

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)							 		
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)								شماره صفحه : 1 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه		
	BK	GCS	MF	120	ME	CN	0003	V01		

طرح نگهداشت و افزایش تولید 27 مخزن

MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)

نگهداشت و افزایش تولید میدان نفتی بینک

V01	MAR. 2025	IFI	MFS	M.Fakharian	S.Faramarzpour	
V00	DEC. 2024	IFI	MFS	M.Fakharian	S.Faramarzpour	
Rev.	Date	Purpose of Issue/Status	Prepared by:	Checked by:	Approved by:	CLIENT Approval

Status:

IFA: Issued For Approval
IFI: Issued For Information
AFC: Approved For Construction

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادرکننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 2 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

REVISION RECORD SHEET

PAGE	V00	V01	V02	V03	V04
1	X	X			
2	X	X			
3	X	X			
4	X	X			
5	X	X			
6	X	X			
7	X	X			
8	X	X			
9	X	X			
10	X	X			
11	X	X			
12	X	X			
13	X	X			
14	X	X			
15	X	X			
16	X	X			
17	X	X			
18	X	X			
19	X	X			
20	X	X			
21	X	X			
22	X	X			
23	X	X			
24	X	X			
25	X	X			
26	X	X			
27	X	X			
28	X	X			
29	X	X			
30	X	X			
31	X	X			
32	X	X			
33	X	X			
34	X	X			
35	X	X			
36	X	X			
37	X	X			
38	X	X			
39	X	X			
40	X	X			
41	X	X			
42	X	X			
43	X	X			
44	X	X			
45	X	X			
46	X	X			
47	X	X			
48	X	X			
49	X	X			
50	X	X			
51	X	X			
52	X	X			
53	X	X			
54	X	X			
55	X	X			
56	X	X			
57	X	X			
58	X	X			
59	X	X			
60	X	X			
61	X	X			
62	X	X			
63	X	X			
64	X	X			
65	X	X			

PAGE	V00	V01	V02	V03	V04
66	X	X			
67	X	X			
68	X	X			
69	X	X			
70	X	X			
71	X	X			
72	X	X			
73	X	X			
74	X	X			
75	X	X			
76	X	X			
77	X	X			
78	X	X			
79	X	X			
80	X	X			
81	X	X			
82	X	X			
83	X	X			
84	X	X			
85	X	X			
86	X	X			
87	X	X			
88	X	X			
89	X	X			
90	X	X			
91	X	X			
92	X	X			
93	X	X			
94	X	X			
95	X	X			
96	X	X			
97	X	X			
98	X	X			
99	X	X			
100	X	X			
101	X	X			
102	X	X			
103	X	X			
104	X	X			
105	X	X			
106	X	X			
107	X	X			
108	X	X			
109	X	X			
110	X	X			
111	X	X			
112	X	X			
113	X	X			
114	X	X			
115	X	X			
116	X	X			
117	X	X			
118	X	X			
119	X	X			
120	X	X			
121	X	X			
122	X	X			
123	X	X			
124	X	X			
125	X	X			
126	X	X			
127	X	X			
128	X	X			
129	X	X			
130	X	X			

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)							
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 3 از 251
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	MF	120	ME	CN	0003	
								V01

PAGE	V00	V01	V02	V03	V04
131	X	X			
132	X	X			
133	X	X			
134	X	X			
135	X	X			
136	X	X			
137	X	X			
138	X	X			
139	X	X			
140	X	X			
141	X	X			
142	X	X			
143	X	X			
144	X	X			
145	X	X			
146	X	X			
147	X	X			
148	X	X			
149	X	X			
150	X	X			
151	X	X			
152	X	X			
153	X	X			
154	X	X			
155	X	X			
156	X	X			
157	X	X			
158	X	X			
159	X	X			
160	X	X			
161	X	X			
162	X	X			
163	X	X			
164	X	X			
165	X	X			
166	X	X			
167	X	X			
168	X	X			
169	X	X			
170	X	X			
171	X	X			
172	X	X			
173	X	X			
174	X	X			
175	X	X			
176	X	X			
177	X	X			
178	X	X			
179	X	X			
180	X	X			
181	X	X			
182	X	X			
183	X	X			
184	X	X			
185	X	X			
186	X	X			
187	X	X			
188	X	X			
189	X	X			
190	X	X			
191	X	X			
192	X	X			
193	X	X			
194	X	X			
195	X	X			

PAGE	V00	V01	V02	V03	V04
196	X	X			
197	X	X			
198	X	X			
199	X	X			
200	X	X			
201	X	X			
202	X	X			
203	X	X			
204	X	X			
205	X	X			
206	X	X			
207	X	X			
208	X	X			
209	X	X			
210	X	X			
211	X	X			
212	X	X			
213	X	X			
214	X	X			
215	X	X			
216	X	X			
217	X	X			
218	X	X			
219	X	X			
220	X	X			
221	X	X			
222	X	X			
223	X	X			
224	X	X			
225	X	X			
226	X	X			
227	X	X			
228	X	X			
229	X	X			
230	X	X			
231	X	X			
232	X	X			
233	X	X			
234	X	X			
235	X	X			
236	X	X			
237	X	X			
238	X	X			
239	X	X			
240	X	X			
241	X	X			
242	X	X			
243	X	X			
244	X	X			
245	X	X			
246	X	X			
247	X	X			
248	X	X			
249	X	X			
250	X	X			
251	X	X			
252	X				
253	X				
254	X				
255	X				
256	X				
257	X				
258	X				
259	X				
260	X				

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 4 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Table of Contents

Cover Sheet.....	5
Vessel Design Summary:.....	6
Nozzle Summary:.....	9
Nozzle Schedule & BOM:.....	11
MDMT Summary:.....	14
Warnings and Errors:.....	16
Input Echo:.....	17
XY Coordinate Calculations:.....	29
Internal Pressure Calculations:.....	30
External Pressure Calculations:.....	37
Element and Detail Weights:.....	43
Nozzle Flange MAWP:.....	46
Wind Load Calculation:.....	47
Earthquake Load Calculation:.....	50
Center of Gravity Calculation:.....	52
Saddle Calcs: Operating Case:.....	53
Saddle Calcs: Test Case:.....	73
Nozzle Calcs.: N08 (2in)	89
Nozzle Calcs.: N01 (1in)	97
Nozzle Calcs.: N05A (1.5in)	103
Nozzle Calcs.: N06 (2in)	109
Nozzle Calcs.: N07 (1in)	114
Nozzle Calcs.: N09 (1in)	120
Nozzle Calcs.: M1 (24in)	126
Nozzle Calcs.: K06 (2in)	133
Nozzle Calcs.: N02 (1in)	141
Nozzle Calcs.: N03 (1in)	147
Nozzle Calcs.: N04 (1in)	153
Nozzle Calcs.: N05B (1.5in)	159
Nozzle Calcs.: K3A (3in)	165
Nozzle Calcs.: K3B (3in)	172
Nozzle Calcs.: K05 (2in)	182
Nozzle Calcs.: K4B (2in)	188
Nozzle Calcs.: K4A (2in)	196
Nozzle Calcs.: K2B (2in)	204
Nozzle Calcs.: K2A (2in)	212
Nozzle Calcs.: K1B (3in)	220
Nozzle Calcs.: K1A (3in)	230
Lifting WRC:.....	240
Lifting Calculation:.....	245

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 5 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

DESIGN CALCULATION

In Accordance with ASME Section VIII Division 1

ASME Code Version : 2019

Analysis Performed by :

Job File : C:\USERS\TECHNICAL2\DESKTOP\V-120.Pvdb

Date of Analysis : Mar 9, 2025 11:16am

PV Elite 2020, January 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 6 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادرکننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

ASME Code, Section VIII Division 1, 2019

Diameter Spec :	1100.000 mm.	ID
Vessel Design Length, Tangent to Tangent	3400.00 mm.	
Specified Datum Line Distance	0.00 mm.	
Internal Design Temperature	120 °C	
Internal Design Pressure	8.000 bars	
External Design Temperature	100 °C	
External Design Pressure	1.034 bars	
Maximum Allowable Working Pressure	9.848 bars	
External Max. Allowable Working Pressure	1.968 bars	
Hydrostatic Test Pressure	10.400 bars	
Required Minimum Design Metal Temperature	5.0 °C	
Warmest Computed Minimum Design Metal Temperature	-29.0 °C	
Wind Design Code	ASCE-2010	
Earthquake Design Code	ASCE 7-2010	

Materials of Construction:

Component Type	Material	Class	Thickness	UNS #	Normal ized	Impact Tested
Shell	SA-516 70	...	...	K02700	Yes	No
Head	SA-516 70	...	...	K02700	Yes	No
Nozzle	SA-105	...	...	K03504	No	No
Nozzle	SA-516 70	...	...	K02700	No	No
Nozzle	SA-106 B	...	...	K03006	No	No
Re-Pad	SA-516 70	...	...	K02700	Yes	No
Nozzle Flg	SA-105	...	...	K03504	No	No
Rings	SA-516 70	...	...	K02700	Yes	No
Hz Bolting	SA-325	...	...		No	No

Normalized is determined based on the UCS-66 material curve selection and Figure UCS-66.

Impact Tested is based on material selection and material data properties.

Element Pressures and MAWP (bars & mm.):

Element Description or Type	Design Pressure + Stat. head	Ext. Press.	Element M.A.W.P	Corrosion Allowance	Str. Flg. Gov.	In Creep Range
Ellipse	8.056	1.03	10.000	6.0000	No	No
Cylinder	8.056	1.03	15.000	6.0000	N/A	No
Cylinder	8.056	1.03	15.000	6.0000	N/A	No
Ellipse	8.056	1.03	10.000	6.0000	No	No

Liquid Level: 550.00 mm. Dens.: 0.001 kg./cm³ Sp. Gr.: 1.020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 7 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Stiffener Ring Specifications:

Elevation mm.	Selected Type	User Description
1700.00	Bar 88.0 x 12.	Ring R1 Fr30

Element Types and Properties:

Element Type	"To" Elev mm.	Element Length mm.	Nominal Thickness mm.	Finished Thickness mm.	Reqd Thk Internal mm.	Reqd Thk External mm.	Long Eff	Circ Eff
Ellipse	50.0	50.0	12.0	10.0	9.2	...	1.00	1.00
Cylinder	1650.0	1600.0	...	12.0	9.3	...	1.00	1.00
Cylinder	3350.0	1700.0	...	12.0	9.3	...	1.00	1.00
Ellipse	3400.0	50.0	12.0	10.0	9.2	...	1.00	1.00

External Pressure Calculations:

From	To	External Actual T. mm.	External Required T. mm.	External Design Pressure bars	External M.A.W.P. bars
10	20	10	8.89963	1.034	1.96782
20	30	12	10.3799	1.034	2.29442
30	Ring	12	10.3799	1.034	2.29442
Ring	40	12	10.3799	1.034	2.29442
40	50	10	8.89963	1.034	1.96782

External Pressure Calculations:

From	To	Actual Length Bet. Stiffeners mm.	Allowable Length Bet. Stiffeners mm.	Ring Inertia Required cm**4	Ring Inertia Available cm**4
10	20	No Calc	No Calc	No Calc	No Calc
20	30	1791.67	3830.13	No Calc	No Calc
30	Ring	1791.67	3830.13	No Calc	No Calc
Ring	40	1791.67	3830.13	18.0627	147.429
40	50	No Calc	No Calc	No Calc	No Calc

Saddle Parameters:

Saddle Width	150.000	mm.
Saddle Bearing Angle	120.000	deg.
Centerline Dimension	1200.000	mm.
Wear Pad Width	200.000	mm.
Wear Pad Thickness	12.000	mm.
Wear Pad Bearing Angle	135.000	deg.
Distance from Saddle to Tangent	450.000	mm.
Baseplate Length	1100.000	mm.
Baseplate Thickness	15.000	mm.
Baseplate Width	170.000	mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																									
شماره پیمان: 053 – 073 – 9184	<table><tr><th colspan="8">MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 8 از 251
MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
V01	0003	CN	ME	120	MF	GCS	BK																			

Number of Ribs (including outside ribs)	4
Rib Thickness	15.000 mm.
Web Thickness	15.000 mm.
Height of Center Web	635.000 mm.
Number of Bolts in Baseplate	4

Baseplate Sketch

----- 1100.000 mm. -----	

	170.000 mm.

Baseplate Plan View

	15.000 mm.

Baseplate Side View

Maximum Tensile Bolt Load	664. N
---------------------------	--------

Summary of Maximum Saddle Loads, Operating Case:

Maximum Vertical Saddle Load	54167.31 N
Maximum Transverse Saddle Shear Load	7854.34 N
Maximum Longitudinal Saddle Shear Load	15708.69 N

Summary of Maximum Saddle Loads, Operating Case, Un-Factored:

Maximum Vertical Saddle Load	66356.16 N
Maximum Transverse Saddle Shear Load	28440.68 N
Maximum Longitudinal Saddle Shear Load	22440.98 N

Summary of Maximum Saddle Loads, Hydrotest Case :

Maximum Vertical Saddle Load	34543.86 N
Maximum Transverse Saddle Shear Load	521.38 N
Maximum Longitudinal Saddle Shear Load	574.31 N

Weights:

Fabricated - Bare W/O Removable Internals	2896.0 kg.
Shop Test - Fabricated + Water (Full)	6474.1 kg.
Shipping - Fab. + Rem. Intls.+ Shipping App.	2998.3 kg.
Erected - Fab. + Rem. Intls.+ Insul. (etc)	3418.3 kg.
Empty - Fab. + Intls. + Details + Wghts.	3418.3 kg.
Operating - Empty + Operating Liquid (No CA)	5243.1 kg.
Field Test - Empty Weight + Water (Full)	5902.9 kg.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 9 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Nozzle Calculation Summary:

Description	MAWP bars	Ext	MAPNC bars	UG-45	[tr] mm.	Weld Path	Areas or Stresses
N08 (2in)	10	OK	...	OK	9.20	OK	Passed
N08 (2in)	10	OK	...	OK	9.20	OK	Passed
N01 (1in)	15	OK	...	OK	9.24	OK	Passed
N05A (1.5in)	15	OK	...	OK	9.26	OK	Passed
N06 (2in)	14	OK	...	OK	9.24	OK	Passed
N07 (1in)	15	OK	...	OK	9.24	OK	Passed
N09 (1in)	15	OK	...	OK	9.24	OK	Passed
M1 (24in)	11	OK	...	...		OK	Passed
K06 (2in)	15	OK	...	OK	9.25	OK	Passed
K06 (2in)	15	OK	...	OK	9.25	OK	Passed
N02 (1in)	15	OK	...	OK	9.26	OK	Passed
N03 (1in)	15	OK	...	OK	9.24	OK	Passed
N04 (1in)	15	OK	...	OK	9.26	OK	Passed
N05B (1.5in)	15	OK	...	OK	9.26	OK	Passed
K3A (3in)	15	OK	...	OK	9.24	OK	Passed
K3B (3in)	15	OK	...	OK	9.26	OK	Passed
K3B (3in)	15	OK	...	OK	9.26	OK	Passed
K05 (2in)	15	OK	...	OK	9.24	OK	Passed
K4B (2in)	15	OK	...	OK	9.26	OK	Passed
K4B (2in)	15	OK	...	OK	9.26	OK	Passed
K4A (2in)	15	OK	...	OK	9.24	OK	Passed
K4A (2in)	15	OK	...	OK	9.24	OK	Passed
K2B (2in)	15	OK	...	OK	9.25	OK	Passed
K2B (2in)	15	OK	...	OK	9.25	OK	Passed
K2A (2in)	15	OK	...	OK	9.24	OK	Passed
K2A (2in)	15	OK	...	OK	9.24	OK	Passed
K1B (3in)	15	OK	...	OK	9.26	OK	Passed
K1B (3in)	15	OK	...	OK	9.26	OK	Passed
K1A (3in)	15	OK	...	OK	9.24	OK	Passed
K1A (3in)	15	OK	...	OK	9.24	OK	Passed

Nozzle MAWP Summary:

Minimum MAWP Nozzles	:	10 Nozzle	: N08 (2in)
Minimum MAWP Shells/Flanges	:	10 Element	:
Minimum MAPnc Shells/Flanges	:	20 Element	:
Computed Vessel M.A.W.P.	:	10 bars	

Note: MAWPs (Internal Case) shown above are at the High Point.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 10 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Check the Spatial Relationship between the Nozzles:

From Node	Nozzle Description	X Coordinate mm.	Layout Angle deg	Dia. Limit mm.
10	N08 (2in)	0.000	270.000	125.600
20	N01 (1in)	200.000	90.000	74.800
20	N05A (1.5in)	1550.000	270.000	100.200
20	N06 (2in)	1350.000	90.000	125.600
20	N07 (1in)	1100.000	90.000	74.800
20	N09 (1in)	850.000	90.000	74.800
20	M1 (24in)	1150.000	0.000	1195.200
20	K06 (2in)	250.000	-32.263	125.600
30	N02 (1in)	3250.000	270.000	74.800
30	N03 (1in)	3150.000	90.000	74.800
30	N04 (1in)	2126.000	270.000	74.800
30	N05B (1.5in)	3050.000	270.000	100.200
30	K3A (3in)	2126.000	0.000	148.460
30	K3B (3in)	2126.000	290.847	148.460
30	K05 (2in)	1850.000	90.000	125.600
30	K4B (2in)	2400.000	-56.751	125.600
30	K4A (2in)	2400.000	-11.703	125.600
30	K2B (2in)	2650.000	-29.882	125.600
30	K2A (2in)	2650.000	7.772	125.600
30	K1B (3in)	3150.000	290.847	148.460
30	K1A (3in)	3150.000	10.250	148.460

The nozzle spacing is computed by the following:

= Sqrt($l_l^2 + l_c^2$) where

l_l - Arc length along the inside vessel surface in the long. direction.

l_c - Arc length along the inside vessel surface in the circ. direction

If any interferences/violations are found, they will be noted below.

No interference violations have been detected !

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 11 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Bill of Materials:

QTY	DESCRIPTION	MATERIAL
2	ELLIPTICAL HEAD: 2.0 X 1, 12.0mm. THK X 1100.0mm. ID X 50.0mm.	SA-516 70
1	CYLINDER: 12.0mm. THK X 1100.0mm. ID X 1600.0mm.	SA-516 70
1	CYLINDER: 12.0mm. THK X 1100.0mm. ID X 1700.0mm.	SA-516 70
2	INSULATION: 325mm X 50mm THK	
2	SADDLE: 150mm X 120 DEG	SA-516 70
1	INSULATION: 1600mm X 50mm THK	
1	INSULATION: 1700mm X 50mm THK	
1	BAR RING STIFFENER: 1124mm ID X 1300mm OD X 12mm	SA-516 70
1	CLASS 150 GR 1.1, 24.0" BLIND FLANGE(S)	SA-516 70
1	NAMEPLATE	...

Nozzle Schedule:

Description	Nominal or Actual Size	Schd or FVC Type	Flg Type	Nozzle O/Dia in	Wall Thk mm	Reinforcing Pad Diameter	Pad Thk mm	Cut Length in	Flg Class
N01 (1in)	1.000 in	Actual	LW	2.000	12.700	...	...	362.0	150
N07 (1in)	1.000 in	Actual	LW	2.000	12.700	...	...	162.5	150
N09 (1in)	1.000 in	Actual	LW	2.000	12.700	...	...	162.5	150
N02 (1in)	1.000 in	Actual	LW	2.000	12.700	...	...	162.5	150
N03 (1in)	1.000 in	Actual	LW	2.000	12.700	...	...	162.5	150
N04 (1in)	1.000 in	Actual	LW	2.000	12.700	...	...	162.5	150
N05A (1.5in)	1.500 in	Actual	LW	2.638	14.450	...	...	163.0	150
N05B (1.5in)	1.500 in	Actual	LW	2.638	14.450	...	...	163.0	150
N08 (2in)	2.000 in	Actual	LW	3.248	15.850	...	...	180.0	150
N06 (2in)	2.000 in	Actual	LW	3.248	15.850	...	...	163.5	150
K06 (2in)	2.000 in	Actual	LW	3.320	16.764	...	...	194.6	300
K05 (2in)	2.000 in	Actual	LW	3.320	16.764	...	...	163.6	300
K4B (2in)	2.000 in	Actual	LW	3.307	16.600	...	...	457.2	300
K4A (2in)	2.000 in	Actual	LW	3.307	16.600	...	...	172.9	300
K2B (2in)	2.000 in	Actual	LW	3.307	16.600	...	...	241.3	300
K2A (2in)	2.000 in	Actual	LW	3.307	16.600	...	...	169.6	300
K3A (3in)	3.000 in	XXS	WN	3.500	15.240	180.00	12.00	163.8	150
K3B (3in)	3.000 in	XXS	WN	3.500	15.240	180.00	12.00	232.5	150
K1B (3in)	3.000 in	XXS	WN	3.500	15.240	180.00	12.00	232.5	150
K1A (3in)	3.000 in	XXS	WN	3.500	15.240	180.00	12.00	172.3	150
M1 (24in)	24.000 in	Actual	WN	24.000	12.000	750.00	12.00	254.1	150

General Notes for the above table:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 12 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

The Cut Length is the Outside Projection + Inside Projection + Drop + In Plane Shell Thickness. This value does not include weld gaps, nor does it account for shrinkage.

In the case of Oblique Nozzles, the Outside Diameter must be increased. The Re-Pad WIDTH around the nozzle is calculated as follows:
Width of Pad = (Pad Outside Dia. (per above) - Nozzle Outside Dia.)/2

For hub nozzles, the thickness and diameter shown are those of the smaller and thinner section.

Nozzle Material and Weld Fillet Leg Size Details (mm.):

Description	Material	Shl Grve Weld	Noz Shl/Pad Weld	Pad OD Weld	Pad Grve Weld	Inside Weld
N01 (1in)	SA-105	12.000	8.000	...	...	...
N07 (1in)	SA-105	12.000	8.000	...	...	...
N09 (1in)	SA-105	12.000	8.000	...	...	...
N02 (1in)	SA-105	12.000	8.000	...	...	...
N03 (1in)	SA-105	12.000	8.000	...	...	...
N04 (1in)	SA-105	12.000	8.000	...	...	...
N05A (1.5in)	SA-105	12.000	8.000	...	...	...
N05B (1.5in)	SA-105	12.000	8.000	...	...	...
N08 (2in)	SA-105	10.000	8.000	...	...	...
N06 (2in)	SA-105	12.000	8.000	...	...	...
K06 (2in)	SA-105	12.000	10.000	...	...	...
K05 (2in)	SA-105	12.000	8.000	...	...	...
K4B (2in)	SA-105	12.000	8.000	...	...	...
K4A (2in)	SA-105	12.000	8.000	...	...	...
K2B (2in)	SA-105	12.000	8.000	...	...	...
K2A (2in)	SA-105	12.000	8.000	...	...	...
K3A (3in)	SA-106 B	12.000	8.000	6.000	12.000	...
K3B (3in)	SA-106 B	12.000	8.000	6.000	12.000	...
K1B (3in)	SA-106 B	12.000	8.000	6.000	12.000	...
K1A (3in)	SA-106 B	12.000	8.000	6.000	12.000	...
M1 (24in)	SA-516 70	12.000	8.000	10.000	12.000	...

Note: The Outside projections below do not include the flange thickness.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 13 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Nozzle Miscellaneous Data:

Description	Elev/Distance From Datum mm.	Layout Angle deg	Proj Outside mm.	Proj Inside mm.	Installed in Component
N01 (1in)	200.000	90.0	150.00	200.00	Node: 20
N07 (1in)	1100.000	90.0	150.00	0.00	Node: 20
N09 (1in)	850.000	90.0	150.00	0.00	Node: 20
N02 (1in)	3250.000	270.0	150.00	0.00	Node: 30
N03 (1in)	3150.000	90.0	150.00	0.00	Node: 30
N04 (1in)	2126.000	270.0	150.00	0.00	Node: 30
N05A (1.5in)	1550.000	270.0	150.00	0.00	Node: 20
N05B (1.5in)	3050.000	270.0	150.00	0.00	Node: 30
N08 (2in)	...	270.0	150.00	0.00	Node: 10
N06 (2in)	1350.000	90.0	150.00	0.00	Node: 20
K06 (2in)	250.000	-32.3	150.00	0.00	Node: 20
K05 (2in)	1850.000	90.0	150.00	0.00	Node: 30
K4B (2in)	2400.000	-56.8	350.00	0.00	Node: 30
K4A (2in)	2400.000	-11.7	150.00	0.00	Node: 30
K2B (2in)	2650.000	-29.9	200.00	0.00	Node: 30
K2A (2in)	2650.000	7.8	150.00	0.00	Node: 30
K3A (3in)	2126.000	0.0	150.00	0.00	Node: 30
K3B (3in)	2126.000	290.8	200.00	0.00	Node: 30
K1B (3in)	3150.000	290.8	200.00	0.00	Node: 30
K1A (3in)	3150.000	10.2	150.00	0.00	Node: 30
M1 (24in)	1150.000	0.0	150.00	0.00	Node: 20

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 14 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Minimum Design Metal Temperature Results Summary :

Description	Notes	Curve	Basic MDMT °C	Reduced MDMT °C	UG-20 (f) MDMT °C	Thickness ratio	Gov Thk mm.	E*	PWHT reqd
	[10]	D	-48	-48	-29	0.985	10.000	1.00	Yes
	[7]	D	-48	-48	-29	0.668	12.000	1.00	Yes
	[8]	D	-48	-48	-29	0.668	12.000	1.00	Yes
	[8]	D	-48	-48	-29	0.668	12.000	1.00	Yes
	[10]	D	-48	-48	-29	0.985	10.000	1.00	Yes
	[7]	D	-48	-48	-29	0.668	12.000	1.00	Yes
N08 (2in)	[1]	A	-8	-29	-29	0.799	10.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					
N01 (1in)	[1]	A	-3	-30	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-29	-48					
N05A (1.5in)	[1]	A	-3	-30	-29	0.543	12.000	1.00	Yes
Nozzle Flg	[5]	A	-29	-48					
N06 (2in)	[1]	A	-3	-30	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-29	-48					
N07 (1in)	[1]	A	-3	-30	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-29	-48					
N09 (1in)	[1]	A	-3	-30	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-29	-48					
M1 (24in)	[1]	B	-48	-48	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-29	-48					
K06 (2in)	[1]	A	-3	-30	-29	0.541	12.000	1.00	Yes
Nozzle Flg	[5]	A	-29	-104					
N02 (1in)	[1]	A	-3	-30	-29	0.543	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					
N03 (1in)	[1]	A	-3	-30	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					
N04 (1in)	[1]	A	-3	-30	-29	0.543	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					
N05B (1.5in)	[1]	A	-3	-30	-29	0.543	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					
K3A (3in)	[1]	B	-23	-48	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					
K3B (3in)	[1]	B	-23	-48	-29	0.543	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					
K05 (2in)	[1]	A	-3	-30	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-104					
K4B (2in)	[1]	A	-3	-30	-29	0.543	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-104					
K4A (2in)	[1]	A	-3	-30	-29	0.540	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-104					
K2B (2in)	[1]	A	-3	-30	-29	0.541	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-104					
K2A (2in)	[1]	A	-3	-30	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-104					
K1B (3in)	[1]	B	-23	-48	-29	0.543	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					
K1A (3in)	[1]	B	-23	-48	-29	0.539	12.000	1.00	Yes
Nozzle Flg	[5]	A	-18	-48					

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																									
شماره پیمان: 053 – 073 – 9184	<table><tr><th colspan="8">MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 15 از 251
MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
V01	0003	CN	ME	120	MF	GCS	BK																			

Warmest MDMT:

-3 -29

Required Minimum Design Metal Temperature 5.0 °C

Warmest Computed Minimum Design Metal Temperature -29.0 °C

Notes:

- [!] - This was an impact tested material.
- [1] - Governing Nozzle Weld.
- [4] - ANSI Flange MDMT Calcs; Thickness ratio per UCS-66(b)(1)(-c).
- [5] - ANSI Flange MDMT Calcs; Thickness ratio per UCS-66(b)(1)(-b).
- [6] - MDMT Calculations at the Shell/Head Joint.
- [7] - MDMT Calculations for the Straight Flange.
- [8] - Cylinder/Cone/Flange Junction MDMT.
- [9] - Calculations in the Spherical Portion of the Head.
- [10] - Calculations in the Knuckle Portion of the Head.
- [11] - Calculated (Body Flange) Flange MDMT.
- [12] - Calculated Flat Head MDMT per UCS-66.3
- [13] - Tubesheet MDMT, shell side, if applicable
- [14] - Tubesheet MDMT, tube side, if applicable
- [15] - Nozzle Material
- [16] - Shell or Head Material
- [17] - Impact Testing required
- [18] - Impact Testing not required, see UCS-66(b)(3)
- [20] - Cylinder/Cone Junction MDMT based on Longitudinal Stress considerations
- [21] - Bolting Material

UG-84(b)(2) was not considered.

