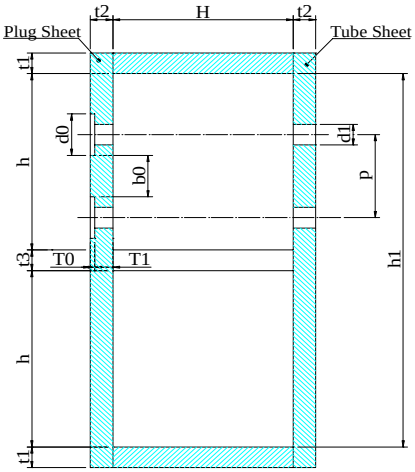
OWNER	PURCHASER	MECHANICAL CALCULATION BOOK FOR	VENDOR	DESIGNER
NIGC	OTC OTEC	EA-TEST	TASHA	SEC Sabz Engineering Company شرکت مهندسی سبز

DOCUMENT NO.	Rev.
XXXXXXX	1

HEADER DESIGN UNDER INTERNAL PRESSURE



REFERENCE
ASME SEC. VIII DIV. 1 APP. 13 - 2001- Sketch-7

P (Internal design pressure; N/mm^2)	8.2	t_1 (Top & bottom plate th'k.; mm)	22
T (Design temp.°C)	160	t_2 (Tube & plug sheet th'k.; mm)	35
Header material	SA-516 Gr.70	t_3 (Stay plate th'k.; mm)	24
Type of material	C.S.	t_5 (End plate th'k.; mm)	22
S (Allowable stress; N/mm^2)	137.9	H (Vessel short side inside length; mm)	100
p (Pitch; mm)	66.68	h (Vessel long side inside length; mm)	140
d_o (Tube outside diameter; mm)	25.4	h_1 (Header long side inside length; mm)	284
No. of Tubes / Bundle	203	T_0 (Lenght of hole d_0; mm)	2
No. of Tube Rows	5	d_0 (Diameter of the seating hole of plug; mm)	36
E (Joint efficiency of end plates)	1.0	T_1 (Lenght of hole d_1; mm)	30
C.A. (Corrosion Allowance; mm)	3	d_1 (Diameter of the tubehole ; mm)	25.7
NP = Size of inlet nozzles (in)	8	L = Approx. Header Length (mm)	2833
No. of inlet nozzles	2	Pass partition hole pitch (mm)	134
Type Of Stay plate (PP=Partition ; SP=Stay plate)	pp	Pass partition hole dia. (mm)	65
		No. of holes on Pass Partition	20

$b_0 = p - d_0$	30.68	$t_2 - X =$	16.24
$b_1 = p - d_1$	40.98	$co_2 = -(t_2 - X)$	-16.24
$ci_2 = X = [b_0T_0(T_0/2+T_1)+b_1T_1(T_1/2)] / (b_0T_0+b_1T_1)$	15.761	c_r (The larger of X or $t_2 - X$)	16.24
$I = (b_0T_0^3 + b_1T_1^3)/12 + b_0T_0(T_0/2 + T_1 - X)^2 + b_1T_1(T_1/2 - X)^2$	107187		
$Dem = (d_oT_o + d_1T_1)/t_2$	26.34	$Deb = p - 6I / t^2c_r$	28.006
c_1 = (Distance from neutral axis of Top & Bottom Plate to outside extreme fibers; mm)			9.50
c_2 = (Distance from neutral axis of Tube Sheet to outside extreme fibers; mm)			16.00
c_{22} = (Distance from neutral axis of Plug Sheet to outside extreme fibers; mm)			16.24

e_{ml} = emb = (p - D_{em}) / p (Membrane efficiency Tube Sheet)	0.619	$I_{21} = t_2^3 / 12$ (Corroded Condition)	2730.67
e_{pp} = Stay plate effeciency	0.55	$I_{22} = t_2^3 / 12$ (Corroded Condition)	2730.67
e_{mb} =(p - D_{eb}) / p (Bending efficiency Plug Sheet)	0.5800	$I_1 = t_1^3 / 12$ (Corroded Condition)	571.58
e_{mm} =(p - D_{em}) / p (Membrane efficiency Plug Sheet)	0.6049	$K_1 = (I_{21} / I_1)$*ALPHA	3.4685
ALPHA = H / h	0.7260	$K_2 = (I_{22} / I_1)$*ALPHA	3.4685

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Membrane stress

Top & Bottom plate :	$(S_m)t_1 = (Ph / 4*e_{ms}*t_1)\{4 -[2+K(5-ALPA^2) / (1+2K)]\}$	28.25
Tube Sheet :	$(S_m)t_2 = PH / 2e_{ml}t_2$	21.94
Plug Sheet :	$(S_m)t_2 = PH / 2e_{mm}t_2$	22.45
Stay plate	$S_m = Ph / 2e_{pp}t_3[2 + K(5 - ALPHA^2) / (1+2K)]$	133.42

Bending stress

Top & Bottom Plates

$(S_b)N = (Pc_1/24EI_1)*[3H^2-2h^2(1+2ALPHA^2K)/(1+2K)]$	46.92
$(S_b)Q = (Ph^2c_1/12EI_1)*(1+2ALPHA^2K)/(1+2K)]$	142.03

Tube Sheet

$(S_b)M = (Ph^2c_2/12e_{bl}I_2)*[1+K(3-ALPHA^2)/(1+2K)]$	166.35
$(S_b)Q = (Ph^2c_2/12EI_2)*(1+2ALPHA^2K)/(1+2K)]$	50.07

Plug Sheet

$(S_b)M = (Ph^2c_{22}/12embI_2)*[1+K(3-ALPHA^2)/(1+2K)]$	180.22
$(S_b)Q = (Ph^2c_{22}/12EI_2)*(1+2ALPHA^2K)/(1+2K)]$	50.82

Total stress

Top & Bottom Plates		Tube Sheet		Plug Sheet	
$(S_T)N = (S_m)t_1 + (S_b)N$	75.17	$(S_T)M = (S_m)t_2 + (S_b)M$	188.29	$(S_T)M = (S_m)t_2 + (S_b)M$	202.67
$(S_T)Q = (S_m)t_1 + (S_b)Q$	170.28	$(S_T)Q = (S_m)t_2 + (S_b)Q$	72.01	$(S_T)Q = (S_m)t_2 + (S_b)Q$	73.27

End plates

$Z = 3.4 - 2.4(H/h)$	2.50	$S = H^2Z(0.2)P/t_5^2E$	127.61

SE = 137.90 1.5 SE = 206.85

Membrain stresses <= [SE]	OK
Total stresses <= [1.5 SE]	OK
End plate stress <=[S]	OK
Stay plate stress <= [SE]	OK

THE ASSUMED THICKNESSES ARE O.K.

SUBJECT	Adopted Th'k. (mm)	SIZE (mm)
TOP & BOT. PLATE	22	2833 x 100 x 22
TUBE & PLUG SHEET	35	2833 x 328 x 35
STAY PLATE	24	2833 x 100 x 24
END PLATE	22	284 x 100 x 22