*		*0.3*		*0.31*		*0.32*
Allow. c1	*0*	in		in	*0*	in	*0* in
Corr.all.c2	*0*	in		in	*0*	in	*0* in
Figure							
Strength for the selected load case temperature							
Strength		psi		psi		psi	psi
Safety							
E-module	*2.7e+7*	psi		psi	*2.7e+7*	psi	*1.48e+7* psi
Therm.dil.		1E-6/°F		1E-6/°F		1E-6/°F	*4.8* 1E-6/°F
Yield str.		psi		psi	*20550*	psi	*31600* psi
Limit temperature		°F		°F		°F	°F
All.stress	*19000*	psi	***0***	psi	*13350*	psi	*11300* psi
Pr.+sec.st	*57000*	psi	***0***	psi		psi	*33900* 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

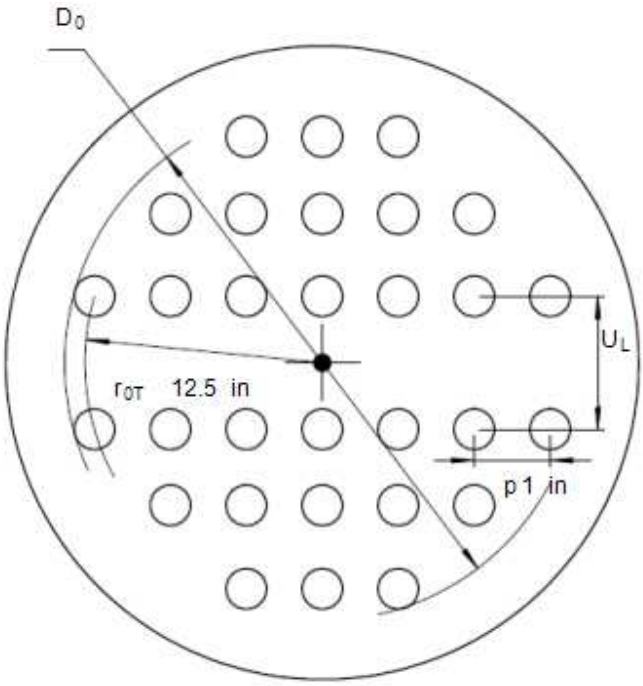
Additional specifications for the geometry and loading

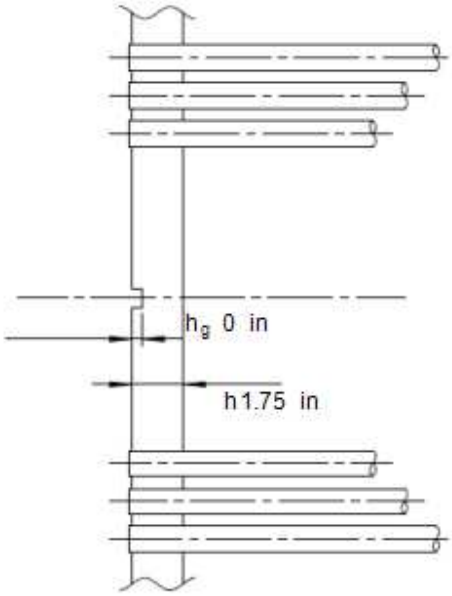
Tubesheet

Tube-tubesheet joint	(1=expanded, 2=welded)		*1* (1, 2)
Tube pattern	(1=Triangle, 2=Square)		*1* (1, 2)
Number of tubes		N_t	*466*



Expanded length of tube in tubesheet		$l_{t,x}$	*1.4*	in
Expanded length ratio $l_{t,x}/h$		ρ	**0.8**	
Radius to outermost tube hole center	UHX-11.1(a)	r_{0T}	*12.5*	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	*1*	in
Total untubed area UL1·LL1+UL2·LL2.. UHX-11.2	A_L	*64.4*	in²
Depth of tube side pass partition groove	h_g	*0*	in
Expanded length ratio ltx/h	ρ	**0.8**	
Tube length between inner tubesheet faces	L	*252.5*	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	*15.38*	in

Results acc. UHX-9		**Shell**		**Channel**	
Effective seating width	b		in		in
Gasket bolt-up force	W	***0***	lbf		lbf
Gasket operating force	W	**0**	lbf	*26225*	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 = $0.5(A_m+A_b)\cdot K_{sp}/S_{sp}$, App.2-5	W	26225	lbf
Channel thickness without allowances	t_c	**0.3125**	in
Shell thickness without allowances	t_s		in

Step 1 acc. UHX 14.5

Basic ligament efficiency for shear	μ	**0.25**	
Effective ligament efficiency for shear	μ*	**0.3853**	
Effective depth of pass partition groove	h_g'	**0**	in
Equivalent radius of outer tube limit circle	a_0	**12.87**	in
Radial channel dimension	a_c	**13.25**	in
Radial shell dimension	a_s	**13.25**	in
Ratio = a_c/a_0	ρ_C	**1.029**	
Ratio = a_s/a_0	ρ_S	**1.029**	
Parameter = $1-N_t\cdot(0.5\cdot d_a TUBE/a_0)^2$	x_s	**0.6047**	
Parameter = $1-N_t\cdot(0.5\cdot d_i TUBE/a_0)^2$	x_t	**0.7603**	

Step 2

Step 3

Effective modulus of el. tubesheet (Fig.UHX-11.3)								E*	**1.091e+7**	psi
Ratio of elasticity tubesheet								E*/E	**0.4039**	
Effective Poisson's ratio tubesheet								v*	**0.3084**	
Effective pitch								p*	**1.068**	in
Effective tube hole diameter								d*	**0.6567**	in
Parameter for table UHX-13.1								X_a	**3.61**	
Z_d	**0.03276**	Z_v	**0.07874**	Z_m	**0.4213**	Z_a	**4.21**	Z_w	**0.07874**	

Step 4

Diameter ratio = A/D0								K	**1.044**	
F	**0.07417**			Φ	**0.09705**			Q_1	**0.02049**	

UHX-14.5.5 Step 5: Coefficients

				ω_S	**0**	in²		ω_S*	**0.07057**	in²
ω_C	**0**	in²		ω_C*	**0.07057**	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	**100**	psi

UHX-14.5.7 Step 7

Q_2	**6.78**	lbf		Q_3	**0.02131**			F_m	**0.0751**	
Strength condition for the tubesheet bending stress, case									3	:
σ =	**6330**	psi		<1.5· σ_B =	**28500**	psi			case 1-3	
				< S_{PS} =	*57000*	psi			case 4-7	

Step 8

Strength condition for the tubesheet shear stress:										
τ =	**0**	psi		<0.8· σ_B =	**15200**	psi				

Strength condition of step 7-8 are satisfied

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

F_q	**2.925**			F_s	**1.787**					
Strength condition for the tube stress with cacluation case									3	:
S_{To} =	**-1641**	psi		≤ σ_T =	*13350*	psi		for calculation case 1-3		
S_{To}				≤ 2·σ_T =	**26700**	psi		for calculation case 4-7		
$\lvert S_{To} \rvert$				≤ S_{tb} =	**9188**	psi		(for S_{To} < 0, Buckling)		
r_t	**0.2376**	in		F_t	**64.72**			C_t	**161**	

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	<	**16950**	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