UCS-66(g) was not considered.

UCS-66(i) was not considered.

Notes:

- Impact test temps were not entered in and not considered in the analysis.
- UCS-66(i) applies to impact tested materials not by specification and
- UCS-66(g) applies to materials impact tested per UG-84.1 General Note (c).
- The Basic MDMT includes the (30F) PWHT credit if applicable.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 16 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Class From To : Basic Element Checks.

Class From To: Check of Additional Element Data

There were no geometry errors or warnings.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 17 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

PV Elite Vessel Analysis Program: Input Data

Design Internal Pressure (for Hydrotest)	8	bars
Design Internal Temperature	120.0	°C
Type of Hydrotest	UG-99 (b) Note [36]	
Hydrotest Position	Horizontal	
Projection of Nozzle from Vessel Top	0	mm.
Projection of Nozzle from Vessel Bottom	0	mm.
Minimum Design Metal Temperature	5.0	°C
Type of Construction	Welded	
Special Service	Lethal	
Degree of Radiography	RT-1	
Use Higher Longitudinal Stresses (Flag)	Y	
Select t for Internal Pressure (Flag)	N	
Select t for External Pressure (Flag)	N	
Select t for Axial Stress (Flag)	N	
Select Location for Stiff. Rings (Flag)	N	
Consider Vortex Shedding	Y	
Perform a Corroded Hydrotest	Y	
Load Case 1	NP+EW+WI+FW+BW	
Load Case 2	NP+EW+EE+FS+BS	
Load Case 3	NP+OW+WI+FW+BW	
Load Case 4	NP+OW+EQ+FS+BS	
Load Case 5	NP+HW+HI	
Load Case 6	NP+HW+HE	
Load Case 7	IP+OW+WI+FW+BW	
Load Case 8	IP+OW+EQ+FS+BS	
Load Case 9	EP+OW+WI+FW+BW	
Load Case 10	EP+OW+EQ+FS+BS	
Load Case 11	HP+HW+HI	
Load Case 12	HP+HW+HE	
Load Case 13	IP+WE+EW	
Load Case 14	IP+WF+CW	
Load Case 15	IP+VO+OW	
Load Case 16	IP+VE+EW	
Load Case 17	NP+VO+OW	
Load Case 18	FS+BS+IP+OW	
Load Case 19	FS+BS+EP+OW	
Wind Design Code	ASCE-7 2010	
Wind Load Reduction Scale Factor	0.600	
Basic Wind Speed	232	Km/hr
Surface Roughness Category	C: Open Terrain	
Importance Factor	1.0	
Type of Surface	Moderately Smooth	
Base Elevation	100	mm.
Percent Wind for Hydrotest	33.0	
Using User defined Wind Press. Vs Elev.	N	
Height of Hill or Escarpment	0	mm.
Distance Upwind of Crest	0	mm.
Distance from Crest to the Vessel	0	mm.
Type of Terrain (Hill, Escarpment)	Flat	

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 18 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Damping Factor (Beta) for Wind (Ope) 0.0100
Damping Factor (Beta) for Wind (Empty) 0.0000
Damping Factor (Beta) for Wind (Filled) 0.0000

Seismic Design Code ASCE 7-2010
Seismic Load Reduction Scale Factor 0.700
Importance Factor 1.250
Table Value Fa 1.000
Table Value Fv 1.330
Short Period Acceleration value Ss 1.125
Long Period Acceleration Value Sl 0.460
Moment Reduction Factor Tau 1.000
Force Modification Factor R 3.000
Site Class D
Component Elevation Ratio z/h 1.000
Amplification Factor Ap 1.000
Force Factor 0.000
Consider Vertical Acceleration Yes
Minimum Acceleration Multiplier 0.000
User Value of Sds (used if > 0) 1.020
User Value of Sd1 (used if > 0) 0.385

Design Pressure + Static Head Y
Consider MAP New and Cold in Noz. Design N
Consider External Loads for Nozzle Des. Y
Use ASME VIII-1 Appendix 1-9 N

Material Database Year Current w/Addenda or Code Year

Configuration Directives:

Do not use Nozzle MDMT Interpretation VIII-1 01-37 No
Use Table G instead of exact equation for "A" Yes
Shell Head Joints are Tapered Yes
Compute "K" in corroded condition Yes
Use Code Case 2286 No
Use the MAWP to compute the MDMT Yes
For thickness ratios <= 0.35, MDMT will be -155F (-104C) Yes
For PWHT & P1 Materials the MDMT can be < -55F (-48C) No

Using Metric Material Databases, ASME II D No
Calculate B31.3 type stress for Nozzles with Loads Yes
Reduce the MDMT due to lower membrane stress Yes
Consider Longitudinal Stress in MDMT calcs. (Div. 1) Yes

Complete Listing of Vessel Elements and Details:

Element From Node 10
Element To Node 20
Element Type Elliptical
Description
Distance "FROM" to "TO" 50 mm.
Inside Diameter 1100 mm.
Element Thickness 10 mm.
Internal Corrosion Allowance 6 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 19 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Nominal Thickness	12	mm.
External Corrosion Allowance	0	mm.
Design Internal Pressure	8	bars
Design Temperature Internal Pressure	120	°C
Design External Pressure	1.034	bars
Design Temperature External Pressure	100	°C
Effective Diameter Multiplier	1.2	
Material Name	SA-516 70	[Normalized]
Allowable Stress, Ambient	137.9	N./mm ²
Allowable Stress, Operating	137.9	N./mm ²
Allowable Stress, Hydrotest	235.8	N./mm ²
Material Density	0.00775	kg./cm ³
P Number Thickness	30.988	mm.
Yield Stress, Operating	236	N./mm ²
UCS-66 Chart Curve Designation	D	
External Pressure Chart Name	CS-2	
UNS Number	K02700	
Product Form	Plate	
Efficiency, Longitudinal Seam	1.0	
Efficiency, Circumferential Seam	1.0	
Elliptical Head Factor	2.0	
Weld is pre-Heated	No	
Element From Node	10	
Detail Type	Liquid	
Detail ID	Liquid: 10	
Dist. from "FROM" Node / Offset dist	0	mm.
Height/Length of Liquid	550	mm.
Liquid Density	0.001018	kg./cm ³
Element From Node	10	
Detail Type	Insulation	
Detail ID	Ins: 20	
Dist. from "FROM" Node / Offset dist	-275	mm.
Height/Length of Insulation	325	mm.
Thickness of Insulation	50	mm.
Density	0.0001249	kg./cm ³
Element From Node	10	
Detail Type	Nozzle	
Detail ID	N08 (2in)	
Dist. from "FROM" Node / Offset dist	400	mm.
Nozzle Diameter	2	in.
Nozzle Schedule	None	
Nozzle Class	150	
Layout Angle	270.0	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	70.808	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-105	

Element From Node	20
Element To Node	30

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادرکننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 20 از 251
پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Element Type	Cylinder
Description	
Distance "FROM" to "TO"	1600 mm.
Inside Diameter	1100 mm.
Element Thickness	12 mm.
Internal Corrosion Allowance	6 mm.
Nominal Thickness	0 mm.
External Corrosion Allowance	0 mm.
Design Internal Pressure	8 bars
Design Temperature Internal Pressure	120 °C
Design External Pressure	1.034 bars
Design Temperature External Pressure	100 °C
Effective Diameter Multiplier	1.2
Material Name	SA-516 70 [Normalized]
Efficiency, Longitudinal Seam	1.0
Efficiency, Circumferential Seam	1.0
Weld is pre-Heated	No

Element From Node	20
Detail Type	Saddle
Detail ID	Lft Sdl
Dist. from "FROM" Node / Offset dist	450 mm.
Width of Saddle	150 mm.
Height of Saddle at Bottom	1200 mm.
Saddle Contact Angle	120.0
Height of Composite Ring Stiffener	0 mm.
Width of Wear Plate	200 mm.
Thickness of Wear Plate	12 mm.
Contact Angle, Wear Plate (degrees)	135.0
Friction coefficient	0.30000001
Moment Factor	3.0
Dimension E at base (optional)	0 mm.
Circumferential Eff. over Saddle	1.0
Circumferential Eff. at Midspan	1.0
Tangent to Tangent dist. (optional)	0 mm.

Element From Node	20
Detail Type	Liquid
Detail ID	Liquid: 20
Dist. from "FROM" Node / Offset dist	0 mm.
Height/Length of Liquid	550 mm.
Liquid Density	0.001018 kg./cm ³

Element From Node	20
Detail Type	Insulation
Detail ID	Ins: 20
Dist. from "FROM" Node / Offset dist	0 mm.
Height/Length of Insulation	1600 mm.
Thickness of Insulation	50 mm.
Density	0.0001249 kg./cm ³

Element From Node	20
Detail Type	Nozzle
Detail ID	N01 (1in)
Dist. from "FROM" Node / Offset dist	150 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 21 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Nozzle Diameter 1 in.
Nozzle Schedule None
Nozzle Class 150
Layout Angle 90.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 54.922 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 20
Detail Type Nozzle
Detail ID N05A (1.5in)
Dist. from "FROM" Node / Offset dist 1500 mm.
Nozzle Diameter 1.5 in.
Nozzle Schedule None
Nozzle Class 150
Layout Angle 270.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 50.094 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 20
Detail Type Nozzle
Detail ID N06 (2in)
Dist. from "FROM" Node / Offset dist 1300 mm.
Nozzle Diameter 2 in.
Nozzle Schedule None
Nozzle Class 150
Layout Angle 90.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 70.808 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 20
Detail Type Nozzle
Detail ID N07 (1in)
Dist. from "FROM" Node / Offset dist 1050 mm.
Nozzle Diameter 1 in.
Nozzle Schedule None
Nozzle Class 150
Layout Angle 90.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 31.816 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 20
Detail Type Nozzle
Detail ID N09 (1in)
Dist. from "FROM" Node / Offset dist 800 mm.
Nozzle Diameter 1 in.
Nozzle Schedule None
Nozzle Class 150

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 مهرت انرژی  MFS شماره ۰۰۱ تهران ۱۳۹۴																
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادرکننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 22 از 251
پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Layout Angle 90.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 31.816 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 20
Detail Type Nozzle
Detail ID M1 (24in)
Dist. from "FROM" Node / Offset dist 1100 mm.
Nozzle Diameter 24 in.
Nozzle Schedule None
Nozzle Class 150
Layout Angle 0.0
Blind Flange (Y/N) Y
Weight of Nozzle (Used if > 0) 3531.8 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-516 70

Element From Node 20
Detail Type Nozzle
Detail ID K06 (2in)
Dist. from "FROM" Node / Offset dist 200 mm.
Nozzle Diameter 2 in.
Nozzle Schedule None
Nozzle Class 300
Layout Angle -32.2631
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 85.081 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 30
Element To Node 40
Element Type Cylinder
Description
Distance "FROM" to "TO" 1700 mm.
Inside Diameter 1100 mm.
Element Thickness 12 mm.
Internal Corrosion Allowance 6 mm.
Nominal Thickness 0 mm.
External Corrosion Allowance 0 mm.
Design Internal Pressure 8 bars
Design Temperature Internal Pressure 120 °C
Design External Pressure 1.034 bars
Design Temperature External Pressure 100 °C
Effective Diameter Multiplier 1.2
Material Name SA-516 70 [Normalized]
Efficiency, Longitudinal Seam 1.0
Efficiency, Circumferential Seam 1.0
Weld is pre-Heated No

Element From Node 30

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 23 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Detail Type	Saddle
Detail ID	New Sdl
Dist. from "FROM" Node / Offset dist	1250 mm.
Width of Saddle	150 mm.
Height of Saddle at Bottom	1200 mm.
Saddle Contact Angle	120.0
Height of Composite Ring Stiffener	0 mm.
Width of Wear Plate	200 mm.
Thickness of Wear Plate	12 mm.
Contact Angle, Wear Plate (degrees)	135.0
Friction coefficient	0.0
Moment Factor	3.0
Dimension E at base (optional)	0 mm.
Circumferential Eff. over Saddle	1.0
Circumferential Eff. at Midspan	1.0
Tangent to Tangent dist. (optional)	0 mm.
Element From Node	30
Detail Type	Liquid
Detail ID	Liquid: 30
Dist. from "FROM" Node / Offset dist	0 mm.
Height/Length of Liquid	550 mm.
Liquid Density	0.001018 kg./cm ³
Element From Node	30
Detail Type	Insulation
Detail ID	Ins: 20
Dist. from "FROM" Node / Offset dist	0 mm.
Height/Length of Insulation	1700 mm.
Thickness of Insulation	50 mm.
Density	0.0001249 kg./cm ³
Element From Node	30
Detail Type	Ring
Detail ID	Ring R1 Fr30
Dist. from "FROM" Node / Offset dist	50 mm.
Inside Diameter of Ring	1124 mm.
Thickness of Ring	12 mm.
Outside Diameter of Ring	1300 mm.
Material Name	SA-516 70 [Normalized]
Height of Section Ring	0 mm.
Using Custom Stiffener Section	No
Element From Node	30
Detail Type	Nozzle
Detail ID	N02 (lin)
Dist. from "FROM" Node / Offset dist	1600 mm.
Nozzle Diameter	1 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	270.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	31.816 N
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-105

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 24 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Element From Node 30
Detail Type Nozzle
Detail ID N03 (1in)
Dist. from "FROM" Node / Offset dist 1500 mm.
Nozzle Diameter 1 in.
Nozzle Schedule None
Nozzle Class 150
Layout Angle 90.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 31.816 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 30
Detail Type Nozzle
Detail ID N04 (1in)
Dist. from "FROM" Node / Offset dist 476 mm.
Nozzle Diameter 1 in.
Nozzle Schedule None
Nozzle Class 150
Layout Angle 270.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 31.816 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 30
Detail Type Nozzle
Detail ID N05B (1.5in)
Dist. from "FROM" Node / Offset dist 1400 mm.
Nozzle Diameter 1.5 in.
Nozzle Schedule None
Nozzle Class 150
Layout Angle 270.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 50.094 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-105

Element From Node 30
Detail Type Nozzle
Detail ID K3A (3in)
Dist. from "FROM" Node / Offset dist 476 mm.
Nozzle Diameter 3 in.
Nozzle Schedule XXS
Nozzle Class 150
Layout Angle 0.0
Blind Flange (Y/N) N
Weight of Nozzle (Used if > 0) 101.26 N
Grade of Attached Flange GR 1.1
Nozzle Matl SA-106 B

Element From Node 30
Detail Type Nozzle

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 25 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Detail ID	K3B (3in)	
Dist. from "FROM" Node / Offset dist	476	mm.
Nozzle Diameter	3	in.
Nozzle Schedule	XXS	
Nozzle Class	150	
Layout Angle	290.84698	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	112.68	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-106 B	

Element From Node	30	
Detail Type	Nozzle	
Detail ID	K05 (2in)	
Dist. from "FROM" Node / Offset dist	200	mm.
Nozzle Diameter	2	in.
Nozzle Schedule	None	
Nozzle Class	300	
Layout Angle	90.0	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	85.081	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-105	

Element From Node	30	
Detail Type	Nozzle	
Detail ID	K4B (2in)	
Dist. from "FROM" Node / Offset dist	750	mm.
Nozzle Diameter	2	in.
Nozzle Schedule	None	
Nozzle Class	300	
Layout Angle	-56.7514	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	138.01	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-105	

Element From Node	30	
Detail Type	Nozzle	
Detail ID	K4A (2in)	
Dist. from "FROM" Node / Offset dist	750	mm.
Nozzle Diameter	2	in.
Nozzle Schedule	None	
Nozzle Class	300	
Layout Angle	-11.7035	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	84.586	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-105	

Element From Node	30	
Detail Type	Nozzle	
Detail ID	K2B (2in)	
Dist. from "FROM" Node / Offset dist	1000	mm.
Nozzle Diameter	2	in.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادرکننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 26 از 251
پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Nozzle Schedule	None	
Nozzle Class	300	
Layout Angle	-29.882401	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	97.943	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-105	
Element From Node	30	
Detail Type	Nozzle	
Detail ID	K2A (2in)	
Dist. from "FROM" Node / Offset dist	1000	mm.
Nozzle Diameter	2	in.
Nozzle Schedule	None	
Nozzle Class	300	
Layout Angle	7.7719998	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	84.586	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-105	
Element From Node	30	
Detail Type	Nozzle	
Detail ID	K1B (3in)	
Dist. from "FROM" Node / Offset dist	1500	mm.
Nozzle Diameter	3	in.
Nozzle Schedule	XXS	
Nozzle Class	150	
Layout Angle	290.84698	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	112.68	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-106 B	
Element From Node	30	
Detail Type	Nozzle	
Detail ID	K1A (3in)	
Dist. from "FROM" Node / Offset dist	1500	mm.
Nozzle Diameter	3	in.
Nozzle Schedule	XXS	
Nozzle Class	150	
Layout Angle	10.2496	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	101.26	N
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-106 B	
Element From Node	30	
Detail Type	Weight	
Detail ID	VORTEX BREAKER	
Dist. from "FROM" Node / Offset dist	1600	mm.
Miscellaneous Weight	490.3	N
Offset from Element Centerline	550	mm.
Element From Node	30	

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 27 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Detail Type	Weight
Detail ID	DEMISTER PAD
Dist. from "FROM" Node / Offset dist	1500 mm.
Miscellaneous Weight	490.3 N
Offset from Element Centerline	550 mm.

Element From Node	30
Detail Type	Weight
Detail ID	BUCKET
Dist. from "FROM" Node / Offset dist	450 mm.
Miscellaneous Weight	1961.2 N
Offset from Element Centerline	0 mm.

Element From Node	30
Detail Type	Weight
Detail ID	WEIR
Dist. from "FROM" Node / Offset dist	700 mm.
Miscellaneous Weight	490.3 N
Offset from Element Centerline	0 mm.

Element From Node	30
Detail Type	Weight
Detail ID	PIPING
Dist. from "FROM" Node / Offset dist	150 mm.
Miscellaneous Weight	4118.5 N
Offset from Element Centerline	0 mm.

Element From Node	40
Element To Node	50
Element Type	Elliptical
Description	
Distance "FROM" to "TO"	50 mm.
Inside Diameter	1100 mm.
Element Thickness	10 mm.
Internal Corrosion Allowance	6 mm.
Nominal Thickness	12 mm.
External Corrosion Allowance	0 mm.
Design Internal Pressure	8 bars
Design Temperature Internal Pressure	120 °C
Design External Pressure	1.034 bars
Design Temperature External Pressure	100 °C
Effective Diameter Multiplier	1.2
Material Name	SA-516 70 [Normalized]
Efficiency, Longitudinal Seam	1.0
Efficiency, Circumferential Seam	1.0
Elliptical Head Factor	2.0
Weld is pre-Heated	No

Element From Node	40
Detail Type	Liquid
Detail ID	Liquid: 40
Dist. from "FROM" Node / Offset dist	0 mm.
Height/Length of Liquid	550 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 28 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Liquid Density	0.001018	kg./cm ³
Element From Node	40	
Detail Type	Insulation	
Detail ID	Ins: 20	
Dist. from "FROM" Node / Offset dist	0	mm.
Height/Length of Insulation	325	mm.
Thickness of Insulation	50	mm.
Density	0.0001249	kg./cm ³

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 29 از 251																
	<table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>		پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01
	پروژه		بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه									
BK	GCS	MF	120	ME	CN	0003	V01											

XY Coordinate Calculations:

From	To	X (Horiz.) mm.	Y (Vert.) mm.	DX (Horiz.) mm.	DY (Vert.) mm.
10	20	50	...	50	...
20	30	1650	...	1600	...
30	40	3350	...	1700	...
40	50	3400	...	50	...

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																									
شماره پیمان: 053 – 073 – 9184	<table><tr><th colspan="8">MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادرکننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 30 از 251
MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه																			
V01	0003	CN	ME	120	MF	GCS	BK																			

Element Thickness, Pressure, Diameter and Allowable Stress :

From	To	Int. Press + Liq. Hd bars	Nominal Thickness mm.	Total Corr Allowance mm.	Element Diameter mm.	Allowable Stress (SE) N./mm ²
10	20	8.0556	12	6	1100	137.9
20	30	8.0556	...	6	1100	137.9
30	40	8.0556	...	6	1100	137.9
40	50	8.0556	12	6	1100	137.9

Element Required Thickness and MAWP :

From	To	Design Pressure bars	M.A.W.P. Corroded bars	M.A.P. New & Cold bars	Minimum Thickness mm.	Required Thickness mm.
10	20	8	9.99983	25.0258	10	9.20401
20	30	8	14.7291	29.6968	12	9.25955
30	40	8	14.7291	29.6968	12	9.25955
40	50	8	9.99983	25.0258	10	9.20401
Minimum			10	20		

Note : The M.A.P.(NC) is Governed by a Flange !

MAWP: 10 bars, limited by: Nozzle Reinforcement.

Elements Suitable for Design Internal Pressure.

Internal Pressure Calculation Results:

ASME Code, Section VIII Division 1, 2019

Elliptical Head From 10 To 20 SA-516 70 , UCS-66 Crv. D at 120 °C

Material UNS Number: K02700

Required Thickness due to Internal Pressure [tr]:

$$\begin{aligned}
 &= (P \cdot D \cdot K_{cor}) / (2 \cdot S \cdot E - 0.2 \cdot P) \text{ Appendix 1-4 (c)} \\
 &= (8.056 \cdot 1112.0 \cdot 0.986) / (2 \cdot 137.9 \cdot 1.0 - 0.2 \cdot 8.056) \\
 &= 3.2040 + 6.0000 = 9.2040 \text{ mm.}
 \end{aligned}$$

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

Less Operating Hydrostatic Head Pressure of 0.056 bars

$$\begin{aligned}
 &= (2 \cdot S \cdot E \cdot t) / (K_{cor} \cdot D + 0.2 \cdot t) \text{ per Appendix 1-4 (c)} \\
 &= (2 \cdot 137.9 \cdot 1.0 \cdot 4.0) / (0.986 \cdot 1112.0 + 0.2 \cdot 4.0) \\
 &= 10 - 0.1 = 10 \text{ bars}
 \end{aligned}$$

Maximum Allowable Pressure, New and Cold [MAPNC]:

$$\begin{aligned}
 &= (2 \cdot S \cdot E \cdot t) / (K \cdot D + 0.2 \cdot t) \text{ per Appendix 1-4 (c)} \\
 &= (2 \cdot 137.9 \cdot 1.0 \cdot 10.0) / (1.0 \cdot 1100.0 + 0.2 \cdot 10.0) \\
 &= 25 \text{ bars}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 31 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Actual stress at given pressure and thickness, corroded [Sact]:

$$= (P * (K_{cor} * D + 0.2 * t)) / (2 * E * t)$$

$$= (8.056 * (0.986 * 1112.0 + 0.2 * 4.0)) / (2 * 1.0 * 4.0)$$

$$= 110.474 \text{ N./mm}^2$$

Straight Flange Required Thickness:

$$= (P * R) / (S * E - 0.6 * P) + c \quad \text{per UG-27 (c) (1)}$$

$$= (8.056 * 556.0) / (137.9 * 1.0 - 0.6 * 8.056) + 6.0$$

$$= 9.260 \text{ mm.}$$

Straight Flange Maximum Allowable Working Pressure:

Less Operating Hydrostatic Head Pressure of 0.056 bars

$$= (S * E * t) / (R + 0.6 * t) \quad \text{per UG-27 (c) (1)}$$

$$= (137.9 * 1.0 * 6.0) / (556.0 + 0.6 * 6.0)$$

$$= 15 - 0.1 = 15 \text{ bars}$$

Factor K, corroded condition [Kcor]:

$$= (2 + (\text{Inside Diameter} / (2 * \text{Inside Head Depth}))^2) / 6$$

$$= (2 + (1112.0 / (2 * 281.0))^2) / 6$$

$$= 0.985841$$

Percent Elong. per UCS-79, VIII-1-01-57 $(75 * t_{nom} / R_f) * (1 - R_f / R_o)$ 4.663 %

MDMT Calculations in the Knuckle Portion:

Govrn. thk, tg = 10.0, tr = 3.939, c = 6.0 mm., E* = 1.0

Thickness Ratio = $tr * (E^*) / (tg - c) = 0.985$, Temp. Reduction = 1 °C

Min Metal Temp. w/o impact per UCS-66, Curve D -48 °C

MDMT Calculations in the Head Straight Flange:

Govrn. thk, tg = 12.0, tr = 4.01, c = 6.0 mm., E* = 1.0

Thickness Ratio = $tr * (E^*) / (tg - c) = 0.668$, Temp. Reduction = 18 °C

Min Metal Temp. w/o impact per UCS-66, Curve D -48 °C

Note:

Post Weld Heat Treatment is required for this Element/Joint and it was specified as being heat treated.

Cylindrical Shell From 20 To 30 SA-516 70 , UCS-66 Crv. D at 120 °C

Material UNS Number: K02700

Required Thickness due to Internal Pressure [tr]:

$$= (P * R) / (S * E - 0.6 * P) \quad \text{per UG-27 (c) (1)}$$

$$= (8.056 * 556.0) / (137.9 * 1.0 - 0.6 * 8.056)$$

$$= 3.2596 + 6.0000 = 9.2596 \text{ mm.}$$

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

Less Operating Hydrostatic Head Pressure of 0.056 bars

$$= (S * E * t) / (R + 0.6 * t) \quad \text{per UG-27 (c) (1)}$$

$$= (137.9 * 1.0 * 6.0) / (556.0 + 0.6 * 6.0)$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 32 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$$= 15 - 0.1 = 15 \text{ bars}$$

Maximum Allowable Pressure, New and Cold [MAPNC]:

$$= (S \cdot E \cdot t) / (R + 0.6 \cdot t) \text{ per UG-27 (c) (1)}$$

$$= (137.9 \cdot 1.0 \cdot 12.0) / (550.0 + 0.6 \cdot 12.0)$$

$$= 30 \text{ bars}$$

Actual stress at given pressure and thickness, corroded [Sact]:

$$= (P \cdot (R + 0.6 \cdot t)) / (E \cdot t)$$

$$= (8.056 \cdot (556.0 + 0.6 \cdot 6.0)) / (1.0 \cdot 6.0)$$

$$= 75.136 \text{ N./mm}^2$$

% Elongation per Table UG-79-1 (50*tnom/Rf*(1-Rf/Ro)) 1.079 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.0, tr = 4.01, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.668, Temp. Reduction = 18 °C

Min Metal Temp. w/o impact per UCS-66, Curve D -48 °C

Note:

Post Weld Heat Treatment is required for this Element/Joint and it was specified as being heat treated.

Cylindrical Shell From 30 To 40 SA-516 70 , UCS-66 Crv. D at 120 °C

Material UNS Number: K02700

Required Thickness due to Internal Pressure [tr]:

$$= (P \cdot R) / (S \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.056 \cdot 556.0) / (137.9 \cdot 1.0 - 0.6 \cdot 8.056)$$

$$= 3.2596 + 6.0000 = 9.2596 \text{ mm.}$$

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

Less Operating Hydrostatic Head Pressure of 0.056 bars

$$= (S \cdot E \cdot t) / (R + 0.6 \cdot t) \text{ per UG-27 (c) (1)}$$

$$= (137.9 \cdot 1.0 \cdot 6.0) / (556.0 + 0.6 \cdot 6.0)$$

$$= 15 - 0.1 = 15 \text{ bars}$$

Maximum Allowable Pressure, New and Cold [MAPNC]:

$$= (S \cdot E \cdot t) / (R + 0.6 \cdot t) \text{ per UG-27 (c) (1)}$$

$$= (137.9 \cdot 1.0 \cdot 12.0) / (550.0 + 0.6 \cdot 12.0)$$

$$= 30 \text{ bars}$$

Actual stress at given pressure and thickness, corroded [Sact]:

$$= (P \cdot (R + 0.6 \cdot t)) / (E \cdot t)$$

$$= (8.056 \cdot (556.0 + 0.6 \cdot 6.0)) / (1.0 \cdot 6.0)$$

$$= 75.136 \text{ N./mm}^2$$

% Elongation per Table UG-79-1 (50*tnom/Rf*(1-Rf/Ro)) 1.079 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.0, tr = 4.01, c = 6.0 mm., E* = 1.0

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 33 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Thickness Ratio = $tr * (E^*) / (tg - c) = 0.668$, Temp. Reduction = 18 °C

Min Metal Temp. w/o impact per UCS-66, Curve D -48 °C

Note:

Post Weld Heat Treatment is required for this Element/Joint and it was specified as being heat treated.

Elliptical Head From 40 To 50 SA-516 70 , UCS-66 Crv. D at 120 °C

Material UNS Number: K02700

Required Thickness due to Internal Pressure [tr]:

$$\begin{aligned}
 &= (P * D * K_{cor}) / (2 * S * E - 0.2 * P) \text{ Appendix 1-4 (c)} \\
 &= (8.056 * 1112.0 * 0.986) / (2 * 137.9 * 1.0 - 0.2 * 8.056) \\
 &= 3.2040 + 6.0000 = 9.2040 \text{ mm.}
 \end{aligned}$$

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

Less Operating Hydrostatic Head Pressure of 0.056 bars

$$\begin{aligned}
 &= (2 * S * E * t) / (K_{cor} * D + 0.2 * t) \text{ per Appendix 1-4 (c)} \\
 &= (2 * 137.9 * 1.0 * 4.0) / (0.986 * 1112.0 + 0.2 * 4.0) \\
 &= 10 - 0.1 = 10 \text{ bars}
 \end{aligned}$$

Maximum Allowable Pressure, New and Cold [MAPNC]:

$$\begin{aligned}
 &= (2 * S * E * t) / (K * D + 0.2 * t) \text{ per Appendix 1-4 (c)} \\
 &= (2 * 137.9 * 1.0 * 10.0) / (1.0 * 1100.0 + 0.2 * 10.0) \\
 &= 25 \text{ bars}
 \end{aligned}$$

Actual stress at given pressure and thickness, corroded [Sact]:

$$\begin{aligned}
 &= (P * (K_{cor} * D + 0.2 * t)) / (2 * E * t) \\
 &= (8.056 * (0.986 * 1112.0 + 0.2 * 4.0)) / (2 * 1.0 * 4.0) \\
 &= 110.474 \text{ N./mm}^2
 \end{aligned}$$

Straight Flange Required Thickness:

$$\begin{aligned}
 &= (P * R) / (S * E - 0.6 * P) + c \text{ per UG-27 (c) (1)} \\
 &= (8.056 * 556.0) / (137.9 * 1.0 - 0.6 * 8.056) + 6.0 \\
 &= 9.260 \text{ mm.}
 \end{aligned}$$

Straight Flange Maximum Allowable Working Pressure:

Less Operating Hydrostatic Head Pressure of 0.056 bars

$$\begin{aligned}
 &= (S * E * t) / (R + 0.6 * t) \text{ per UG-27 (c) (1)} \\
 &= (137.9 * 1.0 * 6.0) / (556.0 + 0.6 * 6.0) \\
 &= 15 - 0.1 = 15 \text{ bars}
 \end{aligned}$$

Factor K, corroded condition [Kcor]:

$$\begin{aligned}
 &= (2 + (\text{Inside Diameter} / (2 * \text{Inside Head Depth}))^2) / 6 \\
 &= (2 + (1112.0 / (2 * 281.0))^2) / 6 \\
 &= 0.985841
 \end{aligned}$$

Percent Elong. per UCS-79, VIII-1-01-57 $(75 * t_{nom} / R_f) * (1 - R_f / R_o)$ 4.663 %

MDMT Calculations in the Knuckle Portion:

Govrn. thk, $tg = 10.0$, $tr = 3.939$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$

Thickness Ratio = $tr * (E^*) / (tg - c) = 0.985$, Temp. Reduction = 1 °C

	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																									
شماره پیمان: 053 - 073 - 9184	<table><tr><th colspan="8">MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 34 از 251
MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
V01	0003	CN	ME	120	MF	GCS	BK																			

Min Metal Temp. w/o impact per UCS-66, Curve D -48 °C

MDMT Calculations in the Head Straight Flange:

Govrn. thk, tg = 12.0, tr = 4.01, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.668, Temp. Reduction = 18 °C

Min Metal Temp. w/o impact per UCS-66, Curve D -48 °C

Note:

Post Weld Heat Treatment is required for this Element/Joint and it was specified as being heat treated.

Note: Heads and Shells Exempted to -20F (-29C) by paragraph UG-20F

Hydrostatic Test Pressure Results:

Pressure per UG99b	= 1.30 * M.A.W.P. * Sa/S	12.802 bars
Pressure per UG99b[36]	= 1.30 * Design Pres * Sa/S	10.400 bars
Pressure per UG99c	= 1.30 * M.A.P. - Head(Hyd)	25.480 bars
Pressure per UG100	= 1.10 * M.A.W.P. * Sa/S	10.833 bars
Pressure per PED	= max(1.43*DP, 1.25*DP*ratio)	11.440 bars
Pressure per App 27-4	= M.A.W.P.	9.848 bars

UG-99(b) Note 36, Test Pressure Calculation:

= Test Factor * Design Pressure * Stress Ratio
= 1.3 * 8.0 * 1.
= 10.400 bars

Horizontal Test performed per: UG-99b (Note 36)

Please note that Nozzle, Shell, Head, Flange, etc MAWPs are all considered when determining the hydrotest pressure for those test types that are based on the MAWP of the vessel.

Stresses on Elements due to Test Pressure (N./mm² & bars):

From To	Stress	Allowable	Ratio	Pressure
10 20	144.1	235.8	0.611	10.51
20 30	98.0	235.8	0.416	10.51
30 40	98.0	235.8	0.416	10.51
40 50	144.1	235.8	0.611	10.51

Stress ratios for Nozzle and Pad Materials (N./mm²):

Description	Pad/Nozzle	Ambient	Operating	Ratio
N08 (2in)	Nozzle	137.90	137.90	1.000
N01 (1in)	Nozzle	137.90	137.90	1.000
N05A (1.5in)	Nozzle	137.90	137.90	1.000

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 35 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

N06 (2in)	Nozzle	137.90	137.90	1.000
N07 (1in)	Nozzle	137.90	137.90	1.000
N09 (1in)	Nozzle	137.90	137.90	1.000
M1 (24in)	Nozzle	137.90	137.90	1.000
M1 (24in)	Pad	137.90	137.90	1.000
K06 (2in)	Nozzle	137.90	137.90	1.000
N02 (1in)	Nozzle	137.90	137.90	1.000
N03 (1in)	Nozzle	137.90	137.90	1.000
N04 (1in)	Nozzle	137.90	137.90	1.000
N05B (1.5in)	Nozzle	137.90	137.90	1.000
K3A (3in)	Nozzle	117.90	117.90	1.000
K3A (3in)	Pad	137.90	137.90	1.000
K3B (3in)	Nozzle	117.90	117.90	1.000
K3B (3in)	Pad	137.90	137.90	1.000
K05 (2in)	Nozzle	137.90	137.90	1.000
K4B (2in)	Nozzle	137.90	137.90	1.000
K4A (2in)	Nozzle	137.90	137.90	1.000
K2B (2in)	Nozzle	137.90	137.90	1.000
K2A (2in)	Nozzle	137.90	137.90	1.000
K1B (3in)	Nozzle	117.90	117.90	1.000
K1B (3in)	Pad	137.90	137.90	1.000
K1A (3in)	Nozzle	117.90	117.90	1.000
K1A (3in)	Pad	137.90	137.90	1.000

Minimum 1.000

Stress ratios for Stiffening Ring Materials (N./mm²):

Description	Ambient	Operating	Ratio
Ring R1 Fr30	137.90	137.90	1.000

Minimum 1.000

Stress ratios for Pressurized Vessel Elements (N./mm²):

Description	Ambient	Operating	Ratio
	137.90	137.90	1.000
	137.90	137.90	1.000
	137.90	137.90	1.000
	137.90	137.90	1.000

Minimum 1.000

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 36 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Hoop Stress in Nozzle Wall during Pressure Test (N./mm²):

Description	Ambient	Operating	Ratio
N08 (2in)	3.98	223.40	0.018
N01 (1in)	3.56	223.40	0.016
N05A (1.5in)	3.75	223.40	0.017
N06 (2in)	3.98	223.40	0.018
N07 (1in)	3.56	223.40	0.016
N09 (1in)	3.56	223.40	0.016
M1 (24in)	52.96	235.81	0.225
K06 (2in)	3.70	223.40	0.017
N02 (1in)	3.56	223.40	0.016
N03 (1in)	3.56	223.40	0.016
N04 (1in)	3.56	223.40	0.016
N05B (1.5in)	3.75	223.40	0.017
K3A (3in)	5.95	217.19	0.027
K3B (3in)	5.95	217.19	0.027
K05 (2in)	3.70	223.40	0.017
K4B (2in)	3.74	223.40	0.017
K4A (2in)	3.74	223.40	0.017
K2B (2in)	3.74	223.40	0.017
K2A (2in)	3.74	223.40	0.017
K1B (3in)	5.95	217.19	0.027
K1A (3in)	5.95	217.19	0.027

Elements Suitable for Test Pressure.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 37 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

External Pressure Calculation Results :

External Pressure Calculations:

From	To	Section Length mm.	Outside Diameter mm.	Corroded Thickness mm.	Factor A	Factor B N./mm ²
10	20	No Calc	1120	4	0.00049603	49.592
20	30	1791.67	1124	6	0.00032246	32.2385
30	Ring	1791.67	1124	6	0.00032246	32.2385
Ring	40	1791.67	1124	6	0.00032246	32.2385
40	50	No Calc	1120	4	0.00049603	49.592

External Pressure Calculations:

From	To	External Actual T. mm.	External Required T. mm.	External Design Pressure bars	External M.A.W.P. bars
10	20	10	8.89963	1.034	1.96782
20	30	12	10.3799	1.034	2.29442
30	Ring	12	10.3799	1.034	2.29442
Ring	40	12	10.3799	1.034	2.29442
40	50	10	8.89963	1.034	1.96782
Minimum					2

External Pressure Calculations:

From	To	Actual Length Bet. Stiffeners mm.	Allowable Length Bet. Stiffeners mm.	Ring Inertia Required cm**4	Ring Inertia Available cm**4
10	20	No Calc	No Calc	No Calc	No Calc
20	30	1791.67	3830.13	No Calc	No Calc
30	Ring	1791.67	3830.13	No Calc	No Calc
Ring	40	1791.67	3830.13	18.0627	147.429
40	50	No Calc	No Calc	No Calc	No Calc

Elements Suitable for External Pressure.

ASME Code, Section VIII Division 1, 2019

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 38 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Elliptical Head From 10 to 20 Ext. Chart: CS-2 at 100 °C

Elastic Modulus from Chart: CS-2 at 100 °C: 199943392.000 KPa.

Results for Maximum Allowable Ext. Pressure						MAEP
Tca	Outer Dia	Do/t	Factor A	Factor B		
4.000	1120.00	280.00	0.0004960	49.59		

$$MAEP = B / (K0 * Do / t) = 49.592 / (0.9 * 280.0) = 1.9678 \text{ bars}$$

Results for Required Thickness						Tca
Tca	Outer Dia	Do/t	Factor A	Factor B		
2.900	1120.00	386.26	0.0003596	35.95		

$$MAEP = B / (K0 * Do / t) = 35.9496 / (0.9 * 386.2563) = 1.0341 \text{ bars}$$

*Check the requirements of UG-33(a)(1) using $P = 1.67 * \text{External Design pressure}$ for this head.*

Material UNS Number: K02700

Required Thickness due to Internal Pressure [tr]:

$$\begin{aligned}
 &= (P * D * K_{cor}) / (2 * S * E - 0.2 * P) \text{ Appendix 1-4 (c)} \\
 &= (1.727 * 1112.0 * 0.986) / (2 * 137.9 * 1.0 - 0.2 * 1.727) \\
 &= 0.6865 + 6.0000 = 6.6865 \text{ mm.}
 \end{aligned}$$

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

$$\begin{aligned}
 &= ((2 * S * E * t) / (K_{cor} * D + 0.2 * t)) / 1.67 \text{ per Appendix 1-4 (c)} \\
 &= ((2 * 137.9 * 1.0 * 4.0) / (0.986 * 1112.0 + 0.2 * 4.0)) / 1.67 \\
 &= 6 \text{ bars}
 \end{aligned}$$

Maximum Allowable External Pressure [MAEP]:

$$\begin{aligned}
 &= \min(MAEP, MAWP) \\
 &= \min(1.97, 6.0212) \\
 &= 1.968 \text{ bars}
 \end{aligned}$$

Thickness requirements per UG-33(a)(1) do not govern the required thickness of this head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 39 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Cylindrical Shell From 20 to 30 Ext. Chart: CS-2 at 100 °C

Elastic Modulus from Chart: CS-2 at 100 °C: 199943392.000 KPa.

Results for Maximum Allowable Ext. Pressure							MAEP
Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B	
6.000	1124.00	1791.67	187.33	1.5940	0.0003225	32.24	

$$MAEP = (4*B) / (3*(Do/t)) = (4*32.2385) / (3*187.3333) = 2.2944 \text{ bars}$$

Results for Required Thickness							Tca
Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B	
4.380	1124.00	1791.67	256.63	1.5940	0.0001991	19.90	

$$MAEP = (4*B) / (3*(Do/t)) = (4*19.9035) / (3*256.625) = 1.0341 \text{ bars}$$

Results for Maximum Stiffened Length							Slen
Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B	
6.000	1124.00	3830.13	187.33	3.4076	0.0001454	14.54	

$$MAEP = (4*B) / (3*(Do/t)) = (4*14.5355) / (3*187.3333) = 1.0345 \text{ bars}$$

Cylindrical Shell From 30 to Ring R1 Fr30 Ext. Chart: CS-2 at 100 °C

Elastic Modulus from Chart: CS-2 at 100 °C: 199943392.000 KPa.

Results for Maximum Allowable Ext. Pressure							MAEP
Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B	
6.000	1124.00	1791.67	187.33	1.5940	0.0003225	32.24	

$$MAEP = (4*B) / (3*(Do/t)) = (4*32.2385) / (3*187.3333) = 2.2944 \text{ bars}$$

Results for Required Thickness							Tca
Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B	
4.380	1124.00	1791.67	256.63	1.5940	0.0001991	19.90	

$$MAEP = (4*B) / (3*(Do/t)) = (4*19.9035) / (3*256.625) = 1.0341 \text{ bars}$$

Results for Maximum Stiffened Length							Slen
Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B	

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 40 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

6.000 | 1124.00 | 3830.13 | 187.33 | 3.4076 | 0.0001454 | 14.54 |

$$MAEP = (4*B) / (3*(Do/t)) = (4*14.5355) / (3*187.3333) = 1.0345 \text{ bars}$$

Cylindrical Shell From Ring R1 Fr30 to 40 Ext. Chart: CS-2 at 100 °C

Elastic Modulus from Chart: CS-2 at 100 °C: 199943392.000 KPa.

Results for Maximum Allowable Ext. Pressure	MAEP
---	------

Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B
6.000	1124.00	1791.67	187.33	1.5940	0.0003225	32.24

$$MAEP = (4*B) / (3*(Do/t)) = (4*32.2385) / (3*187.3333) = 2.2944 \text{ bars}$$

Results for Required Thickness	Tca
--------------------------------	-----

Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B
4.380	1124.00	1791.67	256.63	1.5940	0.0001991	19.90

$$MAEP = (4*B) / (3*(Do/t)) = (4*19.9035) / (3*256.625) = 1.0341 \text{ bars}$$

Results for Maximum Stiffened Length	Slen
--------------------------------------	------

Tca	Outer Dia	Slen	Do/t	L/D	Factor A	Factor B
6.000	1124.00	3830.13	187.33	3.4076	0.0001454	14.54

$$MAEP = (4*B) / (3*(Do/t)) = (4*14.5355) / (3*187.3333) = 1.0345 \text{ bars}$$

Elliptical Head From 40 to 50 Ext. Chart: CS-2 at 100 °C

Elastic Modulus from Chart: CS-2 at 100 °C: 199943392.000 KPa.

Results for Maximum Allowable Ext. Pressure	MAEP
---	------

Tca	Outer Dia	Do/t	Factor A	Factor B
4.000	1120.00	280.00	0.0004960	49.59

$$MAEP = B / (K0*Do/t) = 49.592 / (0.9 * 280.0) = 1.9678 \text{ bars}$$

Results for Required Thickness	Tca
--------------------------------	-----

Tca	Outer Dia	Do/t	Factor A	Factor B
2.900	1120.00	386.26	0.0003596	35.95

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 41 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

$$MAEP = B / (K0 \cdot Do / t) = 35.9496 / (0.9 \cdot 386.2563) = 1.0341 \text{ bars}$$

Check the requirements of UG-33(a)(1) using $P = 1.67 \cdot \text{External Design pressure for this head.}$

Material UNS Number: K02700

Required Thickness due to Internal Pressure [tr]:

$$\begin{aligned}
 &= (P \cdot D \cdot K_{cor}) / (2 \cdot S \cdot E - 0.2 \cdot P) \text{ Appendix 1-4 (c)} \\
 &= (1.727 \cdot 1112.0 \cdot 0.986) / (2 \cdot 137.9 \cdot 1.0 - 0.2 \cdot 1.727) \\
 &= 0.6865 + 6.0000 = 6.6865 \text{ mm.}
 \end{aligned}$$

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

$$\begin{aligned}
 &= ((2 \cdot S \cdot E \cdot t) / (K_{cor} \cdot D + 0.2 \cdot t)) / 1.67 \text{ per Appendix 1-4 (c)} \\
 &= ((2 \cdot 137.9 \cdot 1.0 \cdot 4.0) / (0.986 \cdot 1112.0 + 0.2 \cdot 4.0)) / 1.67 \\
 &= 6 \text{ bars}
 \end{aligned}$$

Maximum Allowable External Pressure [MAEP]:

$$\begin{aligned}
 &= \min(MAEP, MAWP) \\
 &= \min(1.97, 6.0212) \\
 &= 1.968 \text{ bars}
 \end{aligned}$$

Thickness requirements per UG-33(a)(1) do not govern the required thickness of this head.

Stiffening Ring Calcs for : Ring R1 Fr30 , SA-516 70 , Bar Ring: 88 x 12 mm.

Effective Length of Shell: 90 mm.

	Area (cm ²)	Distance (mm.)	Area*Dist
Shell:	5.420	3.0000	16.260
Ring :	10.560	50.0000	528.000
Total:	15.980		544.260

Centroid of Ring plus Shell: 34 mm.

	Inertia	Distance	A*Dist ²
Shell:	0.163	31.0587	5228.421
Ring :	68.147	-15.9413	2683.547
Total:	68.310		7911.968

Available Moment of Inertia, Ring plus Shell: 147 cm⁴

Required Stress in Ring plus Shell Breq 13.23 N./mm²
Required Strain in Ring plus Shell Areq 0.0001320

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 42 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Required Moment of Inertia, Ring plus Shell:

$$\begin{aligned}
 &= (OD^2 * Slen(Tca + Aring/Slen)Areq) / 10.9 \\
 &= (1124.0^2 * 1791.6666(6.0 + 10.56/1791.6666)0.000132) / 10.9 \\
 &= 18 \text{ cm}^4
 \end{aligned}$$

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 43 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Element and Detail Weights:

From	To	Element Metal Wgt. kg.	Element ID Volume Cm.	Corroded Metal Wgt. kg.	Corroded ID Volume Cm.	Extra due Misc %
10	20	153.891	221784	76.9454	228592	15.3891
20	30	519.861	1520803	261.331	1554165	51.9861
30	40	552.351	1615853	277.664	1651301	55.2351
40	50	153.891	221784	76.9454	228592	15.3891
Total		1379	3580224.25	692	3662650.25	137

Weight of Details:

From	Type	Weight of Detail kg.	X Offset, Dtl. Cent. mm.	Y Offset, Dtl. Cent. mm.	Description
10	Liqd	113.04	-91.6667	275	Liquid: 10
10	Insl	13.0809	-112.5	...	Ins: 20
10	Nozl	7.94298	-188.746	...	N08 (2in)
20	Sadl	216.957	450	863	Lft Sdl
20	Liqd	775.134	800	275	Liquid: 20
20	Insl	36.8833	800	...	Ins: 20
20	Nozl	6.16098	150	562.7	N01 (1in)
20	Nozl	5.61931	1500	569.05	N05A (1.5in)
20	Nozl	7.94298	1300	575.4	N06 (2in)
20	Nozl	3.56901	1050	562.7	N07 (1in)
20	Nozl	3.56901	800	562.7	N09 (1in)
20	Nozl	396.186	1100	854.8	M1 (24in)
20	Nozl	9.54402	200	575.4	K06 (2in)
30	Sadl	216.957	1250	863	New Sdl
30	Liqd	823.58	850	275	Liquid: 30
30	Insl	39.1885	850	...	Ins: 20
30	Ring	34.2799	50	...	Ring R1 Fr30
30	Nozl	3.56901	1600	562.7	N02 (1in)
30	Nozl	3.56901	1500	562.7	N03 (1in)
30	Nozl	3.56901	476	562.7	N04 (1in)
30	Nozl	5.61931	1400	569.05	N05B (1.5in)
30	Nozl	11.359	476	581.115	K3A (3in)
30	Nozl	12.6405	476	581.115	K3B (3in)
30	Nozl	9.54402	200	575.4	K05 (2in)
30	Nozl	15.482	750	575.4	K4B (2in)
30	Nozl	9.48856	750	575.4	K4A (2in)
30	Nozl	10.9869	1000	575.4	K2B (2in)
30	Nozl	9.48856	1000	575.4	K2A (2in)
30	Nozl	12.6405	1500	581.115	K1B (3in)
30	Nozl	11.359	1500	581.115	K1A (3in)
30	Wght	50	1600	550	VORTEX BREAKER
30	Wght	50	1500	550	DEMISTER PAD
30	Wght	200	450	...	BUCKET
30	Wght	50	700	...	WEIR
30	Wght	420	150	...	PIPING

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 																
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادرکننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 44 از 251
پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

40|Liqd| 113.04 | 141.667 | 275 | Liquid: 40
40|Insl| 13.0809 | 162.5 | ... | Ins: 20

Total Weight of Each Detail Type:

Saddles	433.9
Liquid	1824.8
Insulation	102.2
Stiffeners	34.3
Nozzles	559.8
Weights	770.0

Sum of the Detail Weights	3725.1 kg.

Weight Summation Results: (kg.)

	Fabricated	Shop Test	Shipping	Erected	Empty	Operating
Main Elements	1518.0	1518.0	1518.0	1518.0	1518.0	1518.0
Saddles	433.9	433.9	433.9	433.9	433.9	433.9
Stif. Rings	34.3	34.3	34.3	34.3	34.3	34.3
Nozzles	559.8	559.8	559.8	559.8	559.8	559.8
Wld Weights	350.0	350.0	350.0	350.0	350.0	350.0
Insulation	...	...	102.2	102.2	102.2	102.2
Empty Weights	...	...	...	420.0	420.0	...
Ope Weights	...	...	...	...	...	420.0
Ope. Liquid	...	...	...	...	...	1824.8
Test Liquid	...	3578.0	...	...	...	...

Totals	2896.0	6474.1	2998.3	3418.3	3418.3	5243.1

Field Installation Options:

Miscellaneous Weight Percent: 10.0 %

Note that the above value for the miscellaneous weight percent has been applied to the shells/heads/flange/tubesheets/tubes etc. in the weight calculations for metallic components.

Weight Summary:

Fabricated Wt.	- Bare Weight without Removable Internals	2896.0 kg.
Shop Test Wt.	- Fabricated Weight + Water (Full)	6474.1 kg.
Shipping Wt.	- Fab. Weight + removable Intls.+ Shipping App.	2998.3 kg.
Erected Wt.	- Fab. Wt + or - loose items (trays,platforms etc.)	3418.3 kg.
Ope. Wt. no Liq	- Fab. Weight + Internals. + Details + Weights	3418.3 kg.
Operating Wt.	- Empty Weight + Operating Liq. Uncorroded	5243.1 kg.
Oper. Wt. + CA	- Corr Wt. + Operating Liquid	4487.2 kg.
Field Test Wt.	- Empty Weight + Water (Full)	5902.9 kg.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 45 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Note:

The Corroded Weight and thickness are used in the Horizontal Vessel Analysis (Ope Case) and Earthquake Load Calculations.

Note: The Field Test weight as computed in the corroded condition.

Outside Surface Areas of Elements:

From	To	Surface Area cm ²
10	20	15460.4
20	30	56498.4
30	40	60029.6
40	50	15460.4
Total		147448.734 cm ²

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 46 از 251																
	<table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>		پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01
	پروژه		بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه									
BK	GCS	MF	120	ME	CN	0003	V01											

Nozzle Flange MAWP Results: (bars & °C)

Nozzle Description	Flange Rating		Design Temp	Class	Grade/Group	Equiv. Press	UG-44 (b)	Max Pressure 50%	DNV
	Ope.	Ambient							
N08 (2in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
N01 (1in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
N05A (1.5in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
N06 (2in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
N07 (1in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
N09 (1in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
M1 (24in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
K06 (2in)	46.00	51.10	120	300	GR 1.1	...	...	...	...
N02 (1in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
N03 (1in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
N04 (1in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
N05B (1.5in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
K3A (3in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
K3B (3in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
K05 (2in)	46.00	51.10	120	300	GR 1.1	...	...	...	...
K4B (2in)	46.00	51.10	120	300	GR 1.1	...	...	...	...
K4A (2in)	46.00	51.10	120	300	GR 1.1	...	...	...	...
K2B (2in)	46.00	51.10	120	300	GR 1.1	...	...	...	...
K2A (2in)	46.00	51.10	120	300	GR 1.1	...	...	...	...
K1B (3in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
K1A (3in)	16.94	19.60	120	150	GR 1.1	...	...	...	...
Min Rating	16.940	19.600 bars [for Core Elements]					0.000	0.000	0.000

ANSI Ratings are per ANSI/ASME B16.5 2013 Metric Edition

Warning:

There are nozzles in this model, but no flange MAWPs were de-rated. Be sure this is what you intended. There is a check box in the nozzle dialog that instructs PV Elite to perform the de-rating for each nozzle flange. See ASME VIII-1, UG-44(b) for more information.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 47 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input Values:

Wind Design Code	ASCE-7 2010
Wind Load Reduction Scale Factor	0.600
Basic Wind Speed	232 Km/hr
Surface Roughness Category	C: Open Terrain
Importance Factor	1.0
Type of Surface	Moderately Smooth
Base Elevation	100 mm.
Percent Wind for Hydrotest	33.0
Using User defined Wind Press. Vs Elev.	N
Height of Hill or Escarpment H or Hh	0 mm.
Distance Upwind of Crest Lh	0 mm.
Distance from Crest to the Vessel x	0 mm.
Type of Terrain (Hill, Escarpment)	Flat
Damping Factor (Beta) for Wind (Ope)	0.0100
Damping Factor (Beta) for Wind (Empty)	0.0000
Damping Factor (Beta) for Wind (Filled)	0.0000

Wind Analysis Results

Static Gust-Effect Factor, Operating Case [G]:

$$\begin{aligned}
 &= \min(0.85, 0.925((1 + 1.7 * gQ * Izbar * Q) / (1 + 1.7 * gV * Izbar))) \\
 &= \min(0.85, 0.925((1 + 1.7 * 3.4 * 0.228 * 0.983) / (1 + 1.7 * 3.4 * 0.228))) \\
 &= \min(0.85, 0.916) \\
 &= 0.850
 \end{aligned}$$

Natural Frequency of Vessel (Operating)	33.000 Hz
Natural Frequency of Vessel (Empty)	33.000 Hz
Natural Frequency of Vessel (Test)	33.000 Hz

Force Coefficient	[Cf] 0.535
Structure Height to Diameter ratio	3.112

This is classified as a rigid structure. Static analysis performed.

Sample Calculation for the First Element

The ASCE code performs all calculations in Imperial Units only. The wind pressure is therefore computed in these units.

Value of [Alpha] and [Zg]:

Exposure Category: C from Table 26.9.1
Alpha = 9.5: Zg = 274320. mm.

Effective Height [z]:

$$\begin{aligned}
 &= \text{Centroid Height} + \text{Vessel Base Elevation} \\
 &= 1200.0 + 100.0 = 1300.0 \text{ mm.} \\
 &= 4.265 \text{ ft. Imperial Units}
 \end{aligned}$$

Velocity Pressure coefficient evaluated at height z [Kz]:

$$\begin{aligned}
 &\text{Because } z (4.265 \text{ ft.}) < 15 \text{ ft.} \\
 &= 2.01 * (15 / Zg)^{2 / \text{Alpha}}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 48 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

$$= 2.01 * (15/900.0)^{2/9.5}$$

$$= 0.849$$

Type of Hill: No Hill

Wind Directionality Factor [Kd]:

$$= 0.95, \text{ per Table } 26.6-1$$

As there is No Hill Present: [Kzt]:

$$K1 = 0, K2 = 0, K3 = 0$$

Topographical Factor [Kzt]:

$$= (1 + K1 * K2 * K3)^2$$

$$= (1 + 0.0 * 0.0 * 0.0)^2$$

$$= 1.0$$

Velocity Pressure evaluated at height z, Imperial Units [qz]:

$$= \max(16, 0.00256 * Kz * Kzt * Kd * V(\text{mph})^2)$$

$$= \max(16, 0.00256 * 0.849 * 1.0 * 0.95 * 144.162^2)$$

$$= 42.9 \text{ psf } [209.487] \text{ Kgs/m}^2$$

Force on the first element [F]:

$$= qz * G * Cf * \text{WindArea}$$

$$= 42.906 * 0.85 * 0.535 * 4.243$$

$$= 82.8 \text{ lbs. } [368.4] \text{ N}$$

Element	Hgt (z) mm.	K1	K2	K3	Kz	Kzt	qz Kgs/m ²
Node 10 to 20	1300.0	0.000	0.000	0.000	0.849	1.000	209.487
Node 20 to 30	1300.0	0.000	0.000	0.000	0.849	1.000	209.487
Node 30 to 40	1300.0	0.000	0.000	0.000	0.849	1.000	209.487
Node 40 to 50	1300.0	0.000	0.000	0.000	0.849	1.000	209.487

Wind Loads on Masses/Equipment/Piping

ID	Wind Area cm ²	Elevation mm.	Pressure Kgs/m ²	Force N
VORTEX BREAKER	0.00	100.00	209.49	0.00
DEMISTER PAD	0.00	1850.00	211.50	0.00
BUCKET	0.00	1300.00	209.49	0.00
WEIR	0.00	1300.00	209.49	0.00
PIPING	0.00	1300.00	209.49	0.00

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 49 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Wind Load Calculation:

From	To	Wind Height mm.	Wind Diameter mm.	Wind Area cm ²	Wind Pressure Kgs/m ²	Element Wind Load N
10	20	1300	1464	3941.92	209.487	221.028
20	30	1300	1468.8	23500.8	209.487	1317.72
30	40	1300	1468.8	24969.6	209.487	1400.08
40	50	1300	1464	3941.92	209.487	221.028

Note:

The Wind Loads calculated and printed in the Wind Load calculation report have been factored by the input scalar/load reduction factor of: 0.600.

Be sure the wind speed is in accordance with the specified wind design code.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 50 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Earthquake Load Calculation:

Input Values:

Seismic Design Code		ASCE 7-2010
Seismic Load Reduction Scale Factor		0.700
Importance Factor		1.250
Table Value Fa		1.000
Table Value Fv		1.330
Short Period Acceleration value Ss		1.125
Long Period Acceleration Value S1		0.460
Moment Reduction Factor Tau		1.000
Force Modification Factor R		3.000
Site Class		D
Component Elevation Ratio	z/h	1.000
Amplification Factor	Ap	1.000
Force Factor		0.000
Consider Vertical Acceleration		Yes
Minimum Acceleration Multiplier		0.000
User Value of Sds (used if > 0)		1.020
User Value of Sd1 (used if > 0)		0.385

Seismic Analysis Results:

$$S_{ms} = F_a * S_s = 1.0 * 1.125 = 1.125$$

$$S_{m1} = F_v * S_1 = 1.33 * 0.46 = 0.612$$

$$S_{ds} = 2/3 * S_{ms} = 2/3 * 1.125 = 0.75$$

$$S_{ds} = \text{Max}(0.8 * S_{ds}, S_{dsUser})$$

$$= \text{Max}(0.6, 1.02)$$

$$= 1.020$$

$$S_{d1} = 2/3 * S_{m1} = 2/3 * 0.612 = 0.408$$

$$S_{d1} = \text{Max}(0.8 * S_{d1}, S_{d1User})$$

$$= \text{Max}(0.326, 0.385)$$

$$= 0.385$$

Check Approximate Fundamental Period from 12.8-7 [Ta]:

$$= C_t * h_n^x \text{ where } C_t = 0.020, x = 0.75 \text{ and } h_n = \text{Structural Height (ft.)}$$

$$= 0.020 * (5.7415^{0.75})$$

$$= 0.074 \text{ seconds}$$

The Coefficient Cu from Table 12.8-1 is : 1.400

Fundamental Period (1/Frequency) [T]:

$$= (1/\text{Natural Frequency}) = (1/33.0)$$

$$= 0.030$$

Check the Value of T which is the smaller of Cu*Ta and T:

$$= \text{Minimum Value of } (1.4 * 0.074, 0.03) \text{ per 12.8.2}$$

$$= 0.030$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 51 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Compute the Seismic Force per equation 13.3-1, [Fp]:

$$= 0.4 * A_p * S_{ds} * W * (1 + 2*(z/h)) / (R / I_e)$$

$$= 0.4 * 1.0 * 1.02 * 44002 * (1 + 2*1.0) / (3.0/1.25)$$

$$= 22440.980 \text{ N}$$

Check the Maximum value of Fp per equation 13.3-2:

$$= 1.6 * S_{ds} * I * W$$

$$= 1.6 * 1.02 * 1.25 * 44002 = 89763.93 \text{ N}$$

Check the Minimum value of Fp per equation 13.3-3:

$$= 0.3 * 1.02 * 1.25 * 44002$$

$$= 16830.736 \text{ N}$$

Compute the Total Base Shear V = Fp, [V]:

$$= 22440.980 \text{ N}$$

Vertical load per 12.4-4, [YEq]:

$$= 0.2 * S_{ds} * W$$

$$= 0.2 * 1.02 * 44002$$

$$= 8976.4 \text{ N}$$

Final Base Shear, V = 15708.69 N

Final Vertical Load, YEq = 6283.47 N

Earthquake Load Calculation:

From	To	Earthquake Height mm.	Earthquake Weight N	Element Ope Load N
10	20	550	7333.65	2618.11
20	30	550	7333.65	2618.11
20	30	550	7333.65	2618.11
30	0	550	7333.65	2618.11
30	40	550	7333.65	2618.11
40	50	550	7333.65	2618.11

Note:

The Earthquake Loads calculated and printed in the Earthquake Load calculation report have been factored by the input scalar/load reduction factor of: 0.700.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 52 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Shop/Field Installation Options :

Insulation is installed in the Shop.

Note : The CG is computed from the first Element From Node

Center of Gravity of the Saddles	1700.000 mm.
Center of Gravity of the Liquid	1700.000 mm.
Center of Gravity of the Insulation	1700.000 mm.
Center of Gravity of the Stiffening Rings	1700.000 mm.
Center of Gravity of the Nozzles	1411.380 mm.
Center of Gravity of the Added Weights (Operating)	2095.455 mm.
Center of Gravity of the Added Weights (Empty)	2095.455 mm.
Center of Gravity of Bare Shell New and Cold	1694.424 mm.
Center of Gravity of Bare Shell Corroded	1694.448 mm.
Vessel CG in the Operating Condition	1730.907 mm.
Vessel CG in the Fabricated (Shop/Empty) Condition	1739.333 mm.
Vessel CG in the Test Condition	1717.634 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 53 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

ASME Horizontal Vessel Analysis: Stresses for the Left Saddle

(per ASME Sec. VIII Div. 2 based on the Zick method.)

Horizontal Vessel Stress Calculations : Operating Case

Note:

Wear Pad Width (200.00) is less than $1.56 \cdot \sqrt{rm \cdot t}$
and less than 2a. The wear plate will be ignored.

Minimum Wear Plate Width to be considered in analysis [b1]:

$$\begin{aligned}
 &= \min(b + 1.56 \cdot \sqrt{R_m \cdot t} , 2a) \\
 &= \min(150.0 + 1.56 \cdot \sqrt{559.0 \cdot 6.0} , 2 \cdot 450.0) \\
 &= 240.3454 \text{ mm.}
 \end{aligned}$$

Input and Calculated Values:

Vessel Mean Radius	Rm	559.00	mm.
Stiffened Vessel Length per 4.15.6	L	3400.00	mm.
Distance from Saddle to Vessel tangent	a	450.00	mm.
Saddle Width	b	150.00	mm.
Saddle Bearing Angle	theta	120.00	degrees
Inside Depth of Head	h2	281.00	mm.
Shell Allowable Stress used in Calculation		137.90	N./mm ²
Head Allowable Stress used in Calculation		137.90	N./mm ²
Circumferential Efficiency in Plane of Saddle		1.00	
Circumferential Efficiency at Mid-Span		1.00	
Distance from Saddle Base to Centerline	B	1200.00	mm.
Coefficient of Friction	mu	0.30	
Saddle Force Q, Operating Case		50871.96	N

Horizontal Vessel Analysis Results:	Actual N./mm ²	Allowable N./mm ²
-----	-----	-----
Long. Stress at Top of Midspan	34.28	137.90
Long. Stress at Bottom of Midspan	40.26	137.90
Long. Stress at Top of Saddles	42.73	137.90
Long. Stress at Bottom of Saddles	34.24	137.90
-----	-----	-----
Tangential Shear in Shell	11.76	110.32
Circ. Stress at Horn of Saddle	113.08	172.37
Circ. Compressive Stress in Shell	2.68	137.90
-----	-----	-----

Intermediate Results: Saddle Reaction Q due to Wind or Seismic:

Saddle Reaction Force due to Wind Ft [Fwt]:

$$\begin{aligned}
 &= F_{tr} (F_t / \text{Num of Saddles} + Z \text{ Force Load}) \cdot B / E \\
 &= 3.0 (3159.9/2 + 0) \cdot 1200.0/994.1971
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 54 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$$= 5720.9 \text{ N}$$

Saddle Reaction Force due to Wind Fl or Friction [Fwl]:

$$= \max(\text{Fl, Friction Load, Sum of X Forces}) * B / Ls$$

$$= \max(1740.34, 7367.63, 0) * 1200.0/2400.0$$

$$= 3683.8 \text{ N}$$

Saddle Reaction Force due to Earthquake Fl or Friction [Fsl]:

$$= \max(\text{Fl, Friction Force, Sum of X Forces}) * B / Ls$$

$$= \max(15708.69, 7367.63, 0) * 1200.0/2400.0$$

$$= 7854.3 \text{ N}$$

Saddle Reaction Force due to Earthquake Ft [Fst]:

$$= \text{Ftr}(\text{Ft/Num of Saddles} + \text{Z Force Load}) * B / E$$

$$= 3.0(15709/2 + 0) * 1200.0/994.1971$$

$$= 28440.7 \text{ N}$$

Load Combination Results for Q + Wind or Seismic [Q]:

$$= \text{Saddle Load} + \max(\text{Fwl, Fwt, Fsl, Fst})$$

$$= 22431 + \max(3684, 5721, 7854, 28441)$$

$$= 50872.0 \text{ N}$$

Longitudinal Wind Force [Fl]:

$$= \text{WindScalar} * \text{WindPress}(\text{Platform Area} + (\text{End Area} * \text{WindDiaMult}))$$

$$= 0.6 * 2054.32(0.0 + (1.177 * 1.2))$$

$$= 1740.430 \text{ N}$$

Summary of Loads at the base of this Saddle:

Vertical Load (including saddle weight)	52999.45	N
Transverse Shear Load Saddle	7854.34	N
Longitudinal Shear Load Saddle	15708.69	N

Formulas and Substitutions for Horizontal Vessel Analysis:

Note: Wear Plate is Welded to the Shell, $k = 0.1$

Saddle Dimension [E]:

$$= \min(2(\text{ShellID}/2 + t + \text{WearPadThickness})\sin(\text{theta}/2), 2*Rm)$$

$$= \min(2(1100.0/2 + 12.0 + 12.0)\sin(60.0/2), 2*559.0)$$

$$= 994.197 \text{ mm.}$$

The Computed K values from Table 4.15.1:

K1 = 0.1066	K2 = 1.1707	K3 = 0.8799	K4 = 0.4011
K5 = 0.7603	K6 = 0.0529	K7 = 0.0374	K8 = 0.3405
K9 = 0.2711	K10 = 0.0581	K1* = 0.1923	

Note: Dimension a is greater than or equal to $Rm / 2$.

Moment per Equation 4.15.3 [M1]:

$$= -Q*a [1 - (1 - a/L + (Rm^2 - h^2)/(2a*L)) / (1 + (4h^2)/3L)]$$

$$= -50872*450.0 [1 - (1 - 450.0/3400.0 + (559.0^2 - 281.0^2) / (2*450.0*3400.0)) / (1 + (4*281.0) / (3*3400.0))]$$

$$= -3429.2 \text{ N-m}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 55 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Moment per Equation 4.15.4 [M2]:

$$\begin{aligned}
 &= Q \cdot L / 4 (1 + 2 (R_m^2 - h^2) / (L^2)) / (1 + (4h^2) / (3L)) - 4a/L \\
 &= 50872 \cdot 3400 / 4 (1 + 2 (559^2 - 281^2) / (3400^2)) / (1 + (4 \cdot 281) / (3 \cdot 3400)) - 4 \cdot 450 / 3400 \\
 &= 17637.5 \text{ N-m}
 \end{aligned}$$

Longitudinal Stress at Top of Shell (4.15.6) [Sigma1]:

$$\begin{aligned}
 &= P \cdot R_m / (2t) - M2 / (\pi \cdot R_m^2 \cdot t) \\
 &= 8.0 \cdot 559.0 / (2 \cdot 6.0) - 17637.5 / (\pi \cdot 559.0^2 \cdot 6.0) \\
 &= 34.28 \text{ N./mm}^2
 \end{aligned}$$

Longitudinal Stress at Bottom of Shell (4.15.7) [Sigma2]:

$$\begin{aligned}
 &= P \cdot R_m / (2t) + M2 / (\pi \cdot R_m^2 \cdot t) \\
 &= 8.0 \cdot 559.0 / (2 \cdot 6.0) + 17637.5 / (\pi \cdot 559.0^2 \cdot 6.0) \\
 &= 40.26 \text{ N./mm}^2
 \end{aligned}$$

Longitudinal Stress at Top of Shell at Support (4.15.10) [Sigma*3]:

$$\begin{aligned}
 &= P \cdot R_m / (2t) - M1 / (K1 \cdot \pi \cdot R_m^2 \cdot t) \\
 &= 8.0 \cdot 559.0 / (2 \cdot 6.0) - 3429.2 / (0.1066 \cdot \pi \cdot 559.0^2 \cdot 6.0) \\
 &= 42.73 \text{ N./mm}^2
 \end{aligned}$$

Longitudinal Stress at Bottom of Shell at Support (4.15.11) [Sigma*4]:

$$\begin{aligned}
 &= P \cdot R_m / (2t) + M1 / (K1 \cdot \pi \cdot R_m^2 \cdot t) \\
 &= 8.0 \cdot 559.0 / (2 \cdot 6.0) + 3429.2 / (0.1923 \cdot \pi \cdot 559.0^2 \cdot 6.0) \\
 &= 34.24 \text{ N./mm}^2
 \end{aligned}$$

Maximum Shear Force in the Saddle (4.15.5) [T]:

$$\begin{aligned}
 &= Q (L - 2a) / (L + (4 \cdot h^2 / 3)) \\
 &= 50872 (3400.0 - 2 \cdot 450.0) / (3400.0 + (4 \cdot 281.0 / 3)) \\
 &= 33693.0 \text{ N}
 \end{aligned}$$

Shear Stress in the shell no rings, not stiffened (4.15.14) [tau2]:

$$\begin{aligned}
 &= K2 \cdot T / (R_m \cdot t) \\
 &= 1.1707 \cdot 33693.02 / (559.0 \cdot 6.0) \\
 &= 11.76 \text{ N./mm}^2
 \end{aligned}$$

Decay Length (4.15.22) [x1,x2]:

$$\begin{aligned}
 &= 0.78 \cdot \sqrt{R_m \cdot t} \\
 &= 0.78 \cdot \sqrt{559.0 \cdot 6.0} \\
 &= 45.173 \text{ mm}
 \end{aligned}$$

Circumferential Stress in shell, no rings (4.15.23) [sigma6]:

$$\begin{aligned}
 &= -K5 \cdot Q \cdot k / (t \cdot (b + X1 + X2)) \\
 &= -0.7603 \cdot 50872 \cdot 0.1 / (6.0 \cdot (150.0 + 45.17 + 45.17)) \\
 &= -2.68 \text{ N./mm}^2
 \end{aligned}$$

Circ. Comp. Stress at Horn of Saddle, L<8Rm (4.15.25) [sigma7*]:

$$\begin{aligned}
 &= -Q / (4 \cdot t \cdot (b + X1 + X2)) - 12 \cdot K7 \cdot Q \cdot R_m / (L \cdot t^2) \\
 &= -50872 / (4 \cdot 6.0 \cdot (150.0 + 45.173 + 45.173)) - \\
 &\quad 12 \cdot 0.037 \cdot 50872 \cdot 559.0 / (3400.0 \cdot 6.0^2) \\
 &= -113.08 \text{ N./mm}^2
 \end{aligned}$$

Effective reinforcing plate width (4.15.1) [B1]:

$$\begin{aligned}
 &= \min(b + 1.56 \cdot \sqrt{R_m \cdot t}, 2a) \\
 &= \min(150.0 + 1.56 \cdot \sqrt{559.0 \cdot 6.0}, 2 \cdot 450.0)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 56 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$$= 240.35 \text{ mm.}$$

Distance between Saddle Supports [Ls]:

$$= 2400.0 \text{ mm.}$$

Free Un-Restrained Thermal Expansion between the Saddles [Exp]:

$$= \alpha * L_s (\text{Design Temperature} - \text{Ambient Temperature})$$

$$= 0.000012 * 2400.0 (120.0 - 21.1)$$

$$= 2.903 \text{ mm.}$$

Results for Vessel Ribs, Web and Base:

Baseplate Length	Bplen	1100.0000	mm.
Baseplate Thickness	Bpthk	15.0000	mm.
Baseplate Width	Bpwid	170.0000	mm.
Number of Ribs (inc. outside ribs)	Nribs	4	
Rib Thickness	Ribtk	15.0000	mm.
Web Thickness	Webtk	15.0000	mm.
Web Location	Webloc	Center	
Saddle Yield Stress	Sy	239.9	N./
Height of Web at Center	Hw,c	635.0	mm.
Friction Coefficient	mu	0.300	

Note: In the tables below Io is I for the rectangle + Area * Centroid Distance^2

Moment of Inertia of Saddle - Transverse Direction (90 degrees to long axis)

	B	D	Y	A	AY	Io
Shell	290.1	6.0	3.0	17.4	5221.8	0.145E+05
Wearplate	200.0	12.0	12.0	24.0	28800.0	0.188E+05
Web	15.0	611.0	323.5	91.6	2964876.5	0.295E+05
BasePlate	170.0	15.0	636.5	25.5	1623074.8	0.304E+05
Totals	...	...	...	158.6	4621973.5	0.930E+05

Distance to Centroid [C1]:

$$= AY / A$$

$$= 1819.675/158.556$$

$$= 291.504 \text{ mm.}$$

Angle [beta]:

$$= 180 - \text{Saddle Angle}/2$$

$$= 180 - 120.0/2$$

$$= 120.0$$

Saddle Splitting Coefficient [K1]:

$$= (1 + \cos(\beta) - 0.5 * \sin(\beta)^2) / (\pi - \beta + \sin(\beta) \cos(\beta))$$

$$= (1 + \cos(120.0) - 0.5 * \sin(120.0)^2) / (\pi - 2.094 + \sin(120.0) \cos(120.0))$$

$$= 0.2035$$

Saddle Splitting Force [Fh]:

$$= K1 * Q$$

$$= 0.204 * 50871.965$$

$$= 10353.5488 \text{ N}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 57 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$\begin{aligned} \text{Tension Stress, } S_t &= (F_h / A_s) = 0.7336 \text{ N./mm}^2 \\ \text{Allowed Stress, } S_a &= 0.6 * \text{Yield Str} = 143.9676 \text{ N./mm}^2 \end{aligned}$$

Saddle Splitting Dimension [d]:

$$\begin{aligned} &= B - R * \sin(\theta/2) / (\theta/2 \text{ in radians}) \\ &= 1200.0 - 556.0 * \sin(120.0/2) / 1.0472 \\ &= 740.192 \text{ mm.} \end{aligned}$$

$$\text{Bending Moment, } M = F_h * d = 7666.7168 \text{ N-m}$$

$$\begin{aligned} \text{Bending Stress, } S_b &= (M * C_1 / I) = 2.4011 \text{ N./mm}^2 \\ \text{Allowed Stress, } S_a &= 2/3 * \text{Yield Str} = 159.9640 \text{ N./mm}^2 \end{aligned}$$

Minimum Thickness of Baseplate per Moss:

$$\begin{aligned} &= (3(Q + \text{Saddle_Wt}) \text{BasePlateWidth} / (4 * \text{BasePlateLength} * \text{AllStress}))^{1/2} \\ &= (3(50872 + 2127)170.0 / (4 * 1100.0 * 159.964))^{1/2} \\ &= 6.197 \text{ mm.} \end{aligned}$$

Calculation of Axial Load, Intermediate Values and Compressive Stress:

Web Length Dimension [Web Length]:

$$\begin{aligned} &= 2 * \cos(90 - \text{Saddle Angle}/2) * (\text{Inside Radius} + \text{Shell Thk} + \text{Wear Plate Thk}) \\ &= 2 * \cos(90 - 120.0/2) * (550.0 + 12.0 + 12.0) \\ &= 994.197 \text{ mm.} \end{aligned}$$

Distance between Ribs [e]:

$$\begin{aligned} &= \text{Web Length} / (\text{Nr ribs} - 1) \\ &= 994.1971 / (4 - 1) \\ &= 331.399 \text{ mm.} \end{aligned}$$

Baseplate Pressure Area [Ap]:

$$\begin{aligned} &= e * \text{Bpwid} / 2 \\ &= 331.399 * 170.0 / 2 \\ &= 281.689 \text{ cm}^2 \end{aligned}$$

Bearing Pressure [Bp]:

$$\begin{aligned} &= Q / (\text{BasePlateLength} * \text{BasePlateWidth}) \\ &= 50871.965 / (1100.0 * 170.0) \\ &= 27.204 \text{ N/cm}^2 \end{aligned}$$

Axial Load [P]:

$$\begin{aligned} &= A_p * B_p \\ &= 281.7 * 27.2 \\ &= 7663.146 \text{ N} \end{aligned}$$

Area of the Rib and Web [Ar]:

$$\begin{aligned} &= \text{Rib Area} + \text{Web Area} \\ &= 20.25 + 24.855 \\ &= 45.105 \text{ cm}^2 \end{aligned}$$

Compressive Stress [Sc]:

$$\begin{aligned} &= P / A_r \\ &= 7663.1 / 45.1049 \\ &= 1.699 \text{ N./mm}^2 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 58 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Check of Outside Ribs:

Inertia of Saddle, Outer Ribs - Longitudinal Direction

	B	D	Y	A	AY	Io
Rib+Web	15.0	150.0	...	22.5	...	422.

Rib dimension [D]:

= Saddle Width - Web Thickness
= 150.0 - 15.0
= 135.000 mm.

Distance to Centroid from Datum [ytot]:

= AY / A
= 0.0/45.105
= 0.000 mm.

Distance to Centroid [C1]:

= Saddle Width / 2
= 150.0/2
= 75.000 mm.

Radius of Gyration [r]:

= sqrt(Total Inertia / Total Area)
= sqrt(421.9/45.105)
= 30.583 mm.

Length of Outer Rib [L]:

= Saddle Height - cos(theta/2) (radius + shlthk + wpdthk) - bpthk
= 1200.0 - cos(120.0/2) (550.0 + 12.0 + 12.0) - 15.0
= 898.000 mm.

Intermediate Term [Cc]:

= sqrt(2 * pi² * Elastic Modulus / Yield Stress)
= sqrt(2 * pi² * 0.19994E+09/239.9)
= 128.255

Slenderness ratio [KL/r]:

= KL/r
= 1 * 898.0/30.583
= 29.363

Bending Moment [Rm]:

= Fl / (2 * Bplen) * e * L / 2
= 15708.7 / (2 * 1100.0) * 331.399 * 898.0/2
= 1062.896 N-m

Compressive Allowable, KL/r < Cc (29.3627 < 128.2549) per AISC E2-1 [Sca]:

= (1 - (KL/r)² / (2*Cc²)) Fy / (5/3 + 3*(KL/r) / (8*Cc) - (KL/r)³ / (8*Cc³))
= (1 - (29.36)² / (2 * 128.25²)) 240 /
(5/3 + 3*(29.36) / (8* 128.25) - (29.36³) / (8*128.25³))
= 133.4 N./mm²

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 59 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

AISC Unity Check of Outside Ribs (must be <= 1)

$$\begin{aligned}
 &= S_c / S_{ca} + (R_m * C_1 / I) / S_{ba} \\
 &= 1.7 / 133.44 + (1062.9 * 75.0 / 4218750) / 159.96 \\
 &= 0.131
 \end{aligned}$$

Check of Inside Ribs:

Inertia of Saddle, Inner Ribs - Axial Direction

	B	D	Y	A	AY	I _o
Rib	15.0	135.0	0.0	20.2	0.0	421.
Web	331.4	15.0	0.0	49.7	0.0	9.32
Totals	...	...	...	70.0	...	431.

Distance to Centroid from Datum [ytot]:

$$\begin{aligned}
 &= AY / A \\
 &= 0.0 / 69.96 \\
 &= 0.000 \text{ mm.}
 \end{aligned}$$

Distance to Centroid [C1]:

$$\begin{aligned}
 &= \text{Saddle Width} / 2 \\
 &= 150.0 / 2 \\
 &= 75.000 \text{ mm.}
 \end{aligned}$$

Length of Inner Rib [L]:

$$\begin{aligned}
 &= \text{Saddle Height} - \sqrt{ (R_o + W_{pdthk})^2 - (Pitch/2)^2 } - B_{pthk} \\
 &= 1200.0 - \sqrt{ (574.0 + 12.0)^2 - (331.399/2)^2 } - 15.0 \\
 &= 635.437 \text{ mm.}
 \end{aligned}$$

Radius of Gyration [r]:

$$\begin{aligned}
 &= \sqrt{ \text{Total Inertia} / \text{Total Area} } \\
 &= \sqrt{ 430.8 / 69.96 } \\
 &= 24.814 \text{ mm.}
 \end{aligned}$$

Slenderness ratio [KL/r]:

$$\begin{aligned}
 &= KL / r \\
 &= 1 * 635.437 / 24.814 \\
 &= 25.608
 \end{aligned}$$

Unit Force [Force,u]:

$$\begin{aligned}
 &= F_1 / (2 * \text{Baseplate Length}) \\
 &= 15708.688 / (2 * 1100.0) \\
 &= 7.140 \text{ N/mm.}
 \end{aligned}$$

Moment at base of inner Rib [Mbase,c]:

$$\begin{aligned}
 &= \text{Unit Force} * e * L \\
 &= 7.14 * 331.399 * 635.437 \\
 &= 1504.239 \text{ N-m}
 \end{aligned}$$

Bending Stress due to Transverse Force and Weight Load [SigmaB,base,c]:

$$\begin{aligned}
 &= \text{Bending Moment} / \text{Section Modulus} \\
 &= 1504.239 / 57436.492 \\
 &= 26.181 \text{ N./mm}^2
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 60 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Compressive Allowable, $KL/r < C_c$ ($25.6078 < 128.2549$) per AISC E2-1 [Sca]:

$$= (1 - (KL/r)^2 / (2 * C_c^2)) F_y / (5/3 + 3 * (KL/r) / (8 * C_c) - (KL/r)^3 / (8 * C_c^3))$$

$$= (1 - (25.61)^2 / (2 * 128.25^2)) 240 / (5/3 + 3 * (25.61) / (8 * 128.25) - (25.61^3) / (8 * 128.25^3))$$

$$= 135.1 \text{ N./mm}^2$$

AISC Unity Check of Inside Ribs (must be ≤ 1)

$$= S_c / S_{ca} + (M_{base,c} * C_1 / I) / S_{ba}$$

$$= 2.22 / 135.11 + (1504.24 * 75.0 / 430.773) / 159.96$$

$$= 0.180$$

Input Data for Base Plate Bolting Calculations:

Total Number of Bolts per BasePlate	Nbolts	4
Total Number of Bolts in Tension/Baseplate	Nbt	2
Bolt Material Specification		SA-325
Bolt Allowable Stress	Stba	300.00 N./mm ²
Bolt Corrosion Allowance	Bca	0.0 mm.
Distance from Bolts to Edge	Edgedis	30.5 mm.
Nominal Bolt Diameter	Bnd	20.0000 mm.
Thread Series	Series	TEMA Metric
BasePlate Allowable Stress	S	95.15 N./mm ²
Area Available in a Single Bolt	BltArea	2.1705 cm ²
Saddle Load QO (Weight)	QO	24558.8 N
Saddle Load QL (Wind/Seismic contribution)	QL	7854.3 N
Maximum Transverse Force	Ft	7854.3 N
Maximum Longitudinal Force	F1	15708.7 N
Saddle Bolted to Steel Foundation		No

Shear Stress in a Single Bolt, Longitudinal Direction [taub,l]:

$$= F_1 / (\text{Bolt Area} * \text{Number of Bolts})$$

$$= 15709 / (2.17 * 4)$$

$$= 18.1 \text{ N./mm}^2. \text{ Must be less than } 180.0 \text{ N./mm}^2.$$

Shear Stress in a Single Bolt, Transverse Direction [taub,t]:

$$= F_t / (\text{Bolt Area} * \text{Number of Bolts})$$

$$= 7854 / (2.17 * 4)$$

$$= 9.0 \text{ N./mm}^2. \text{ Must be less than } 180.0 \text{ N./mm}^2.$$

Bolt Area Calculation per Dennis R. Moss

Bolt Area Requirement Due to Longitudinal Load [Bltarearl]:

$$= 0.0 \text{ (} Q_O > Q_L \text{ --> No Uplift in Longitudinal direction)}$$

Bolt Area due to Shear Load [Bltarears]:

$$= F_1 / (\text{BoltShearAllowable} * \text{Nbolts})$$

$$= 15708.69 / (180.0 * 4.0)$$

$$= 0.2182 \text{ cm}^2$$

Bolt Area due to Transverse Load:

Moment on Baseplate Due to Transverse Load [Rmom]:

$$= B * F_t + \text{Sum of X Moments}$$

$$= 1200.0 * 7854.34 + 0.0$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 61 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادرکننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

$$= 9429.03 \text{ N-m}$$

Eccentricity (e):

$$= R_{mom} / QO$$

$$= 9429.03/24558.77$$

$$= 383.78 \text{ mm.} > B_{plen}/6 \rightarrow \text{Uplift in Transverse direction}$$

$$f = B_{plen} / 2 - E_{dgedis}$$

$$= 1100.0/2 - 30.51$$

$$= 519.49 \text{ mm.}$$

Modular Ratio Of Steel/Concrete (n1):

$$= E_S / E_C$$

$$= 203402.5/21526.32$$

$$= 9.45$$

$$K1 = 3 (e - 0.5 * B_{plen})$$

$$= 3 (383.78 - 0.5*1100.0)$$

$$= -498.65 \text{ mm.}$$

$$K2 = 6 * n1 * A_t / B_{pwid} * (f + e)$$

$$= 6 * 9.45 * 4.34/170.0 * (519.49 + 383.78)$$

$$= 130767.96 \text{ mm.}^2$$

$$K3 = -K2 * (0.5 * B_{plen} + f)$$

$$= -130767.96 * (0.5 * 1100.0 + 519.49)$$

$$= -139855619.31 \text{ mm.}^3$$

Iteratively Solving for the Effective Bearing Length:

$$Y^3 + K1 * Y^2 + K2 * Y + K3 = 0$$

$$Y^3 + -498.65 * Y^2 + 130767.96 * Y + -0.1E+09 = 0$$

$$Y = 637.59 \text{ mm.}$$

$$Num = (B_{plen} / 2 - Y / 3 - e)$$

$$= (1100.0/2 - 637.59/3 - 383.78)$$

$$= -46.31$$

$$Denom = (B_{plen} / 2 - Y / 3 + f)$$

$$= (1100.0/2 - 637.59/3 + 519.49)$$

$$= 856.97$$

Total Bolt Tension Force [Tforce]:

$$= - QO * Num / Denom$$

$$= - 24558.77 * -46.31/856.97$$

$$= 1327.19 \text{ N}$$

Bolt Area Required due to Transverse Load [Bltareart]:

$$= Tforce / (Stba * Nbt)$$

$$= 1327.19/(300.0 * 2.0)$$

$$= 0.0221 \text{ cm}^2$$

Required Area of a Single Bolt [Bltarearl]:

$$= \max[Bltarearl, Bltarears, Bltareart]$$

$$= \max[0.0, 0.2182, 0.0221]$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 62 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

$$= 0.2182 \text{ cm}^2$$

Baseplate Thickness Calculation per D. Moss:

Bearing Pressure (fc)

$$= 2(QO + Tforce) / (Y * Bpwid)$$

$$= 2(24558.77 + 1327.19) / (637.59 * 170.0)$$

$$= 4.78 \text{ bars}$$

Distance from Baseplate Edge to the Web [ADIST]:

$$= (Bplen - Weblength) / 2$$

$$= (1100.0 - 1049.2) / 2$$

$$= 25.4000 \text{ mm.}$$

Overturning Moment due To Bolt Tension [Mt]:

$$= Tforce * Adist$$

$$= 1327.19 * 25.4$$

$$= 33.72 \text{ N-m}$$

Equivalent Bearing Pressure (f1):

$$= fc * (Y - Adist) / Y$$

$$= 4.78 * (637.59 - 25.4) / 637.59$$

$$= 4.59 \text{ bars}$$

Overturning Moment due to Bearing Pressure [Mc]:

$$= (Adist^2 * Bpwid / 6) * (f1 + 2 * fc)$$

$$= (25.4^2 * 170.0 / 6) * (4.59 + 2 * 4.78)$$

$$= 25.86 \text{ N-m}$$

Baseplate Required Thickness [Treq]:

$$= (6 * \max(Mt, Mc) / (Bpwid * Sba))^{1/2}$$

$$= (6 * \max(33.72, 25.86) / (170.0 * 142.73))^{1/2}$$

$$= 2.8874 \text{ mm.}$$

ASME Horizontal Vessel Analysis: Stresses for the Right Saddle

(per ASME Sec. VIII Div. 2 based on the Zick method.)

Note:

Wear Pad Width (200.00) is less than $1.56 * \sqrt{rm * t}$
and less than 2a. The wear plate will be ignored.

Minimum Wear Plate Width to be considered in analysis [b1]:

$$= \min(b + 1.56 * \sqrt{Rm * t}, 2a)$$

$$= \min(150.0 + 1.56 * \sqrt{559.0 * 6.0}, 2 * 450.0)$$

$$= 240.3454 \text{ mm.}$$

Input and Calculated Values:

Vessel Mean Radius	Rm	559.00	mm.
Stiffened Vessel Length per 4.15.6	L	3400.00	mm.
Distance from Saddle to Vessel tangent	a	450.00	mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 63 از 251	
	پروژه	بسته کاری	صادر کننده	تسهيلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Saddle Width	b	150.00	mm.
Saddle Bearing Angle	theta	120.00	degrees
Inside Depth of Head	h2	281.00	mm.
Shell Allowable Stress used in Calculation		137.90	N./mm ²
Head Allowable Stress used in Calculation		137.90	N./mm ²
Circumferential Efficiency in Plane of Saddle		1.00	
Circumferential Efficiency at Mid-Span		1.00	
Distance from Saddle Base to Centerline	B	1200.00	mm.
Coefficient of Friction	mu	0.00	
Saddle Force Q, Operating Case		52039.84	N

Horizontal Vessel Analysis Results:	Actual	Allowable
	N./mm ²	N./mm ²

Long. Stress at Top of Midspan	34.21	137.90
Long. Stress at Bottom of Midspan	40.33	137.90
Long. Stress at Top of Saddles	42.85	137.90
Long. Stress at Bottom of Saddles	34.17	137.90

Tangential Shear in Shell	12.03	110.32
Circ. Stress at Horn of Saddle	115.68	172.37
Circ. Compressive Stress in Shell	2.74	137.90

Intermediate Results: Saddle Reaction Q due to Wind or Seismic:

Saddle Reaction Force due to Wind Ft [Fwt]:

$$= F_{tr} (F_t / \text{Num of Saddles} + Z \text{ Force Load}) * B / E$$

$$= 3.0 (3159.9/2 + 0) * 1200.0/994.1971$$

$$= 5720.9 \text{ N}$$

Saddle Reaction Force due to Wind Fl or Friction [Fwl]:

$$= \max (F_l, \text{Friction Load, Sum of X Forces}) * B / L_s$$

$$= \max (1740.34, 0.0, 0) * 1200.0/2400.0$$

$$= 870.2 \text{ N}$$

Saddle Reaction Force due to Earthquake Fl or Friction [Fsl]:

$$= \max (F_l, \text{Friction Force, Sum of X Forces}) * B / L_s$$

$$= \max (15708.69, 0.0, 0) * 1200.0/2400.0$$

$$= 7854.3 \text{ N}$$

Saddle Reaction Force due to Earthquake Ft [Fst]:

$$= F_{tr} (F_t / \text{Num of Saddles} + Z \text{ Force Load}) * B / E$$

$$= 3.0 (15709/2 + 0) * 1200.0/994.1971$$

$$= 28440.7 \text{ N}$$

Load Combination Results for Q + Wind or Seismic [Q]:

$$= \text{Saddle Load} + \max (F_{wl}, F_{wt}, F_{sl}, F_{st})$$

$$= 23599 + \max (870, 5721, 7854, 28441)$$

$$= 52039.8 \text{ N}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 64 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Longitudinal Wind Force [F]:

$$\begin{aligned}
 &= \text{WindScalar} * \text{WindPress}(\text{Platform Area} + (\text{End Area} * \text{WindDiaMult})) \\
 &= 0.6 * 2054.32(0.0 + (1.177 * 1.2)) \\
 &= 1740.430 \text{ N}
 \end{aligned}$$

Summary of Loads at the base of this Saddle:

Vertical Load (including saddle weight)	54167.31	N
Transverse Shear Load Saddle	7854.34	N
Longitudinal Shear Load Saddle	15708.69	N

Formulas and Substitutions for Horizontal Vessel Analysis:

Note: Wear Plate is Welded to the Shell, $k = 0.1$

Saddle Dimension [E]:

$$\begin{aligned}
 &= \min(2(\text{ShellID}/2 + t + \text{WearPadThickness})\sin(\theta/2), 2R_m) \\
 &= \min(2(1100.0/2 + 12.0 + 12.0)\sin(60.0/2), 2*559.0) \\
 &= 994.197 \text{ mm.}
 \end{aligned}$$

The Computed K values from Table 4.15.1:

K1 = 0.1066	K2 = 1.1707	K3 = 0.8799	K4 = 0.4011
K5 = 0.7603	K6 = 0.0529	K7 = 0.0374	K8 = 0.3405
K9 = 0.2711	K10 = 0.0581	K1* = 0.1923	

Note: Dimension a is greater than or equal to $R_m / 2$.

Moment per Equation 4.15.3 [M1]:

$$\begin{aligned}
 &= -Q*a [1 - (1 - a/L + (R_m^2 - h^2)/(2a*L)) / (1 + (4h^2)/3L)] \\
 &= -52040*450.0 [1 - (1 - 450.0/3400.0 + (559.0^2 - 281.0^2) / (2*450.0*3400.0)) / (1 + (4*281.0)/(3*3400.0))] \\
 &= -3507.9 \text{ N-m}
 \end{aligned}$$

Moment per Equation 4.15.4 [M2]:

$$\begin{aligned}
 &= Q*L/4 (1 + 2(R_m^2 - h^2)/(L^2)) / (1 + (4h^2)/(3L)) - 4a/L \\
 &= 52040*3400/4 (1 + 2(559^2 - 281^2)/(3400^2)) / (1 + (4*281)/(3*3400)) - 4*450/3400 \\
 &= 18042.4 \text{ N-m}
 \end{aligned}$$

Longitudinal Stress at Top of Shell (4.15.6) [Sigma1]:

$$\begin{aligned}
 &= P * R_m / (2t) - M2 / (\pi * R_m^2 * t) \\
 &= 8.0 * 559.0 / (2*6.0) - 18042.4 / (\pi * 559.0^2 * 6.0) \\
 &= 34.21 \text{ N./mm}^2
 \end{aligned}$$

Longitudinal Stress at Bottom of Shell (4.15.7) [Sigma2]:

$$\begin{aligned}
 &= P * R_m / (2t) + M2 / (\pi * R_m^2 * t) \\
 &= 8.0 * 559.0 / (2 * 6.0) + 18042.4 / (\pi * 559.0^2 * 6.0) \\
 &= 40.33 \text{ N./mm}^2
 \end{aligned}$$

Longitudinal Stress at Top of Shell at Support (4.15.10) [Sigma*3]:

$$\begin{aligned}
 &= P * R_m / (2t) - M1 / (K1 * \pi * R_m^2 * t) \\
 &= 8.0 * 559.0 / (2*6.0) - 3507.9 / (0.1066 * \pi * 559.0^2 * 6.0) \\
 &= 42.85 \text{ N./mm}^2
 \end{aligned}$$

Longitudinal Stress at Bottom of Shell at Support (4.15.11) [Sigma*4]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 65 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

$$= P * Rm / (2t) + M1 / (K1 * \pi * Rm^2 * t)$$

$$= 8.0 * 559.0 / (2 * 6.0) + 3507.9 / (0.1923 * \pi * 559.0^2 * 6.0)$$

$$= 34.17 \text{ N./mm}^2$$

Maximum Shear Force in the Saddle (4.15.5) [T]:

$$= Q (L - 2a) / (L + (4 * h^2 / 3))$$

$$= 52040 (3400.0 - 2 * 450.0) / (3400.0 + (4 * 281.0^2 / 3))$$

$$= 34466.5 \text{ N}$$

Shear Stress in the shell no rings, not stiffened (4.15.14) [tau2]:

$$= K2 * T / (Rm * t)$$

$$= 1.1707 * 34466.51 / (559.0 * 6.0)$$

$$= 12.03 \text{ N./mm}^2$$

Decay Length (4.15.22) [x1,x2]:

$$= 0.78 * \sqrt{Rm * t}$$

$$= 0.78 * \sqrt{559.0 * 6.0}$$

$$= 45.173 \text{ mm.}$$

Circumferential Stress in shell, no rings (4.15.23) [sigma6]:

$$= -K5 * Q * k / (t * (b + X1 + X2))$$

$$= -0.7603 * 52040 * 0.1 / (6.0 * (150.0 + 45.17 + 45.17))$$

$$= -2.74 \text{ N./mm}^2$$

Circ. Comp. Stress at Horn of Saddle, L<8Rm (4.15.25) [sigma7*]:

$$= -Q / (4 * t * (b + X1 + X2)) - 12 * K7 * Q * Rm / (L * t^2)$$

$$= -52040 / (4 * 6.0 * (150.0 + 45.173 + 45.173)) - 12 * 0.037 * 52040 * 559.0 / (3400.0 * 6.0^2)$$

$$= -115.68 \text{ N./mm}^2$$

Effective reinforcing plate width (4.15.1) [B1]:

$$= \min(b + 1.56 * \sqrt{Rm * t}, 2a)$$

$$= \min(150.0 + 1.56 * \sqrt{559.0 * 6.0}, 2 * 450.0)$$

$$= 240.35 \text{ mm.}$$

Results for Vessel Ribs, Web and Base:

Baseplate Length	Bplen	1100.0000	mm.
Baseplate Thickness	Bpthk	15.0000	mm.
Baseplate Width	Bpwid	170.0000	mm.
Number of Ribs (inc. outside ribs)	Nribs	4	
Rib Thickness	Ribtk	15.0000	mm.
Web Thickness	Webtk	15.0000	mm.
Web Location	Webloc	Center	
Saddle Yield Stress	Sy	239.9	N./
Height of Web at Center	Hw, c	635.0	mm.
Friction Coefficient	mu	0.000	

Note: In the tables below I is I for the rectangle + Area * Centroid Distance^2

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 66 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Moment of Inertia of Saddle - Transverse Direction (90 degrees to long axis)

	B	D	Y	A	AY	Io
Shell	290.1	6.0	3.0	17.4	5221.8	0.145E+05
Wearplate	200.0	12.0	12.0	24.0	28800.0	0.188E+05
Web	15.0	611.0	323.5	91.6	2964876.5	0.295E+05
BasePlate	170.0	15.0	636.5	25.5	1623074.8	0.304E+05
Totals	...	...	...	158.6	4621973.5	0.930E+05

Distance to Centroid [C1]:

$$= AY / A$$

$$= 1819.675/158.556$$

$$= 291.504 \text{ mm.}$$

Angle [beta]:

$$= 180 - \text{Saddle Angle}/2$$

$$= 180 - 120.0/2$$

$$= 120.0$$

Saddle Splitting Coefficient [K1]:

$$= (1 + \cos(\text{beta}) - 0.5 \cdot \sin(\text{beta})^2) / (\pi - \text{beta} + \sin(\text{beta}) \cos(\text{beta}))$$

$$= (1 + \cos(120.0) - 0.5 \cdot \sin(120.0)^2) / (\pi - 2.094 + \sin(120.0) \cos(120.0))$$

$$= 0.2035$$

Saddle Splitting Force [Fh]:

$$= K1 * Q$$

$$= 0.204 * 52039.836$$

$$= 10591.2354 \text{ N}$$

$$\text{Tension Stress, } St = (Fh/As) = 0.7504 \text{ N./mm}^2$$

$$\text{Allowed Stress, } Sa = 0.6 * \text{Yield Str} = 143.9676 \text{ N./mm}^2$$

Saddle Splitting Dimension [d]:

$$= B - R * \sin(\text{theta}/2) / (\text{theta}/2 \text{ in radians})$$

$$= 1200.0 - 556.0 * \sin(120.0/2) / 1.0472$$

$$= 740.192 \text{ mm.}$$

$$\text{Bending Moment, } M = Fh * d = 7842.7222 \text{ N-m}$$

$$\text{Bending Stress, } Sb = (M * C1 / I) = 2.4562 \text{ N./mm}^2$$

$$\text{Allowed Stress, } Sa = 2/3 * \text{Yield Str} = 159.9640 \text{ N./mm}^2$$

Minimum Thickness of Baseplate per Moss:

$$= (3 (Q + \text{Saddle_Wt}) \text{BasePlateWidth} / (4 * \text{BasePlateLength} * \text{AllStress}))^{1/2}$$

$$= (3 (52040 + 2127) 170.0 / (4 * 1100.0 * 159.964))^{1/2}$$

$$= 6.265 \text{ mm.}$$

Calculation of Axial Load, Intermediate Values and Compressive Stress:

Web Length Dimension [Web Length]:

$$= 2 * \cos(90 - \text{Saddle Angle}/2) (\text{Inside Radius} + \text{Shell Thk} + \text{Wear Plate Thk})$$

$$= 2 * \cos(90 - 120.0/2) (550.0 + 12.0 + 12.0)$$

$$= 994.197 \text{ mm.}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادرکننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 67 از 251
پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Distance between Ribs [e]:

$$\begin{aligned}
 &= \text{Web Length} / (\text{Nr ribs} - 1) \\
 &= 994.1971 / (4 - 1) \\
 &= 331.399 \text{ mm.}
 \end{aligned}$$

Baseplate Pressure Area [Ap]:

$$\begin{aligned}
 &= e * \text{Bpwid} / 2 \\
 &= 331.399 * 170.0 / 2 \\
 &= 281.689 \text{ cm}^2
 \end{aligned}$$

Bearing Pressure [Bp]:

$$\begin{aligned}
 &= Q / (\text{BasePlateLength} * \text{BasePlateWidth}) \\
 &= 52039.84 / (1100.0 * 170.0) \\
 &= 27.829 \text{ N/cm}^2
 \end{aligned}$$

Axial Load [P]:

$$\begin{aligned}
 &= \text{Ap} * \text{Bp} \\
 &= 281.7 * 27.83 \\
 &= 7839.069 \text{ N}
 \end{aligned}$$

Area of the Rib and Web [Ar]:

$$\begin{aligned}
 &= \text{Rib Area} + \text{Web Area} \\
 &= 20.25 + 24.855 \\
 &= 45.105 \text{ cm}^2
 \end{aligned}$$

Compressive Stress [Sc]:

$$\begin{aligned}
 &= P / \text{Ar} \\
 &= 7839.1 / 45.1049 \\
 &= 1.738 \text{ N./mm}^2
 \end{aligned}$$

Check of Outside Ribs:

Inertia of Saddle, Outer Ribs - Longitudinal Direction

	B	D	Y	A	AY	Io
-----	-----	-----	-----	-----	-----	-----
Rib+Web	15.0	150.0	...	22.5	...	422.

Rib dimension [D]:

$$\begin{aligned}
 &= \text{Saddle Width} - \text{Web Thickness} \\
 &= 150.0 - 15.0 \\
 &= 135.000 \text{ mm.}
 \end{aligned}$$

Distance to Centroid from Datum [ytot]:

$$\begin{aligned}
 &= \text{AY} / \text{A} \\
 &= 0.0 / 45.105 \\
 &= 0.000 \text{ mm.}
 \end{aligned}$$

Distance to Centroid [C1]:

$$\begin{aligned}
 &= \text{Saddle Width} / 2 \\
 &= 150.0 / 2 \\
 &= 75.000 \text{ mm.}
 \end{aligned}$$

Radius of Gyration [r]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 68 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$= \sqrt{\text{Total Inertia} / \text{Total Area}}$
 $= \sqrt{421.9/45.105}$
 $= 30.583 \text{ mm.}$

Length of Outer Rib [L]:

$= \text{Saddle Height} - \cos(\theta/2) (\text{radius} + \text{shlthk} + \text{wpdthk}) - \text{bpthk}$
 $= 1200.0 - \cos(120.0/2) (550.0 + 12.0 + 12.0) - 15.0$
 $= 898.000 \text{ mm.}$

Intermediate Term [Cc]:

$= \sqrt{2 * \pi^2 * \text{Elastic Modulus} / \text{Yield Stress}}$
 $= \sqrt{2 * \pi^2 * 0.19994\text{E}+09/239.9}$
 $= 128.255$

Slenderness ratio [KL/r]:

$= KL/r$
 $= 1 * 898.0/30.583$
 $= 29.363$

Bending Moment [Rm]:

$= F1 / (2 * B_{plen}) * e * L / 2$
 $= 15708.7 / (2 * 1100.0) * 331.399 * 898.0/2$
 $= 1062.896 \text{ N-m}$

Compressive Allowable, $KL/r < Cc$ ($29.3627 < 128.2549$) per AISC E2-1 [Sca]:

$= (1 - (KL/r)^2 / (2 * Cc^2)) Fy / (5/3 + 3 * (KL/r) / (8 * Cc) - (KL/r^3) / (8 * Cc^3))$
 $= (1 - (29.36)^2 / (2 * 128.25^2)) 240 /$
 $(5/3 + 3 * (29.36) / (8 * 128.25) - (29.36^3) / (8 * 128.25^3))$
 $= 133.4 \text{ N./mm}^2$

AISC Unity Check of Outside Ribs (must be ≤ 1)

$= Sc/Sca + (Rm * C1 / I) / Sba$
 $= 1.74/133.44 + (1062.9 * 75.0/4218750) / 159.96$
 $= 0.131$

Check of Inside Ribs:

Inertia of Saddle, Inner Ribs - Axial Direction

	B	D	Y	A	AY	Io
Rib	15.0	135.0	0.0	20.2	0.0	421.
Web	331.4	15.0	0.0	49.7	0.0	9.32
Totals	...	...	...	70.0	...	431.

Distance to Centroid from Datum [ytot]:

$= AY / A$
 $= 0.0/69.96$
 $= 0.000 \text{ mm.}$

Distance to Centroid [C1]:

$= \text{Saddle Width} / 2$
 $= 150.0/2$
 $= 75.000 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 69 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Length of Inner Rib [L]:

$$\begin{aligned}
 &= \text{Saddle Height} - \sqrt{(\text{Ro} + \text{Wpdthk})^2 - (\text{Pitch}/2)^2} - \text{Bpthk} \\
 &= 1200.0 - \sqrt{(574.0 + 12.0)^2 - (331.399/2)^2} - 15.0 \\
 &= 635.437 \text{ mm.}
 \end{aligned}$$

Radius of Gyration [r]:

$$\begin{aligned}
 &= \sqrt{\text{Total Inertia} / \text{Total Area}} \\
 &= \sqrt{430.8/69.96} \\
 &= 24.814 \text{ mm.}
 \end{aligned}$$

Slenderness ratio [KL/r]:

$$\begin{aligned}
 &= \text{KL}/r \\
 &= 1 * 635.437/24.814 \\
 &= 25.608
 \end{aligned}$$

Unit Force [Force,u]:

$$\begin{aligned}
 &= \text{Fl} / (2 * \text{Baseplate Length}) \\
 &= 15708.688 / (2 * 1100.0) \\
 &= 7.140 \text{ N/mm.}
 \end{aligned}$$

Moment at base of inner Rib [Mbase,c]:

$$\begin{aligned}
 &= \text{Unit Force} * e * L \\
 &= 7.14 * 331.399 * 635.437 \\
 &= 1504.239 \text{ N-m}
 \end{aligned}$$

Bending Stress due to Transverse Force and Weight Load [SigmaB,base,c]:

$$\begin{aligned}
 &= \text{Bending Moment} / \text{Section Modulus} \\
 &= 1504.239/57436.492 \\
 &= 26.181 \text{ N./mm}^2
 \end{aligned}$$

Compressive Allowable, $KL/r < Cc$ ($25.6078 < 128.2549$) per AISC E2-1 [Sca]:

$$\begin{aligned}
 &= (1 - (KL/r)^2 / (2 * Cc^2)) Fy / (5/3 + 3 * (KL/r) / (8 * Cc) - (KL/r)^3 / (8 * Cc^3)) \\
 &= (1 - (25.61)^2 / (2 * 128.25^2)) 240 / \\
 &\quad (5/3 + 3 * (25.61) / (8 * 128.25) - (25.61)^3 / (8 * 128.25^3)) \\
 &= 135.1 \text{ N./mm}^2
 \end{aligned}$$

AISC Unity Check of Inside Ribs (must be ≤ 1)

$$\begin{aligned}
 &= \text{Sc}/\text{Sca} + (\text{Mbase,c} * \text{Cl}/\text{I}) / \text{Sba} \\
 &= 2.27/135.11 + (1504.24 * 75.0/430.773) / 159.96 \\
 &= 0.180
 \end{aligned}$$

Input Data for Base Plate Bolting Calculations:

Total Number of Bolts per BasePlate	Nbolts	4	
Total Number of Bolts in Tension/Baseplate	Nbt	2	
Bolt Material Specification		SA-325	
Bolt Allowable Stress	Stba	300.00	N./mm ²
Bolt Corrosion Allowance	Bca	0.0	mm.
Distance from Bolts to Edge	Edgedis	30.5	mm.
Nominal Bolt Diameter	Bnd	20.0000	mm.
Thread Series	Series	TEMA Metric	
BasePlate Allowable Stress	S	95.15	N./mm ²
Area Available in a Single Bolt	BlArea	2.1705	cm ²
Saddle Load QO (Weight)	QO	25726.6	N
Saddle Load QL (Wind/Seismic contribution)	QL	7854.3	N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 70 از 251
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	MF	120	ME	CN	0003	
							V01	

Maximum Transverse Force	Ft	7854.3	N
Maximum Longitudinal Force	Fl	15708.7	N
Saddle Bolted to Steel Foundation	No		

Shear Stress in a Single Bolt, Transverse Direction [taub,t]:

$$= Ft / (Bolt Area * Number of Bolts)$$

$$= 7854 / (2.17 * 4)$$

$$= 9.0 \text{ N./mm}^2. \text{ Must be less than } 180.0 \text{ N./mm}^2.$$

Bolt Area Calculation per Dennis R. Moss

Bolt Area Requirement Due to Longitudinal Load [Bltarearl]:

$$= 0.0 \text{ (} QO > QL \text{ --> No Uplift in Longitudinal direction)}$$

Bolt Area due to Shear Load [Bltarears]:

$$= Fl / (BoltShearAllowable * Nbolts)$$

$$= 15708.69 / (180.0 * 4.0)$$

$$= 0.2182 \text{ cm}^2$$

Bolt Area due to Transverse Load:

Moment on Baseplate Due to Transverse Load [Rmom]:

$$= B * Ft + \text{Sum of X Moments}$$

$$= 1200.0 * 7854.34 + 0.0$$

$$= 9429.03 \text{ N-m}$$

Eccentricity (e):

$$= Rmom / QO$$

$$= 9429.03 / 25726.63$$

$$= 366.36 \text{ mm.} > Bplen / 6 \text{ --> Uplift in Transverse direction}$$

$$f = Bplen / 2 - Edgedis$$

$$= 1100.0 / 2 - 30.51$$

$$= 519.49 \text{ mm.}$$

Modular Ratio Of Steel/Concrete (n1):

$$= ES / EC$$

$$= 203402.5 / 21526.32$$

$$= 9.45$$

$$K1 = 3 (e - 0.5 * Bplen)$$

$$= 3 (366.36 - 0.5 * 1100.0)$$

$$= -550.92 \text{ mm.}$$

$$K2 = 6 * n1 * At / Bpwid * (f + e)$$

$$= 6 * 9.45 * 4.34 / 170.0 * (519.49 + 366.36)$$

$$= 128245.79 \text{ mm.}^2$$

$$K3 = -K2 * (0.5 * Bplen + f)$$

$$= -128245.8 * (0.5 * 1100.0 + 519.49)$$

$$= -137158178.24 \text{ mm.}^3$$

Iteratively Solving for the Effective Bearing Length:

$$Y^3 + K1 * Y^2 + K2 * Y + K3 = 0$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 71 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

$$Y^3 + -550.92 * Y^2 + 128245.8 * Y + -0.1E+09 = 0$$

$$Y = 666.97 \text{ mm.}$$

$$\text{Num} = (\text{Bplen} / 2 - Y / 3 - e)$$

$$= (1100.0/2 - 666.97/3 - 366.36)$$

$$= -38.68$$

$$\text{Denom} = (\text{Bplen} / 2 - Y / 3 + f)$$

$$= (1100.0/2 - 666.97/3 + 519.49)$$

$$= 847.17$$

Total Bolt Tension Force [Tforce]:

$$= - QO * \text{Num} / \text{Denom}$$

$$= - 25726.63 * -38.68/847.17$$

$$= 1174.69 \text{ N}$$

Bolt Area Required due to Transverse Load [Bltareart]:

$$= \text{Tforce} / (\text{Stba} * \text{Nbt})$$

$$= 1174.69 / (300.0 * 2.0)$$

$$= 0.0196 \text{ cm}^2$$

Required Area of a Single Bolt [Bltarear]:

$$= \max[\text{Bltarearl}, \text{Bltarears}, \text{Bltareart}]$$

$$= \max[0.0, 0.2182, 0.0196]$$

$$= 0.2182 \text{ cm}^2$$

Baseplate Thickness Calculation per D. Moss:

Bearing Pressure (fc)

$$= 2(QO + \text{Tforce}) / (Y * \text{Bpwid})$$

$$= 2(25726.63 + 1174.69) / (666.97 * 170.0)$$

$$= 4.75 \text{ bars}$$

Distance from Baseplate Edge to the Web [ADIST]:

$$= (\text{Bplen} - \text{Weblength}) / 2$$

$$= (1100.0 - 1049.2) / 2$$

$$= 25.4000 \text{ mm.}$$

Overturning Moment due To Bolt Tension [Mt]:

$$= \text{Tforce} * \text{Adist}$$

$$= 1174.69 * 25.4$$

$$= 29.85 \text{ N-m}$$

Equivalent Bearing Pressure (f1):

$$= fc * (Y - \text{Adist}) / Y$$

$$= 4.75 * (666.97 - 25.4) / 666.97$$

$$= 4.56 \text{ bars}$$

Overturning Moment due to Bearing Pressure [Mc]:

$$= (\text{Adist}^2 * \text{Bpwid} / 6) * (f1 + 2 * fc)$$

$$= (25.4^2 * 170.0/6) * (4.56 + 2 * 4.75)$$

$$= 25.70 \text{ N-m}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 72 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Baseplate Required Thickness [Treq]:

$$= (6 * \max(Mt, Mc) / (Bpwid * Sba))^{1/2}$$

$$= (6 * \max(29.85, 25.7 / (170.0 * 142.73))^{1/2}$$

$$= 2.7164 \text{ mm.}$$

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 																
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 73 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

ASME Horizontal Vessel Analysis: Stresses for the Left Saddle

(per ASME Sec. VIII Div. 2 based on the Zick method.)

Horizontal Vessel Stress Calculations : Test Case

Note:

Wear Pad Width (200.00) is less than $1.56 \cdot \sqrt{rm \cdot t}$
and less than 2a. The wear plate will be ignored.

Minimum Wear Plate Width to be considered in analysis [b1]:

$$\begin{aligned}
 &= \min(b + 1.56 \cdot \sqrt{R_m \cdot t} , 2a) \\
 &= \min(150.0 + 1.56 \cdot \sqrt{559.0 \cdot 6.0} , 2 \cdot 450.0) \\
 &= 240.3454 \text{ mm.}
 \end{aligned}$$

Input and Calculated Values:

Vessel Mean Radius	Rm	559.00	mm.
Stiffened Vessel Length per 4.15.6	L	3400.00	mm.
Distance from Saddle to Vessel tangent	a	450.00	mm.
Saddle Width	b	150.00	mm.
Saddle Bearing Angle	theta	120.00	degrees
Inside Depth of Head	h2	281.00	mm.
Shell Allowable Stress used in Calculation		212.40	N./mm ²
Head Allowable Stress used in Calculation		212.40	N./mm ²
Circumferential Efficiency in Plane of Saddle		1.00	
Circumferential Efficiency at Mid-Span		1.00	
Distance from Saddle Base to Centerline	B	1200.00	mm.
Coefficient of Friction	mu	0.30	
Saddle Force Q, Test Case, no Ext. Forces		31591.73	N

Horizontal Vessel Analysis Results:	Actual N./mm ²	Allowable N./mm ²
Long. Stress at Top of Midspan	46.85	212.40
Long. Stress at Bottom of Midspan	50.56	212.40
Long. Stress at Top of Saddles	52.09	212.40
Long. Stress at Bottom of Saddles	46.83	212.40
Tangential Shear in Shell	7.30	139.65
Circ. Stress at Horn of Saddle	70.22	318.60
Circ. Compressive Stress in Shell	1.67	212.40

Intermediate Results: Saddle Reaction Q due to Wind or Seismic:

Saddle Reaction Force due to Wind Ft [Fwt]:

$$\begin{aligned}
 &= F_{tr} (F_t / \text{Num of Saddles} + Z \text{ Force Load}) \cdot B / E \\
 &= 3.0 (1042.8/2 + 0) \cdot 1200.0/994.1971
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 74 از 251
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	MF	120	ME	CN	0003	V01

$$= 1887.9 \text{ N}$$

Saddle Reaction Force due to Wind Fl or Friction [Fwl]:

$$= \max(\text{Fl, Friction Load, Sum of X Forces}) * B / Ls$$

$$= \max(574.31, 0.0, 0) * 1200.0/2400.0$$

$$= 287.2 \text{ N}$$

Load Combination Results for Q + Wind or Seismic [Q]:

$$= \text{Saddle Load} + \max(\text{Fwl, Fwt, Fsl, Fst})$$

$$= 29704 + \max(287, 1888, 0, 0)$$

$$= 31591.7 \text{ N}$$

Longitudinal Wind Force [Fl]:

$$= \text{WindScalar} * \text{WindPress}(\text{Platform Area} + (\text{End Area} * \text{WindDiaMult}))$$

$$= 0.6 * 2054.32(0.0 + (1.177 * 1.2))$$

$$= 1740.430 \text{ N}$$

Summary of Loads at the base of this Saddle:

Vertical Load (including saddle weight)		33719.21	N
Transverse Shear Load Saddle	Ft	521.38	N
Longitudinal Shear Load Saddle		574.31	N

Hydrostatic Test Pressure at center of Vessel 10.455 bars

Formulas and Substitutions for Horizontal Vessel Analysis:

Note: Wear Plate is Welded to the Shell, $k = 0.1$

Saddle Dimension [E]:

$$= \min(2(\text{ShellID}/2 + t + \text{WearPadThickness})\sin(\text{theta}/2), 2*Rm)$$

$$= \min(2(1100.0/2 + 12.0 + 12.0)\sin(60.0/2), 2*559.0)$$

$$= 994.197 \text{ mm.}$$

The Computed K values from Table 4.15.1:

K1 = 0.1066	K2 = 1.1707	K3 = 0.8799	K4 = 0.4011
K5 = 0.7603	K6 = 0.0529	K7 = 0.0374	K8 = 0.3405
K9 = 0.2711	K10 = 0.0581	K1* = 0.1923	

Note: Dimension a is greater than or equal to $Rm / 2$.

Moment per Equation 4.15.3 [M1]:

$$= -Q*a [1 - (1 - a/L + (Rm^2 - h^2)/(2a*L)) / (1 + (4h^2)/3L)]$$

$$= -31592*450.0 [1 - (1 - 450.0/3400.0 + (559.0^2 - 281.0^2)/(2*450.0*3400.0)) / (1 + (4*281.0)/(3*3400.0))]$$

$$= -2129.5 \text{ N-m}$$

Moment per Equation 4.15.4 [M2]:

$$= Q*L/4 (1 + 2(Rm^2 - h^2)/(L^2)) / (1 + (4h^2)/(3L)) - 4a/L$$

$$= 31592*3400/4 (1 + 2(559^2 - 281^2)/(3400^2)) / (1 + (4*281)/(3*3400)) - 4*450/3400$$

$$= 10953.0 \text{ N-m}$$

Longitudinal Stress at Top of Shell (4.15.6) [Sigma1]:

$$= P * Rm/(2t) - M2/(\pi*Rm^2*t)$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 75 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= 10.455 * 559.0 / (2 * 6.0) - 10953.0 / (\pi * 559.0^2 * 6.0)$$

$$= 46.85 \text{ N./mm}^2$$

Longitudinal Stress at Bottom of Shell (4.15.7) [Sigma2]:

$$= P * R_m / (2t) + M_2 / (\pi * R_m^2 * t)$$

$$= 10.455 * 559.0 / (2 * 6.0) + 10953.0 / (\pi * 559.0^2 * 6.0)$$

$$= 50.56 \text{ N./mm}^2$$

Longitudinal Stress at Top of Shell at Support (4.15.10) [Sigma*3]:

$$= P * R_m / (2t) - M_1 / (K_1 * \pi * R_m^2 * t)$$

$$= 10.455 * 559.0 / (2 * 6.0) - 2129.5 / (0.1066 * \pi * 559.0^2 * 6.0)$$

$$= 52.09 \text{ N./mm}^2$$

Longitudinal Stress at Bottom of Shell at Support (4.15.11) [Sigma*4]:

$$= P * R_m / (2t) + M_1 / (K_1 * \pi * R_m^2 * t)$$

$$= 10.455 * 559.0 / (2 * 6.0) + 2129.5 / (0.1923 * \pi * 559.0^2 * 6.0)$$

$$= 46.83 \text{ N./mm}^2$$

Maximum Shear Force in the Saddle (4.15.5) [T]:

$$= Q(L-2a) / (L + (4 * h^2 / 3))$$

$$= 31592(3400.0 - 2 * 450.0) / (3400.0 + (4 * 281.0^2 / 3))$$

$$= 20923.5 \text{ N}$$

Shear Stress in the shell no rings, not stiffened (4.15.14) [tau2]:

$$= K_2 * T / (\pi * R_m * t)$$

$$= 1.1707 * 20923.52 / (\pi * 559.0 * 6.0)$$

$$= 7.30 \text{ N./mm}^2$$

Decay Length (4.15.22) [x1,x2]:

$$= 0.78 * \sqrt{R_m * t}$$

$$= 0.78 * \sqrt{559.0 * 6.0}$$

$$= 45.173 \text{ mm.}$$

Circumferential Stress in shell, no rings (4.15.23) [sigma6]:

$$= -K_5 * Q * k / (t * (b + X_1 + X_2))$$

$$= -0.7603 * 31592 * 0.1 / (6.0 * (150.0 + 45.17 + 45.17))$$

$$= -1.67 \text{ N./mm}^2$$

Circ. Comp. Stress at Horn of Saddle, L<8Rm (4.15.25) [sigma7*]:

$$= -Q / (4 * t * (b + X_1 + X_2)) - 12 * K_7 * Q * R_m / (L * t^2)$$

$$= -31592 / (4 * 6.0 * (150.0 + 45.173 + 45.173)) - 12 * 0.037 * 31592 * 559.0 / (3400.0 * 6.0^2)$$

$$= -70.22 \text{ N./mm}^2$$

Effective reinforcing plate width (4.15.1) [B1]:

$$= \min(b + 1.56 * \sqrt{R_m * t}, 2a)$$

$$= \min(150.0 + 1.56 * \sqrt{559.0 * 6.0}, 2 * 450.0)$$

$$= 240.35 \text{ mm.}$$

Results for Vessel Ribs, Web and Base:

Baseplate Length	Bplen	1100.0000	mm.
Baseplate Thickness	Bpthk	15.0000	mm.
Baseplate Width	Bpwid	170.0000	mm.
Number of Ribs (inc. outside ribs)	Nribs	4	
Rib Thickness	Ribtk	15.0000	mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 76 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Web Thickness	Webtk	15.0000	mm.
Web Location	Webloc	Center	
Saddle Yield Stress	Sy	239.9	N./
Height of Web at Center	Hw, c	635.0	mm.
Friction Coefficient	mu	0.300	

Note: In the tables below Io is I for the rectangle + Area * Centroid Distance^2

Moment of Inertia of Saddle - Transverse Direction (90 degrees to long axis)

	B	D	Y	A	AY	Io
Shell	290.1	6.0	3.0	17.4	5221.8	0.145E+05
Wearplate	200.0	12.0	12.0	24.0	28800.0	0.188E+05
Web	15.0	611.0	323.5	91.6	2964876.5	0.295E+05
BasePlate	170.0	15.0	636.5	25.5	1623074.8	0.304E+05
Totals	...	...	...	158.6	4621973.5	0.930E+05

Distance to Centroid [C1]:

= AY / A
= 1819.675/158.556
= 291.504 mm.

Angle [beta]:

= 180 - Saddle Angle/2
= 180 - 120.0/2
= 120.0

Saddle Splitting Coefficient [K1]:

= (1 + cos(beta) - 0.5*sin(beta)^2) / (pi - beta + sin(beta)cos(beta))
= (1 + cos(120.0) - 0.5*sin(120.0)^2) / (pi - 2.094 + sin(120.0)cos(120.0))
= 0.2035

Saddle Splitting Force [Fh]:

= K1 * Q
= 0.204 * 31591.73
= 6429.6025 N

Tension Stress, St = (Fh/As) = 0.4556 N./mm²
Allowed Stress, Sa = 0.6 * Yield Str = 143.9676 N./mm²

Saddle Splitting Dimension [d]:

= B - R * sin(theta/2) / (theta/2 in radians)
= 1200.0 - 556.0 * sin(120.0/2) / 1.0472
= 740.192 mm.

Bending Moment, M = Fh * d = 4761.0674 N-m

Bending Stress, Sb = (M * C1 / I) = 1.4911 N./mm²
Allowed Stress, Sa = 2/3 * Yield Str = 159.9640 N./mm²

Minimum Thickness of Baseplate per Moss:

= (3 (Q + Saddle_Wt) BasePlateWidth / (4 * BasePlateLength * AllStress))^{1/2}
= (3(31592 + 2127)170.0 / (4 * 1100.0 * 159.964))^{1/2}
= 4.943 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 77 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Calculation of Axial Load, Intermediate Values and Compressive Stress:

Web Length Dimension [Web Length]:

$$\begin{aligned}
 &= 2 * \cos(90 - \text{Saddle Angle}/2) (\text{Inside Radius} + \text{Shell Thk} + \text{Wear Plate Thk}) \\
 &= 2 * \cos(90 - 120.0/2) (550.0 + 12.0 + 12.0) \\
 &= 994.197 \text{ mm.}
 \end{aligned}$$

Distance between Ribs [e]:

$$\begin{aligned}
 &= \text{Web Length} / (\text{Nr ribs} - 1) \\
 &= 994.1971 / (4 - 1) \\
 &= 331.399 \text{ mm.}
 \end{aligned}$$

Baseplate Pressure Area [Ap]:

$$\begin{aligned}
 &= e * \text{Bpwid} / 2 \\
 &= 331.399 * 170.0/2 \\
 &= 281.689 \text{ cm}^2
 \end{aligned}$$

Bearing Pressure [Bp]:

$$\begin{aligned}
 &= Q / (\text{BasePlateLength} * \text{BasePlateWidth}) \\
 &= 31591.73 / (1100.0 * 170.0) \\
 &= 16.894 \text{ N/cm}^2
 \end{aligned}$$

Axial Load [P]:

$$\begin{aligned}
 &= A_p * B_p \\
 &= 281.7 * 16.89 \\
 &= 4758.850 \text{ N}
 \end{aligned}$$

Area of the Rib and Web [Ar]:

$$\begin{aligned}
 &= \text{Rib Area} + \text{Web Area} \\
 &= 20.25 + 24.855 \\
 &= 45.105 \text{ cm}^2
 \end{aligned}$$

Compressive Stress [Sc]:

$$\begin{aligned}
 &= P/Ar \\
 &= 4758.9/45.1049 \\
 &= 1.055 \text{ N./mm}^2
 \end{aligned}$$

Check of Outside Ribs:

Inertia of Saddle, Outer Ribs - Longitudinal Direction

	B	D	Y	A	AY	Io
-----	-----	-----	-----	-----	-----	-----
Rib+Web	15.0	150.0	...	22.5	...	422.

Rib dimension [D]:

$$\begin{aligned}
 &= \text{Saddle Width} - \text{Web Thickness} \\
 &= 150.0 - 15.0 \\
 &= 135.000 \text{ mm.}
 \end{aligned}$$

Distance to Centroid from Datum [ytot]:

$$\begin{aligned}
 &= AY / A \\
 &= 0.0/45.105
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 78 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= 0.000 \text{ mm.}$$

Distance to Centroid [C1]:

$$= \text{Saddle Width} / 2$$

$$= 150.0/2$$

$$= 75.000 \text{ mm.}$$

Radius of Gyration [r]:

$$= \sqrt{\text{Total Inertia} / \text{Total Area}}$$

$$= \sqrt{421.9/45.105}$$

$$= 30.583 \text{ mm.}$$

Length of Outer Rib [L]:

$$= \text{Saddle Height} - \cos(\text{theta}/2) (\text{radius} + \text{shlthk} + \text{wpdthk}) - \text{bpthk}$$

$$= 1200.0 - \cos(120.0/2) (550.0 + 12.0 + 12.0) - 15.0$$

$$= 898.000 \text{ mm.}$$

Intermediate Term [Cc]:

$$= \sqrt{2 * \pi^2 * \text{Elastic Modulus} / \text{Yield Stress}}$$

$$= \sqrt{2 * \pi^2 * 0.19994\text{E}+09/239.9}$$

$$= 128.255$$

Slenderness ratio [KL/r]:

$$= KL/r$$

$$= 1 * 898.0/30.583$$

$$= 29.363$$

Bending Moment [Rm]:

$$= F1 / (2 * Bpln) * e * L / 2$$

$$= 574.3 / (2 * 1100.0) * 331.399 * 898.0/2$$

$$= 38.860 \text{ N-m}$$

Compressive Allowable, $KL/r < Cc$ ($29.3627 < 128.2549$) per AISC E2-1 [Sca]:

$$= (1 - (KL/r)^2 / (2 * Cc^2)) Fy / (5/3 + 3 * (KL/r) / (8 * Cc) - (KL/r^3) / (8 * Cc^3))$$

$$= (1 - (29.36)^2 / (2 * 128.25^2)) 240 /$$

$$(5/3 + 3 * (29.36) / (8 * 128.25) - (29.36^3) / (8 * 128.25^3))$$

$$= 133.4 \text{ N./mm}^2$$

AISC Unity Check of Outside Ribs (must be <= 1)

$$= Sc/Sca + (Rm * C1 / I) / Sba$$

$$= 1.06/133.44 + (38.86 * 75.0/4218750) / 159.96$$

$$= 0.012$$

Check of Inside Ribs:

Inertia of Saddle, Inner Ribs - Axial Direction

	B	D	Y	A	AY	Io
Rib	15.0	135.0	0.0	20.2	0.0	421.
Web	331.4	15.0	0.0	49.7	0.0	9.32
Totals	...	...	...	70.0	...	431.

Distance to Centroid from Datum [ytot]:

$$= AY / A$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 79 از 251
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	MF	120	ME	CN	0003	V01

$$= 0.0/69.96$$

$$= 0.000 \text{ mm.}$$

Distance to Centroid [C1]:

$$= \text{Saddle Width} / 2$$

$$= 150.0/2$$

$$= 75.000 \text{ mm.}$$

Length of Inner Rib [L]:

$$= \text{Saddle Height} - \sqrt{(\text{Ro} + \text{Wpdthk})^2 - (\text{Pitch}/2)^2} - \text{Bpthk}$$

$$= 1200.0 - \sqrt{(574.0 + 12.0)^2 - (331.399/2)^2} - 15.0$$

$$= 635.437 \text{ mm.}$$

Radius of Gyration [r]:

$$= \sqrt{\text{Total Inertia} / \text{Total Area}}$$

$$= \sqrt{430.8/69.96}$$

$$= 24.814 \text{ mm.}$$

Slenderness ratio [KL/r]:

$$= \text{KL}/r$$

$$= 1 * 635.437/24.814$$

$$= 25.608$$

Unit Force [Force,u]:

$$= \text{F1} / (2 * \text{Baseplate Length})$$

$$= 574.312 / (2 * 1100.0)$$

$$= 0.261 \text{ N/mm.}$$

Moment at base of inner Rib [Mbase,c]:

$$= \text{Unit Force} * e * L$$

$$= 0.261 * 331.399 * 635.437$$

$$= 54.995 \text{ N-m}$$

Bending Stress due to Transverse Force and Weight Load [SigmaB,base,c]:

$$= \text{Bending Moment} / \text{Section Modulus}$$

$$= 54.995/57436.492$$

$$= 0.957 \text{ N./mm}^2$$

Compressive Allowable, $\text{KL}/r < \text{Cc}$ ($25.6078 < 128.2549$) per AISC E2-1 [Sca]:

$$= (1 - (\text{KL}/r)^2 / (2 * \text{Cc}^2)) \text{Fy} / (5/3 + 3 * (\text{KL}/r) / (8 * \text{Cc}) - (\text{KL}/r^3) / (8 * \text{Cc}^3))$$

$$= (1 - (25.61)^2 / (2 * 128.25^2)) 240 / (5/3 + 3 * (25.61) / (8 * 128.25) - (25.61^3) / (8 * 128.25^3))$$

$$= 135.1 \text{ N./mm}^2$$

AISC Unity Check of Inside Ribs (must be ≤ 1)

$$= \text{Sc}/\text{Sca} + (\text{Mbase,c} * \text{Cl}/\text{I})/\text{Sba}$$

$$= 1.38/135.11 + (55.0 * 75.0/430.773)/159.96$$

$$= 0.016$$

Input Data for Base Plate Bolting Calculations:

Total Number of Bolts per BasePlate	Nbolts	4
Total Number of Bolts in Tension/Baseplate	Nbt	2
Bolt Material Specification		SA-325
Bolt Allowable Stress	Stba	300.00 N./mm ²

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 80 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Bolt Corrosion Allowance	Bca	0.0	mm.
Distance from Bolts to Edge	Edgedis	30.5	mm.
Nominal Bolt Diameter	Bnd	20.0000	mm.
Thread Series	Series	TEMA Metric	
BasePlate Allowable Stress	S	95.15	N./mm ²
Area Available in a Single Bolt	BltArea	2.1705	cm ²
Saddle Load QO (Weight)	QO	31831.3	N
Saddle Load QL (Wind/Seismic contribution)	QL	287.2	N
Maximum Transverse Force	Ft	521.4	N
Maximum Longitudinal Force	F1	574.3	N
Saddle Bolted to Steel Foundation	No		

Shear Stress in a Single Bolt, Longitudinal Direction [taub,l]:

$$= F1 / (\text{Bolt Area} * \text{Number of Bolts})$$

$$= 574 / (2.17 * 4)$$

$$= 0.7 \text{ N./mm}^2. \text{ Must be less than } 180.0 \text{ N./mm}^2.$$

Shear Stress in a Single Bolt, Transverse Direction [taub,t]:

$$= Ft / (\text{Bolt Area} * \text{Number of Bolts})$$

$$= 521 / (2.17 * 4)$$

$$= 0.6 \text{ N./mm}^2. \text{ Must be less than } 180.0 \text{ N./mm}^2.$$

Bolt Area Calculation per Dennis R. Moss

Bolt Area Requirement Due to Longitudinal Load [Bltarearl]:

$$= 0.0 \text{ (} QO > QL \text{ --> No Uplift in Longitudinal direction)}$$

Bolt Area due to Shear Load [Bltarears]:

$$= F1 / (\text{BoltShearAllowable} * \text{Nbolts})$$

$$= 574.31 / (180.0 * 4.0)$$

$$= 0.0080 \text{ cm}^2$$

Bolt Area due to Transverse Load:

Moment on Baseplate Due to Transverse Load [Rmom]:

$$= B * Ft + \text{Sum of X Moments}$$

$$= 1200.0 * 521.38 + 0.0$$

$$= 625.90 \text{ N-m}$$

Eccentricity (e):

$$= Rmom / QO$$

$$= 625.9 / 31831.3$$

$$= 19.66 \text{ mm.} < Bplen/6 \text{ --> No Uplift in Transverse direction}$$

Bolt Area due to Transverse Load [Bltareart]:

$$= 0 \text{ (No Uplift)}$$

Required Area of a Single Bolt [Bltarear]:

$$= \max[Bltarearl, Bltarears, Bltareart]$$

$$= \max[0.0, 0.008, 0.0]$$

$$= 0.0080 \text{ cm}^2$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 81 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

ASME Horizontal Vessel Analysis: Stresses for the Right Saddle

(per ASME Sec. VIII Div. 2 based on the Zick method.)

Note:

Wear Pad Width (200.00) is less than $1.56 \cdot \sqrt{r_m \cdot t}$
and less than $2a$. The wear plate will be ignored.

Minimum Wear Plate Width to be considered in analysis [b1]:

$$\begin{aligned}
 &= \min(b + 1.56 \cdot \sqrt{R_m \cdot t} , 2a) \\
 &= \min(150.0 + 1.56 \cdot \sqrt{559.0 \cdot 6.0} , 2 \cdot 450.0) \\
 &= 240.3454 \text{ mm.}
 \end{aligned}$$

Input and Calculated Values:

Vessel Mean Radius	Rm	559.00	mm.
Stiffened Vessel Length per 4.15.6	L	3400.00	mm.
Distance from Saddle to Vessel tangent	a	450.00	mm.
Saddle Width	b	150.00	mm.
Saddle Bearing Angle	theta	120.00	degrees
Inside Depth of Head	h2	281.00	mm.
Shell Allowable Stress used in Calculation		212.40	N./mm ²
Head Allowable Stress used in Calculation		212.40	N./mm ²
Circumferential Efficiency in Plane of Saddle		1.00	
Circumferential Efficiency at Mid-Span		1.00	
Distance from Saddle Base to Centerline	B	1200.00	mm.
Coefficient of Friction	mu	0.00	
Saddle Force Q, Test Case, no Ext. Forces		32416.38	N

Horizontal Vessel Analysis Results:	Actual	Allowable
	N./mm ²	N./mm ²
-----	-----	-----
Long. Stress at Top of Midspan	46.80	212.40
Long. Stress at Bottom of Midspan	50.61	212.40
Long. Stress at Top of Saddles	52.18	212.40
Long. Stress at Bottom of Saddles	46.78	212.40
-----	-----	-----
Tangential Shear in Shell	7.49	139.65
Circ. Stress at Horn of Saddle	72.06	318.60
Circ. Compressive Stress in Shell	1.71	212.40
-----	-----	-----

Intermediate Results: Saddle Reaction Q due to Wind or Seismic:

Saddle Reaction Force due to Wind Ft [Fwt]:

$$\begin{aligned}
 &= F_{tr} (F_t / \text{Num of Saddles} + Z \text{ Force Load}) \cdot B / E \\
 &= 3.0 (1042.8/2 + 0) \cdot 1200.0/994.1971 \\
 &= 1887.9 \text{ N}
 \end{aligned}$$

Saddle Reaction Force due to Wind FI or Friction [Fwl]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 82 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$= \max(F_l, \text{Friction Load, Sum of X Forces}) * B / L_s$
 $= \max(574.31, 0.0, 0) * 1200.0/2400.0$
 $= 287.2 \text{ N}$

Load Combination Results for Q + Wind or Seismic [Q]:

$= \text{Saddle Load} + \max(F_{wl}, F_{wt}, F_{sl}, F_{st})$
 $= 30528 + \max(287, 1888, 0, 0)$
 $= 32416.4 \text{ N}$

Longitudinal Wind Force [F_l]:

$= \text{WindScalar} * \text{WindPress}(\text{Platform Area} + (\text{End Area} * \text{WindDiaMult}))$
 $= 0.6 * 2054.32(0.0 + (1.177 * 1.2))$
 $= 1740.430 \text{ N}$

Summary of Loads at the base of this Saddle:

Vertical Load (including saddle weight)	34543.86	N
Transverse Shear Load Saddle	521.38	N
Longitudinal Shear Load Saddle	574.31	N

Hydrostatic Test Pressure at center of Vessel 10.455 bars

Formulas and Substitutions for Horizontal Vessel Analysis:

Note: Wear Plate is Welded to the Shell, $k = 0.1$

Saddle Dimension [E]:

$= \min(2(\text{ShellID}/2 + t + \text{WearPadThickness}) \sin(\text{theta}/2), 2 * R_m)$
 $= \min(2(1100.0/2 + 12.0 + 12.0) \sin(60.0/2), 2 * 559.0)$
 $= 994.197 \text{ mm.}$

The Computed K values from Table 4.15.1:

K1 = 0.1066	K2 = 1.1707	K3 = 0.8799	K4 = 0.4011
K5 = 0.7603	K6 = 0.0529	K7 = 0.0374	K8 = 0.3405
K9 = 0.2711	K10 = 0.0581	K1* = 0.1923	

Note: Dimension a is greater than or equal to $R_m / 2$.

Moment per Equation 4.15.3 [M1]:

$= -Q * a [1 - (1 - a/L + (R_m^2 - h^2) / (2a * L)) / (1 + (4h^2) / (3L))]$
 $= -32416 * 450.0 [1 - (1 - 450.0/3400.0 + (559.0^2 - 281.0^2) / (2 * 450.0 * 3400.0)) / (1 + (4 * 281.0) / (3 * 3400.0))]$
 $= -2185.1 \text{ N-m}$

Moment per Equation 4.15.4 [M2]:

$= Q * L / 4 (1 + 2 (R_m^2 - h^2) / (L^2)) / (1 + (4h^2) / (3L)) - 4a/L$
 $= 32416 * 3400 / 4 (1 + 2 (559^2 - 281^2) / (3400^2)) / (1 + (4 * 281) / (3 * 3400)) - 4 * 450 / 3400$
 $= 11238.9 \text{ N-m}$

Longitudinal Stress at Top of Shell (4.15.6) [Sigma1]:

$= P * R_m / (2t) - M2 / (\pi * R_m^2 t)$
 $= 10.455 * 559.0 / (2 * 6.0) - 11238.9 / (\pi * 559.0^2 * 6.0)$
 $= 46.80 \text{ N./mm}^2$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 83 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Longitudinal Stress at Bottom of Shell (4.15.7) [Sigma2]:

$$= P * Rm / (2t) + M2 / (\pi * Rm^2 * t)$$

$$= 10.455 * 559.0 / (2 * 6.0) + 11238.9 / (\pi * 559.0^2 * 6.0)$$

$$= 50.61 \text{ N./mm}^2$$

Longitudinal Stress at Top of Shell at Support (4.15.10) [Sigma*3]:

$$= P * Rm / (2t) - M1 / (K1 * \pi * Rm^2 * t)$$

$$= 10.455 * 559.0 / (2 * 6.0) - 2185.1 / (0.1066 * \pi * 559.0^2 * 6.0)$$

$$= 52.18 \text{ N./mm}^2$$

Longitudinal Stress at Bottom of Shell at Support (4.15.11) [Sigma*4]:

$$= P * Rm / (2t) + M1 / (K1 * \pi * Rm^2 * t)$$

$$= 10.455 * 559.0 / (2 * 6.0) + 2185.1 / (0.1923 * \pi * 559.0^2 * 6.0)$$

$$= 46.78 \text{ N./mm}^2$$

Maximum Shear Force in the Saddle (4.15.5) [T]:

$$= Q(L-2a) / (L + (4 * h^2 / 3))$$

$$= 32416(3400.0 - 2 * 450.0) / (3400.0 + (4 * 281.0 / 3))$$

$$= 21469.7 \text{ N}$$

Shear Stress in the shell no rings, not stiffened (4.15.14) [tau2]:

$$= K2 * T / (Rm * t)$$

$$= 1.1707 * 21469.7 / (559.0 * 6.0)$$

$$= 7.49 \text{ N./mm}^2$$

Decay Length (4.15.22) [x1,x2]:

$$= 0.78 * \sqrt{Rm * t}$$

$$= 0.78 * \sqrt{559.0 * 6.0}$$

$$= 45.173 \text{ mm.}$$

Circumferential Stress in shell, no rings (4.15.23) [sigma6]:

$$= -K5 * Q * k / (t * (b + X1 + X2))$$

$$= -0.7603 * 32416 * 0.1 / (6.0 * (150.0 + 45.17 + 45.17))$$

$$= -1.71 \text{ N./mm}^2$$

Circ. Comp. Stress at Horn of Saddle, L<8Rm (4.15.25) [sigma7*]:

$$= -Q / (4 * t * (b + X1 + X2)) - 12 * K7 * Q * Rm / (L * t^2)$$

$$= -32416 / (4 * 6.0 * (150.0 + 45.173 + 45.173)) -$$

$$12 * 0.037 * 32416 * 559.0 / (3400.0 * 6.0^2)$$

$$= -72.06 \text{ N./mm}^2$$

Effective reinforcing plate width (4.15.1) [B1]:

$$= \min(b + 1.56 * \sqrt{Rm * t}, 2a)$$

$$= \min(150.0 + 1.56 * \sqrt{559.0 * 6.0}, 2 * 450.0)$$

$$= 240.35 \text{ mm.}$$

Results for Vessel Ribs, Web and Base:

Baseplate Length	Bplen	1100.0000	mm.
Baseplate Thickness	Bpthk	15.0000	mm.
Baseplate Width	Bpwid	170.0000	mm.
Number of Ribs (inc. outside ribs)	Nribs	4	
Rib Thickness	Ribtk	15.0000	mm.
Web Thickness	Webtk	15.0000	mm.
Web Location	Webloc	Center	

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 84 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Saddle Yield Stress S_y 239.9 N./
Height of Web at Center H_w, c 635.0 mm.
Friction Coefficient μ 0.000

Note: In the tables below I_o is I for the rectangle + Area * Centroid Distance²

Moment of Inertia of Saddle - Transverse Direction (90 degrees to long axis)

	B	D	Y	A	AY	I_o
Shell	290.1	6.0	3.0	17.4	5221.8	0.145E+05
Wearplate	200.0	12.0	12.0	24.0	28800.0	0.188E+05
Web	15.0	611.0	323.5	91.6	2964876.5	0.295E+05
BasePlate	170.0	15.0	636.5	25.5	1623074.8	0.304E+05
Totals	...	...	...	158.6	4621973.5	0.930E+05

Distance to Centroid [C1]:

$$= AY / A$$

$$= 1819.675/158.556$$

$$= 291.504 \text{ mm.}$$

Angle [beta]:

$$= 180 - \text{Saddle Angle}/2$$

$$= 180 - 120.0/2$$

$$= 120.0$$

Saddle Splitting Coefficient [K1]:

$$= (1 + \cos(\beta) - 0.5 \sin^2(\beta)) / (\pi - \beta + \sin(\beta) \cos(\beta))$$

$$= (1 + \cos(120.0) - 0.5 \sin^2(120.0)) / (\pi - 2.094 + \sin(120.0) \cos(120.0))$$

$$= 0.2035$$

Saddle Splitting Force [Fh]:

$$= K1 * Q$$

$$= 0.204 * 32416.383$$

$$= 6597.4365 \text{ N}$$

Tension Stress, $St = (F_h / A_s) = 0.4674 \text{ N./mm}^2$
Allowed Stress, $Sa = 0.6 * \text{Yield Str} = 143.9676 \text{ N./mm}^2$

Saddle Splitting Dimension [d]:

$$= B - R * \sin(\theta/2) / (\theta/2 \text{ in radians})$$

$$= 1200.0 - 556.0 * \sin(120.0/2) / 1.0472$$

$$= 740.192 \text{ mm.}$$

Bending Moment, $M = F_h * d = 4885.3472 \text{ N-m}$

Bending Stress, $S_b = (M * C1 / I) = 1.5300 \text{ N./mm}^2$
Allowed Stress, $Sa = 2/3 * \text{Yield Str} = 159.9640 \text{ N./mm}^2$

Minimum Thickness of Baseplate per Moss:

$$= (3(Q + \text{Saddle Wt}) \text{BasePlateWidth} / (4 * \text{BasePlateLength} * \text{AllStress}))^{1/2}$$

$$= (3(32416 + 2127)170.0 / (4 * 1100.0 * 159.964))^{1/2}$$

$$= 5.003 \text{ mm.}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 85 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Calculation of Axial Load, Intermediate Values and Compressive Stress:

Web Length Dimension [Web Length]:

$$\begin{aligned}
 &= 2 * \cos(90 - \text{Saddle Angle}/2) (\text{Inside Radius} + \text{Shell Thk} + \text{Wear Plate Thk}) \\
 &= 2 * \cos(90 - 120.0/2) (550.0 + 12.0 + 12.0) \\
 &= 994.197 \text{ mm.}
 \end{aligned}$$

Distance between Ribs [e]:

$$\begin{aligned}
 &= \text{Web Length} / (\text{Nr ribs} - 1) \\
 &= 994.1971 / (4 - 1) \\
 &= 331.399 \text{ mm.}
 \end{aligned}$$

Baseplate Pressure Area [Ap]:

$$\begin{aligned}
 &= e * \text{Bpwid} / 2 \\
 &= 331.399 * 170.0/2 \\
 &= 281.689 \text{ cm}^2
 \end{aligned}$$

Bearing Pressure [Bp]:

$$\begin{aligned}
 &= Q / (\text{BasePlateLength} * \text{BasePlateWidth}) \\
 &= 32416.381 / (1100.0 * 170.0) \\
 &= 17.335 \text{ N/cm}^2
 \end{aligned}$$

Axial Load [P]:

$$\begin{aligned}
 &= \text{Ap} * \text{Bp} \\
 &= 281.7 * 17.33 \\
 &= 4883.072 \text{ N}
 \end{aligned}$$

Area of the Rib and Web [Ar]:

$$\begin{aligned}
 &= \text{Rib Area} + \text{Web Area} \\
 &= 20.25 + 24.855 \\
 &= 45.105 \text{ cm}^2
 \end{aligned}$$

Compressive Stress [Sc]:

$$\begin{aligned}
 &= P/\text{Ar} \\
 &= 4883.1/45.1049 \\
 &= 1.083 \text{ N./mm}^2
 \end{aligned}$$

Check of Outside Ribs:

Inertia of Saddle, Outer Ribs - Longitudinal Direction

	B	D	Y	A	AY	Io
-----	-----	-----	-----	-----	-----	-----
Rib+Web	15.0	150.0	...	22.5	...	422.

Rib dimension [D]:

$$\begin{aligned}
 &= \text{Saddle Width} - \text{Web Thickness} \\
 &= 150.0 - 15.0 \\
 &= 135.000 \text{ mm.}
 \end{aligned}$$

Distance to Centroid from Datum [ytot]:

$$\begin{aligned}
 &= \text{AY} / \text{A} \\
 &= 0.0/45.105 \\
 &= 0.000 \text{ mm.}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 86 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Distance to Centroid [C1]:

$$= \text{Saddle Width} / 2$$

$$= 150.0/2$$

$$= 75.000 \text{ mm.}$$

Radius of Gyration [r]:

$$= \sqrt{\text{Total Inertia} / \text{Total Area}}$$

$$= \sqrt{421.9/45.105}$$

$$= 30.583 \text{ mm.}$$

Length of Outer Rib [L]:

$$= \text{Saddle Height} - \cos(\theta/2) (\text{radius} + \text{shlthk} + \text{wpdthk}) - \text{bpthk}$$

$$= 1200.0 - \cos(120.0/2) (550.0 + 12.0 + 12.0) - 15.0$$

$$= 898.000 \text{ mm.}$$

Intermediate Term [Cc]:

$$= \sqrt{2 * \pi^2 * \text{Elastic Modulus} / \text{Yield Stress}}$$

$$= \sqrt{2 * \pi^2 * 0.19994\text{E}+09/239.9}$$

$$= 128.255$$

Slenderness ratio [KL/r]:

$$= KL/r$$

$$= 1 * 898.0/30.583$$

$$= 29.363$$

Bending Moment [Rm]:

$$= F1 / (2 * B_{plen}) * e * L / 2$$

$$= 574.3 / (2 * 1100.0) * 331.399 * 898.0/2$$

$$= 38.860 \text{ N-m}$$

Compressive Allowable, $KL/r < Cc$ ($29.3627 < 128.2549$) per AISC E2-1 [Sca]:

$$= (1 - (KL/r)^2 / (2 * Cc^2)) Fy / (5/3 + 3 * (KL/r) / (8 * Cc) - (KL/r^3) / (8 * Cc^3))$$

$$= (1 - (29.36)^2 / (2 * 128.25^2)) 240 /$$

$$(5/3 + 3 * (29.36) / (8 * 128.25) - (29.36^3) / (8 * 128.25^3))$$

$$= 133.4 \text{ N./mm}^2$$

AISC Unity Check of Outside Ribs (must be ≤ 1)

$$= Sc/Sca + (Rm * C1 / I) / Sba$$

$$= 1.08/133.44 + (38.86 * 75.0/4218750) / 159.96$$

$$= 0.012$$

Check of Inside Ribs:

Inertia of Saddle, Inner Ribs - Axial Direction

	B	D	Y	A	AY	Io
Rib	15.0	135.0	0.0	20.2	0.0	421.
Web	331.4	15.0	0.0	49.7	0.0	9.32
Totals	...	...	...	70.0	...	431.

Distance to Centroid from Datum [ytot]:

$$= AY / A$$

$$= 0.0/69.96$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 87 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$$= 0.000 \text{ mm.}$$

Distance to Centroid [C1]:

$$= \text{Saddle Width} / 2$$

$$= 150.0/2$$

$$= 75.000 \text{ mm.}$$

Length of Inner Rib [L]:

$$= \text{Saddle Height} - \sqrt{(\text{Ro} + \text{Wpdthk})^2 - (\text{Pitch}/2)^2} - \text{Bpthk}$$

$$= 1200.0 - \sqrt{(574.0 + 12.0)^2 - (331.399/2)^2} - 15.0$$

$$= 635.437 \text{ mm.}$$

Radius of Gyration [r]:

$$= \sqrt{\text{Total Inertia} / \text{Total Area}}$$

$$= \sqrt{430.8/69.96}$$

$$= 24.814 \text{ mm.}$$

Slenderness ratio [KL/r]:

$$= \text{KL}/r$$

$$= 1 * 635.437/24.814$$

$$= 25.608$$

Unit Force [Force,u]:

$$= \text{F}_1 / (2 * \text{Baseplate Length})$$

$$= 574.312 / (2 * 1100.0)$$

$$= 0.261 \text{ N/mm.}$$

Moment at base of inner Rib [Mbase,c]:

$$= \text{Unit Force} * e * L$$

$$= 0.261 * 331.399 * 635.437$$

$$= 54.995 \text{ N-m}$$

Bending Stress due to Transverse Force and Weight Load [SigmaB,base,c]:

$$= \text{Bending Moment} / \text{Section Modulus}$$

$$= 54.995/57436.492$$

$$= 0.957 \text{ N./mm}^2$$

Compressive Allowable, $\text{KL}/r < \text{Cc}$ ($25.6078 < 128.2549$) per AISC E2-1 [Sca]:

$$= (1 - (\text{KL}/r)^2 / (2 * \text{Cc}^2)) \text{Fy} / (5/3 + 3 * (\text{KL}/r) / (8 * \text{Cc}) - (\text{KL}/r)^3 / (8 * \text{Cc}^3))$$

$$= (1 - (25.61)^2 / (2 * 128.25^2)) 240 /$$

$$(5/3 + 3 * (25.61) / (8 * 128.25) - (25.61^3) / (8 * 128.25^3))$$

$$= 135.1 \text{ N./mm}^2$$

AISC Unity Check of Inside Ribs (must be ≤ 1)

$$= \text{Sc}/\text{Sca} + (\text{Mbase,c} * \text{C1}/\text{I})/\text{Sba}$$

$$= 1.41/135.11 + (55.0 * 75.0/430.773)/159.96$$

$$= 0.016$$

Input Data for Base Plate Bolting Calculations:

Total Number of Bolts per BasePlate	Nbolts	4	
Total Number of Bolts in Tension/Baseplate	Nbt	2	
Bolt Material Specification		SA-325	
Bolt Allowable Stress	Stba	300.00	N./mm ²
Bolt Corrosion Allowance	Bca	0.0	mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 88 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Distance from Bolts to Edge	Edgedis	30.5	mm.
Nominal Bolt Diameter	Bnd	20.0000	mm.
Thread Series	Series	TEMA Metric	
BasePlate Allowable Stress	S	95.15	N./mm ²
Area Available in a Single Bolt	BltArea	2.1705	cm ²
Saddle Load QO (Weight)	QO	32656.0	N
Saddle Load QL (Wind/Seismic contribution)	QL	287.2	N
Maximum Transverse Force	Ft	521.4	N
Maximum Longitudinal Force	F1	574.3	N
Saddle Bolted to Steel Foundation	No		

Shear Stress in a Single Bolt, Transverse Direction [taub,t]:

$$= F_t / (\text{Bolt Area} * \text{Number of Bolts})$$

$$= 521 / (2.17 * 4)$$

$$= 0.6 \text{ N./mm}^2. \text{ Must be less than } 180.0 \text{ N./mm}^2.$$

Bolt Area Calculation per Dennis R. Moss

Bolt Area Requirement Due to Longitudinal Load [Bltarearl]:

$$= 0.0 \text{ (} QO > QL \text{ --> No Uplift in Longitudinal direction)}$$

Bolt Area due to Shear Load [Bltarears]:

$$= F_1 / (\text{BoltShearAllowable} * \text{Nbols})$$

$$= 574.31 / (180.0 * 4.0)$$

$$= 0.0080 \text{ cm}^2$$

Bolt Area due to Transverse Load:

Moment on Baseplate Due to Transverse Load [Rmom]:

$$= B * F_t + \text{Sum of X Moments}$$

$$= 1200.0 * 521.38 + 0.0$$

$$= 625.90 \text{ N-m}$$

Eccentricity (e):

$$= R_{mom} / QO$$

$$= 625.9 / 32655.95$$

$$= 19.16 \text{ mm.} < B_{plen}/6 \text{ --> No Uplift in Transverse direction}$$

Bolt Area due to Transverse Load [Bltareart]:

$$= 0 \text{ (No Uplift)}$$

Required Area of a Single Bolt [Bltarearl]:

$$= \max[Bltarearl, Bltarears, Bltareart]$$

$$= \max[0.0, 0.008, 0.0]$$

$$= 0.0080 \text{ cm}^2$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 89 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Input, Nozzle Desc: N08 (2in)

From: 10

Pressure for Reinforcement Calculations	P	8.040	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Elliptical Head	D	1100.00	mm.
Aspect Ratio of Elliptical Head	Ar	2.00	
Head Finished (Minimum) Thickness	t	10.0000	mm.
Head Internal Corrosion Allowance	c	6.0000	mm.
Head External Corrosion Allowance	co	0.0000	mm.
Distance from Head Centerline	L1	400.0000	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

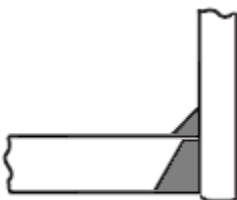
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		270.00	deg
Diameter		2.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	15.8500	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	10.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 90 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Note : Checking Nozzle in the Meridional direction.

Reinforcement CALCULATION, Description: N08 (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.000 in.
Actual Thickness Used in Calculation	0.624 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Elliptical Head, Tr [Int. Press]
 $= (P \cdot D \cdot K) / (2 \cdot S_v \cdot E - 0.2 \cdot P)$ Appendix 1-4 (c)
 $= (8.04 \cdot 1112.0 \cdot 0.986) / (2 \cdot 137.9 \cdot 1.0 - 0.2 \cdot 8.04)$
 $= 3.1978 \text{ mm.}$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]
 $= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P)$ per UG-27 (c) (1)
 $= (8.04 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.04)$
 $= 0.1837 \text{ mm.}$

Required Nozzle thickness under External Pressure per UG-28 : 0.3393 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	141.7608 mm.
Parallel to Vessel Wall, opening length	d	70.8804 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	10.0000 mm.

Weld Strength Reduction Factor [fr1]:

$= \min(1, S_n / S_v)$
 $= \min(1, 137.9 / 137.9)$
 $= 1.000$

Weld Strength Reduction Factor [fr2]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 91 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$= \min(1, S_n/S_v)$
 $= \min(1, 137.9/137.9)$
 $= 1.000$

Weld Strength Reduction Factor [fr3]:

$= \min(fr2, fr4)$
 $= \min(1.0, 1.0)$
 $= 1.000$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.267	1.028	NA
Area in Shell	A1	0.569	0.780	NA
Area in Nozzle Wall	A2	2.110	2.076	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	3.319	3.496	NA

The Internal Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 62.37 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$= (d * tr * F + 2 * t_n * tr * F * (1 - fr1))$ UG-37(c)
 $= (70.8804 * 3.1978 * 1.0 + 2 * 9.85 * 3.1978 * 1.0 * (1 - 1.0))$
 $= 2.267 \text{ cm}^2$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$= d(E1 * t - F * tr) - 2 * t_n(E1 * t - F * tr) * (1 - fr1)$
 $= 70.88(1.0 * 4.0 - 1.0 * 3.198) - 2 * 9.85$
 $(1.0 * 4.0 - 1.0 * 3.1978) * (1 - 1.0)$
 $= 0.569 \text{ cm}^2$

Area Available in Nozzle Projecting Outward [A2]:

$= (2 * t_{lnp})(t_n - t_{rn})fr2/\sin(\alpha3)$
 $= (2 * 10.0)(9.85 - 0.18)1.0/\sin(66.4)$
 $= 2.110 \text{ cm}^2$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$= W_o^2 * fr2 + (W_i - can/0.707)^2 * fr2$
 $= 8.0^2 * 1.0 + (0.0)^2 * 1.0$
 $= 0.640 \text{ cm}^2$

	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																									
شماره پیمان: 053 - 073 - 9184	<table><tr><th colspan="8">MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 92 از 251
MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
V01	0003	CN	ME	120	MF	GCS	BK																			

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $t_g = 10.0$, $t_r = 3.198$, $c = 6.0$ mm., $E^* = 1.0$
 Thickness Ratio = $t_r * (E^*) / (t_g - c) = 0.799$, Temp. Reduction = 11°C

Min Metal Temp. w/o impact per UCS-66, Curve A -8°C
 Min Metal Temp. at Required thickness (UCS 66.1) -19°C
 Min Metal Temp. w/o impact per UG-20(f) -29°C

Gov. MDMT of the nozzle to shell joint welded assembly : -29°C

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -18°C
 Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) -48°C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.04/19.60 = 0.410$

Weld Size Calculations, Description: N08 (2in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000$ mm.

Results Per UW-16.1:

Required Thickness Actual Thickness
 Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o$ mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - t_r)) * S_v)$$

$$= \max(0, (2.2666 - 0.5686 + 2 * 9.85 * 1.0 * (1.0 * 4.0 - 3.1978)) * 138)$$

$$= 25592.73 \text{ N}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$= (A2 + A5 + A4 - (W_i - C_{an} / .707)^2 * f_{r2}) * S_v$$

$$= (2.1099 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 37918.07 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (2.1099 + 0.0 + 0.64 + (0.788)) * 138$$

$$= 48783.67 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (2.1099 + 0.0 + 0.64 + 0.0 + (0.788)) * 138$$

$$= 48783.67 \text{ N}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 93 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw} \\
 &= (3.1416/2.0) * 93.1152 * 8.0 * 0.49 * 138 \\
 &= 79059. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n \\
 &= (3.1416 * 40.9989) * (15.85 - 6.0) * 0.7 * 138 \\
 &= 122457. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

$$\begin{aligned}
 &= (\pi/2) * D_{lo} * (W_{gvi} - Cas) * 0.74 * S_{ng} \\
 &= (3.1416/2.0) * 93.1152 * (10.0 - 6.0) * 0.74 * 138 \\
 &= 59698. \text{ N}
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 \text{PATH11} &= (SONW + SNW) = (79059 + 122457) = 201517 \text{ N} \\
 \text{PATH22} &= (Sonw + Tpgw + Tngw + Sinw) \\
 &= (79059 + 0 + 59698 + 0) = 138757 \text{ N} \\
 \text{PATH33} &= (Sonw + Tngw + Sinw) \\
 &= (79059 + 59698 + 0) = 138757 \text{ N}
 \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned}
 \text{Path 1-1} &= 201516 \text{ N} , \text{ must exceed } W = 25592 \text{ N} \quad \text{or } W1 = 37918 \text{ N} \\
 \text{Path 2-2} &= 138757 \text{ N} , \text{ must exceed } W = 25592 \text{ N} \quad \text{or } W2 = 48783 \text{ N} \\
 \text{Path 3-3} &= 138757 \text{ N} , \text{ must exceed } W = 25592 \text{ N} \quad \text{or } W3 = 48783 \text{ N}
 \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 10 bars

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in the Latitudinal direction.

Reinforcement CALCULATION, Description: N08 (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.000 in.
Actual Thickness Used in Calculation 0.624 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Elliptical Head, Tr [Int. Press]

$$\begin{aligned}
 &= (P * D * K) / (2 * S_v * E - 0.2 * P) \quad \text{Appendix 1-4 (c)} \\
 &= (8.04 * 1112.0 * 0.986) / (2 * 137.9 * 1.0 - 0.2 * 8.04) \\
 &= 3.1978 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P * R) / (S_n * E - 0.6 * P) \quad \text{per UG-27 (c) (1)} \\
 &= (8.04 * 31.4) / (138 * 1.0 - 0.6 * 8.04)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 94 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$$= 0.1837 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3393 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	125.6000	mm.
Parallel to Vessel Wall, opening length	d	62.8000	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	10.0000	mm.

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.008	0.910	NA
Area in Shell	A1	0.504	0.691	NA
Area in Nozzle Wall	A2	1.933	1.902	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	3.077	3.233	NA

The Internal Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F \cdot (1 - fr1)) \text{ UG-37(c)}$$

$$= (62.8 \cdot 3.1978 \cdot 1.0 + 2 \cdot 9.85 \cdot 3.1978 \cdot 1.0 \cdot (1 - 1.0))$$

$$= 2.008 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot tr) - 2 \cdot tn (E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 62.8 (1.0 \cdot 4.0 - 1.0 \cdot 3.198) - 2 \cdot 9.85$$

$$(1.0 \cdot 4.0 - 1.0 \cdot 3.1978) \cdot (1 - 1.0)$$

$$= 0.504 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp) (tn - trn) fr2$$

$$= (2 \cdot 10.0) (9.85 - 0.18) 1.0$$

$$= 1.933 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can / 0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures	ta	6.3393	mm.
Wall Thickness per UG16(b),	tr16b	7.5000	mm.
Wall Thickness, shell/head, internal pressure	trbl	9.1978	mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 95 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Wall Thickness $tb1 = \max(trb1, tr16b) = 9.1978 \text{ mm.}$
 Wall Thickness, shell/head, external pressure $trb2 = 6.4111 \text{ mm.}$
 Wall Thickness $tb2 = \max(trb2, tr16b) = 7.5000 \text{ mm.}$
 Wall Thickness per table UG-45 $tb3 = 10.8000 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$= \min[tb3, \max(tb1, tb2)]$
 $= \min[10.8, \max(9.1978, 7.5)]$
 $= 9.1978 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$= \max(ta, tb)$
 $= \max(6.3393, 9.1978)$
 $= 9.1978 \text{ mm.}$

Available Nozzle Neck Thickness = 15.8500 mm. --> OK

Weld Size Calculations, Description: N08 (2in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness $Actual \text{ Thickness}$
 Nozzle Weld $4.2000 = 0.7 * t_{min}. \quad 5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (2.0082 - 0.5038 + 2 * 9.85 * 1.0 * (1.0 * 4.0 - 3.1978))138)$
 $= 22923.56 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$= (A2+A5+A4-(W_i-Can/.707)^2*fr2)*Sv$
 $= (1.9333 + 0.0 + 0.64 - 0.0 * 1.0) * 138$
 $= 35482.16 \text{ N}$

Weld Load [W2]:

$= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv$
 $= (1.9333 + 0.0 + 0.64 + (0.788)) * 138$
 $= 46347.75 \text{ N}$

Weld Load [W3]:

$= (A2+A3+A4+A5+(2*tn*t*fr1))*S$
 $= (1.9333 + 0.0 + 0.64 + 0.0 + (0.788)) * 138$
 $= 46347.75 \text{ N}$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 96 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= (3.1416/2.0) * 82.5 * 8.0 * 0.49 * 138$$

$$= 70047. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 36.325) * (15.85 - 6.0) * 0.7 * 138$$

$$= 108497. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi / 2) * D_{lo} * (W_{gnvi} - Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 82.5 * (10.0 - 6.0) * 0.74 * 138$$

$$= 52892. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (70047 + 108497) = 178543 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (70047 + 0 + 52892 + 0) = 122939 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (70047 + 52892 + 0) = 122939 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 178543 N , must exceed W = 22923 N or W1 = 35482 N

Path 2-2 = 122938 N , must exceed W = 22923 N or W2 = 46347 N

Path 3-3 = 122938 N , must exceed W = 22923 N or W3 = 46347 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 10 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 19.1775 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 180.0822 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 97 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Input, Nozzle Desc: N01 (1in)

From: 20

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		200.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

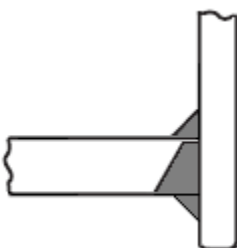
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		90.00	deg
Diameter		1.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.7000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	200.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	
Flange Series	Series	z	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 98 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, with Inside projection

Reinforcement CALCULATION, Description: N01 (1in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	1.000 in.
Actual Thickness Used in Calculation	0.500 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 18.7) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.1089 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.2564 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	74.8000	mm.
Parallel to Vessel Wall, opening length	d	37.4000	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000	mm.
Normal to Vessel Wall, Inward		1.7500	mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 99 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$= \min(1, S_n/S_v)$
 $= \min(1, 137.9/137.9)$
 $= 1.000$

Weld Strength Reduction Factor [fr3]:

$= \min(fr2, fr4)$
 $= \min(1.0, 1.0)$
 $= 1.000$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.211	0.819	NA
Area in Shell	A1	1.033	0.606	NA
Area in Nozzle Wall	A2	1.977	1.933	NA
Area in Inward Nozzle	A3	0.024	0.024	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	3.675	3.203	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1))$ per UG-37(d)
 $= 0.5(37.4 \cdot 4.3799 \cdot 1 + 2 \cdot 6.7 \cdot 4.3799 \cdot 1(1 - 1.0))$
 $= 0.819 \text{ cm}^2$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$
 $= 37.4(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 6.7$
 $(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$
 $= 0.606 \text{ cm}^2$

Area Available in Nozzle Projecting Outward [A2]:

$= (2 \cdot tlnp)(tn - trn)fr2$
 $= (2 \cdot 15.0)(6.7 - 0.26)1.0$
 $= 1.933 \text{ cm}^2$

Area Available in Inward Nozzle [A3]:

$= 2 \cdot ti \cdot \min(h, Tl, 2.5 \cdot ti) \cdot fr2$
 $= 2 \cdot 0.7 \cdot (1.75) \cdot 1.0$
 $= 0.024 \text{ cm}^2$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$
 $= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$
 $= 0.640 \text{ cm}^2$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 100 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $t_a = 6.2564 \text{ mm.}$
Wall Thickness per UG16(b), $t_{r16b} = 7.5000 \text{ mm.}$
Wall Thickness, shell/head, internal pressure $t_{rb1} = 9.2370 \text{ mm.}$
Wall Thickness $t_{b1} = \max(t_{rb1}, t_{r16b}) = 9.2370 \text{ mm.}$
Wall Thickness, shell/head, external pressure $t_{rb2} = 6.4171 \text{ mm.}$
Wall Thickness $t_{b2} = \max(t_{rb2}, t_{r16b}) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $t_{b3} = 9.4200 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$= \min[t_{b3}, \max(t_{b1}, t_{b2})]$
 $= \min[9.42, \max(9.237, 7.5)]$
 $= 9.2370 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$= \max(t_a, t_b)$
 $= \max(6.2564, 9.237)$
 $= 9.2370 \text{ mm.}$

Available Nozzle Neck Thickness = 12.7000 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)(1)(b)), min(Curve:A, Curve:D)

Govrn. thk, $t_g = 12.0$, $t_r = 3.237$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio $= t_r * (E^*) / (t_g - c) = 0.539$, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ } ^\circ\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ } ^\circ\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ } ^\circ\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ } ^\circ\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-29 \text{ } ^\circ\text{C}$
Flange MDMT with Temp reduction per UCS-66(b)(1)(-b) $-48 \text{ } ^\circ\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.00/19.60 = 0.408$

Weld Size Calculations, Description: N01 (1in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 101 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (0.819 - 0.6059 + 2 * 6.7 * 1.0 * \\
 &\quad (1.0 * 6.0 - 4.3799)) 138) \\
 &= 5932.37 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (1.9331 + 0.0 + 0.64 - 0.0 * 1.0) * 138 \\
 &= 35479.61 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (1.9331 + 0.0245 + 0.64 + (0.804)) * 138 \\
 &= 46903.65 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A2+A3+A4+A5+(2*tn*t*fr1))*S \\
 &= (1.9331 + 0.0245 + 0.64 + 0.0 + (0.804)) * 138 \\
 &= 46903.65 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416/2.0) * 50.8 * 8.0 * 0.49 * 138 \\
 &= 43132. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 22.05) * (12.7 - 6.0) * 0.7 * 138 \\
 &= 44798. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng \\
 &= (3.1416/2.0) * 50.8 * (12.0 - 6.0) * 0.74 * 138 \\
 &= 48853. \text{ N}
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 \text{PATH11} &= (\text{SONW} + \text{SNW}) = (43132 + 44798) = 87930 \text{ N} \\
 \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\
 &= (43132 + 0 + 48853 + 0) = 91985 \text{ N} \\
 \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\
 &= (43132 + 48853 + 0) = 91985 \text{ N}
 \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned}
 \text{Path 1-1} &= 87929 \text{ N} , \text{ must exceed } W = 5932 \text{ N} \quad \text{or } W1 = 35479 \text{ N} \\
 \text{Path 2-2} &= 91985 \text{ N} , \text{ must exceed } W = 5932 \text{ N} \quad \text{or } W2 = 46903 \text{ N} \\
 \text{Path 3-3} &= 91985 \text{ N} , \text{ must exceed } W = 5932 \text{ N} \quad \text{or } W3 = 46903 \text{ N}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 102 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 0.5868 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 362.0000 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 103 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Input, Nozzle Desc: N05A (1.5in)

From: 20

Pressure for Reinforcement Calculations	P	8.055	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		1550.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

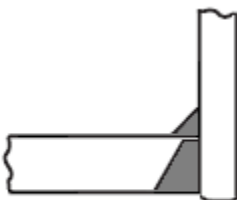
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		270.00	deg
Diameter		1.5000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	14.4500	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 104 از 251
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه										
V01	0003	CN	ME	120	MF	GCS	BK											

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N05A (1.5in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	1.500 in.
Actual Thickness Used in Calculation	0.569 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 3.2593 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 25.05) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 0.1468 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3000 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	100.2000 mm.
Parallel to Vessel Wall, opening length	d	50.1000 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000 mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 105 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.633	1.097	NA
Area in Shell	A1	1.373	0.812	NA
Area in Nozzle Wall	A2	2.491	2.445	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	4.504	3.897	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(50.1 \cdot 4.3799 \cdot 1 + 2 \cdot 8.45 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 1.097 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 50.1(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 8.45$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 0.812 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2$$

$$= (2 \cdot 15.0)(8.45 - 0.3)1.0$$

$$= 2.445 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.3000 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2593 \text{ mm.}$

Wall Thickness $tbl = \max(trb1, tr16b) = 9.2593 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 106 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Wall Thickness $tb2 = \max(tb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 10.5200 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$= \min[tb3, \max(tb1, tb2)]$
 $= \min[10.52, \max(9.2593, 7.5)]$
 $= 9.2593 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$= \max(ta, tb)$
 $= \max(6.3, 9.2593)$
 $= 9.2593 \text{ mm.}$

Available Nozzle Neck Thickness = 14.4500 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.259$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio $= tr * (E^*) / (tg - c) = 0.543$, Temp. Reduction = 27 °C

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^{\circ}\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^{\circ}\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^{\circ}\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^{\circ}\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-29 \text{ }^{\circ}\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-48 \text{ }^{\circ}\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.05/19.60 = 0.411$

Weld Size Calculations, Description: N05A (1.5in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (1.0972 - 0.8117 + 2 * 8.45 * 1.0 * (1.0 * 6.0 - 4.3799))138)$
 $= 7712.23 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 107 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Weld Load [W1]:

$$= (A2+A5+A4-(W_i-Can/.707)^2*fr2)*Sv$$

$$= (2.445 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 42538.47 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv$$

$$= (2.445 + 0.0 + 0.64 + (1.014)) * 138$$

$$= 56520.34 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*tn*t*fr1))*S$$

$$= (2.445 + 0.0 + 0.64 + 0.0 + (1.014)) * 138$$

$$= 56520.34 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * Snw$$

$$= (3.1416/2.0) * 67.0 * 8.0 * 0.49 * 138$$

$$= 56886. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo})/4) * (Thk - Can) * 0.7 * Sn$$

$$= (3.1416 * 29.275) * (14.45 - 6.0) * 0.7 * 138$$

$$= 75012. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gnvi}-Cas) * 0.74 * Sng$$

$$= (3.1416/2.0) * 67.0 * (12.0 - 6.0) * 0.74 * 138$$

$$= 64433. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (56886 + 75012) = 131898 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (56886 + 0 + 64433 + 0) = 121319 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (56886 + 64433 + 0) = 121319 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 131898 N , must exceed W = 7712 N or W1 = 42538 N

Path 2-2 = 121318 N , must exceed W = 7712 N or W2 = 56520 N

Path 3-3 = 121318 N , must exceed W = 7712 N or W3 = 56520 N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 108 از 251
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	MF	120	ME	CN	0003	
							V01	

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 1.0212 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 163.0211 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 109 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: N06 (2in)

From: 20

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516 70	
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		1350.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

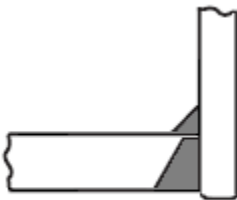
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		90.00	deg
Diameter		2.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	15.8500	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 110 از 251
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	
	V01	0003	CN	ME	120	MF	GCS	BK

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N06 (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.000 in.
Actual Thickness Used in Calculation	0.624 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.1828 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3393 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	125.6000	mm.
Parallel to Vessel Wall, opening length	d	62.8000	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000	mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 111 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادرکننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.033	1.375	NA
Area in Shell	A1	1.735	1.017	NA
Area in Nozzle Wall	A2	2.900	2.853	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	5.275	4.511	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d * tr * F + 2 * tn * tr * F(1-fr1)) \text{ per UG-37(d)}$$

$$= 0.5(62.8 * 4.3799 * 1 + 2 * 9.85 * 4.3799 * 1(1-1.0))$$

$$= 1.375 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 * t - F * tr) - 2 * tn(E1 * t - F * tr) * (1 - fr1)$$

$$= 62.8(1.0 * 6.0 - 1.0 * 4.38) - 2 * 9.85$$

$$(1.0 * 6.0 - 1.0 * 4.3799) * (1 - 1.0)$$

$$= 1.017 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 * tlnp) (tn - trn) fr2$$

$$= (2 * 15.0) (9.85 - 0.34) 1.0$$

$$= 2.853 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 * fr2 + (Wi - can / 0.707)^2 * fr2$$

$$= 8.0^2 * 1.0 + (0.0)^2 * 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.3393 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2370 \text{ mm.}$

Wall Thickness $tbl = \max(trb1, tr16b) = 9.2370 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 112 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Wall Thickness $tb2 = \max(trb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 10.8000 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:
 $= \min[tb3, \max(tb1, tb2)]$
 $= \min[10.8, \max(9.237, 7.5)]$
 $= 9.2370 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:
 $= \max(ta, tb)$
 $= \max(6.3393, 9.237)$
 $= 9.2370 \text{ mm.}$

Available Nozzle Neck Thickness = 15.8500 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.237$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio $= tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^{\circ}\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^{\circ}\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^{\circ}\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^{\circ}\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-29 \text{ }^{\circ}\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-48 \text{ }^{\circ}\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
Design Pressure/Ambient Rating $= 8.00/19.60 = 0.408$

Weld Size Calculations, Description: N06 (2in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:
 $= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (1.3753 - 1.0174 + 2 * 9.85 * 1.0 * (1.0 * 6.0 - 4.3799))138)$
 $= 9335.71 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																									
شماره پیمان: 053 – 073 – 9184	<table><tr><th colspan="8">MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)</th></tr><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)								نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 113 از 251
MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)																										
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه																			
V01	0003	CN	ME	120	MF	GCS	BK																			

Weld Load [W1]:

$$= (A2+A5+A4-(W_i-Can/.707)^2*fr2)*Sv$$

$$= (2.8532 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 48167.27 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv$$

$$= (2.8532 + 0.0 + 0.64 + (1.182)) * 138$$

$$= 64465.67 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*tn*t*fr1))*S$$

$$= (2.8532 + 0.0 + 0.64 + 0.0 + (1.182)) * 138$$

$$= 64465.67 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 82.5 * 8.0 * 0.49 * 138$$

$$= 70047. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 36.325) * (15.85 - 6.0) * 0.7 * 138$$

$$= 108497. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gnvi}-Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 82.5 * (12.0 - 6.0) * 0.74 * 138$$

$$= 79339. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (70047 + 108497) = 178543 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (70047 + 0 + 79339 + 0) = 149385 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (70047 + 79339 + 0) = 149385 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 178543 N , must exceed W = 9335 N or W1 = 48167 N

Path 2-2 = 149385 N , must exceed W = 9335 N or W2 = 64465 N

Path 3-3 = 149385 N , must exceed W = 9335 N or W3 = 64465 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 14 bars

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 1.5490 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 163.5490 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 114 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: N07 (1in)

From: 20

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		1100.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

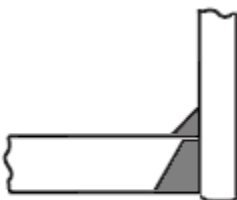
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		90.00	deg
Diameter		1.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.7000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 115 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N07 (1in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	1.000 in.
Actual Thickness Used in Calculation	0.500 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 18.7) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.1089 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.2564 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	74.8000 mm.
Parallel to Vessel Wall, opening length	d	37.4000 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000 mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 116 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.211	0.819	NA
Area in Shell	A1	1.033	0.606	NA
Area in Nozzle Wall	A2	1.977	1.933	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	3.651	3.179	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d * tr * F + 2 * tn * tr * F(1-fr1)) \text{ per UG-37(d)}$$

$$= 0.5(37.4 * 4.3799 * 1 + 2 * 6.7 * 4.3799 * 1(1-1.0))$$

$$= 0.819 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 * t - F * tr) - 2 * tn(E1 * t - F * tr) * (1 - fr1)$$

$$= 37.4(1.0 * 6.0 - 1.0 * 4.38) - 2 * 6.7$$

$$(1.0 * 6.0 - 1.0 * 4.3799) * (1 - 1.0)$$

$$= 0.606 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 * tlnp) (tn - trn) fr2$$

$$= (2 * 15.0) (6.7 - 0.26) 1.0$$

$$= 1.933 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 * fr2 + (Wi - can / 0.707)^2 * fr2$$

$$= 8.0^2 * 1.0 + (0.0)^2 * 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.2564 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2370 \text{ mm.}$

Wall Thickness $tbl = \max(trb1, tr16b) = 9.2370 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 117 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Wall Thickness $tb2 = \max(tb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 9.4200 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:
 $= \min[tb3, \max(tb1, tb2)]$
 $= \min[9.42, \max(9.237, 7.5)]$
 $= 9.2370 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:
 $= \max(ta, tb)$
 $= \max(6.2564, 9.237)$
 $= 9.2370 \text{ mm.}$

Available Nozzle Neck Thickness = 12.7000 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.237$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = $28 \text{ }^\circ\text{C}$

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^\circ\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^\circ\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^\circ\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^\circ\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-29 \text{ }^\circ\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-48 \text{ }^\circ\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
Design Pressure/Ambient Rating = $8.00/19.60 = 0.408$

Weld Size Calculations, Description: N07 (1in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:
 $= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (0.819 - 0.6059 + 2 * 6.7 * 1.0 * (1.0 * 6.0 - 4.3799))138)$
 $= 5932.37 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 118 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Weld Load [W1]:

$$= (A2+A5+A4 - (W_i - Can / .707)^2 * fr2) * Sv$$

$$= (1.9331 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 35479.61 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * fr1)) * Sv$$

$$= (1.9331 + 0.0 + 0.64 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*t_n*t*fr1))*S$$

$$= (1.9331 + 0.0 + 0.64 + 0.0 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 50.8 * 8.0 * 0.49 * 138$$

$$= 43132. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 22.05) * (12.7 - 6.0) * 0.7 * 138$$

$$= 44798. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gvi} - Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 50.8 * (12.0 - 6.0) * 0.74 * 138$$

$$= 48853. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (43132 + 44798) = 87930 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (43132 + 0 + 48853 + 0) = 91985 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (43132 + 48853 + 0) = 91985 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 87929 N , must exceed W = 5932 N or W1 = 35479 N

Path 2-2 = 91985 N , must exceed W = 5932 N or W2 = 46565 N

Path 3-3 = 91985 N , must exceed W = 5932 N or W3 = 46565 N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 119 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 0.5868 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 162.5868 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 120 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Input, Nozzle Desc: N09 (1in)

From: 20

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516 70	
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		850.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

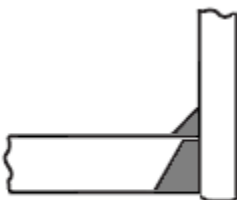
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		90.00	deg
Diameter		1.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.7000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 121 از 251
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه										
V01	0003	CN	ME	120	MF	GCS	BK											

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N09 (1in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	1.000 in.
Actual Thickness Used in Calculation	0.500 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 18.7) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.1089 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.2564 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	74.8000 mm.
Parallel to Vessel Wall, opening length	d	37.4000 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000 mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 122 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.211	0.819	NA
Area in Shell	A1	1.033	0.606	NA
Area in Nozzle Wall	A2	1.977	1.933	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	3.651	3.179	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(37.4 \cdot 4.3799 \cdot 1 + 2 \cdot 6.7 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 0.819 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 37.4(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 6.7$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 0.606 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2$$

$$= (2 \cdot 15.0)(6.7 - 0.26)1.0$$

$$= 1.933 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.2564 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2370 \text{ mm.}$

Wall Thickness $tbl = \max(trb1, tr16b) = 9.2370 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 123 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Wall Thickness $tb2 = \max(tb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 9.4200 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$= \min[tb3, \max(tb1, tb2)]$
 $= \min[9.42, \max(9.237, 7.5)]$
 $= 9.2370 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$= \max(ta, tb)$
 $= \max(6.2564, 9.237)$
 $= 9.2370 \text{ mm.}$

Available Nozzle Neck Thickness = 12.7000 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.237$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio $= tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^{\circ}\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^{\circ}\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^{\circ}\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^{\circ}\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-29 \text{ }^{\circ}\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-48 \text{ }^{\circ}\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.00/19.60 = 0.408$

Weld Size Calculations, Description: N09 (1in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (0.819 - 0.6059 + 2 * 6.7 * 1.0 * (1.0 * 6.0 - 4.3799))138)$
 $= 5932.37 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 124 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Weld Load [W1]:

$$= (A2+A5+A4 - (W_i - Can / .707)^2 * fr2) * Sv$$

$$= (1.9331 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 35479.61 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * fr1)) * Sv$$

$$= (1.9331 + 0.0 + 0.64 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*t_n*t*fr1))*S$$

$$= (1.9331 + 0.0 + 0.64 + 0.0 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 50.8 * 8.0 * 0.49 * 138$$

$$= 43132. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 22.05) * (12.7 - 6.0) * 0.7 * 138$$

$$= 44798. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gvi} - Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 50.8 * (12.0 - 6.0) * 0.74 * 138$$

$$= 48853. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (43132 + 44798) = 87930 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (43132 + 0 + 48853 + 0) = 91985 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (43132 + 48853 + 0) = 91985 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 87929 N , must exceed W = 5932 N or W1 = 35479 N

Path 2-2 = 91985 N , must exceed W = 5932 N or W2 = 46565 N

Path 3-3 = 91985 N , must exceed W = 5932 N or W3 = 46565 N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 125 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 0.5868 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 162.5868 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 126 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: M1 (24in)

From: 20

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516 70	
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		1150.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

Type of Element Connected to the Shell : Nozzle

Material		SA-516 70	
Material UNS Number		K02700	
Material Specification/Type		Plate	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		OD	
Layout Angle		0.00	deg
Diameter		24.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.0000	mm.
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material [Normalized]		SA-516 70	
Pad Allowable Stress at Temperature	Sp	137.90	N./mm ²
Pad Allowable Stress At Ambient	Spa	137.90	N./mm ²
Diameter of Pad along vessel surface	Dp	750.0000	mm.
Thickness of Pad	te	12.0000	mm.

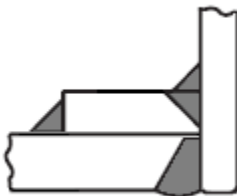
 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 127 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Weld leg size between Pad and Shell Wp 10.0000 mm.
Groove weld depth between Pad and Nozzle Wgpn 12.0000 mm.
Reinforcing Pad Width 70.2000 mm.
This is a Manway or Access Opening.

Flange Class 150
Flange Grade GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle With Pad, no Inside projection

Reinforcement CALCULATION, Description: M1 (24in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Outside Diameter Used in Calculation 24.000 in.
Actual Thickness Used in Calculation 0.472 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0)$$

$$= 3.2370 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R_o) / (S_n \cdot E + 0.4 \cdot P) \text{ per Appendix 1-1 (a) (1)}$$

$$= (8.0 \cdot 304.8) / (138 \cdot 1.0 + 0.4 \cdot 8.0)$$

$$= 1.7642 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 1.0868 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 1195.2000 mm.
Parallel to Vessel Wall, opening length d 597.6000 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 128 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Normal to Vessel Wall (Thickness Limit), pad side Tlwp 15.0000 mm.

Weld Strength Reduction Factor [fr1]:

$$= \min(1, S_n/S_v)$$

$$= \min(1, 137.9/137.9)$$

$$= 1.000$$

Weld Strength Reduction Factor [fr2]:

$$= \min(1, S_n/S_v)$$

$$= \min(1, 137.9/137.9)$$

$$= 1.000$$

Weld Strength Reduction Factor [fr4]:

$$= \min(1, S_p/S_v)$$

$$= \min(1, 137.9/137.9)$$

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	19.344	13.087	NA
Area in Shell	A1	16.512	9.682	NA
Area in Nozzle Wall	A2	1.271	1.474	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		1.390	1.390	NA
Area in Element	A5	12.636	12.636	NA
TOTAL AREA AVAILABLE	Atot	31.809	25.181	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Insufficient.

The area available with the given pad is Sufficient.

SELECTION OF POSSIBLE REINFORCING PADS:	Diameter	Thickness
Based on given Pad Thickness:	615.6194	12.0000 mm.
Based on given Pad Diameter:	750.0000	0.5145 mm.
Based on Shell or Nozzle Thickness:	615.6194	12.0000 mm.

Area Required [A]:

$$= 0.5 (d * tr * F + 2 * t_n * tr * F (1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5 (597.6 * 4.3799 * 1 + 2 * 6.0 * 4.3799 * 1 (1 - 1.0))$$

$$= 13.087 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 129 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 597.6(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 6.0$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 9.682 \text{ cm}^2$$

Area Available in Nozzle Wall Projecting Outward [A2]:

$$= (2 \cdot Tlwp) \cdot (tn - trn) \cdot fr2$$

$$= (2 \cdot 15.0) \cdot (6.0 - 1.09) \cdot 1.0$$

$$= 1.474 \text{ cm}^2$$

Area Available in Welds [A41 + A42 + A43]:

$$= (Wo^2 - Ar \text{ Lost}) \cdot Fr3 + ((Wi - can / 0.707)^2 - Ar \text{ Lost}) \cdot fr2 + Wp^2 \cdot fr4$$

$$= (0.39) \cdot 1.0 + (0.0) \cdot 1.0 + 254.0^2 \cdot 1.0$$

$$= 1.390 \text{ cm}^2$$

Area Available in Element, also see UG-37(h) [A5]:

$$= (\min(Dp, DL) - (Nozzle \text{ OD})) (\min(tp, Tlwp, te)) \cdot fr4 \cdot 0.75$$

$$= (750.0 - 609.6) 12.0 \cdot 1.0 \cdot 0.75$$

$$= 12.636 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle Neck to Flange Weld, min(Curve:B, Curve:A)

Govrn. thk, tg = 12.0, tr = 1.764, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.294, Temp. Reduction = 78 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	-3 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-104 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Nozzle Neck to Pad Weld for the Nozzle, Curve: B

Govrn. thk, tg = 12.0, tr = 1.764, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.294, Temp. Reduction = 78 °C

Min Metal Temp. w/o impact per UCS-66, Curve B	-23 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-104 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Nozzle Neck to Pad Weld for Reinforcement pad, Curve: D

Govrn. thk, tg = 12.0, tr = 1.764, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.294, Temp. Reduction = 78 °C

Min Metal Temp. w/o impact per UCS-66, Curve D	-48 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-104 °C

Shell to Pad Weld Junction at Pad OD, Curve: D

Govrn. thk, tg = 12.0, tr = 3.237, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.539, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve D	-48 °C
--	--------

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 130 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:B, Curve:D)

Govrn. thk, $t_g = 12.0$, $t_r = 3.237$, $c = 6.0$ mm., $E^* = 1.0$
 Thickness Ratio = $t_r * (E^*) / (t_g - c) = 0.539$, Temp. Reduction = 28°C

Min Metal Temp. w/o impact per UCS-66, Curve B -23°C
 Min Metal Temp. at Required thickness (UCS 66.1) -48°C
 Min Metal Temp. w/o impact per UG-20(f) -29°C

Gov. MDMT of the Nozzle : -48°C
 Gov. MDMT of the Reinforcement Pad : -48°C
 Gov. MDMT of the nozzle to shell joint welded assembly : -48°C

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -29°C
 Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) -48°C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
 Design Pressure/Ambient Rating = $8.00/19.60 = 0.408$

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 896.4000 mm.
 Parallel to Vessel Wall, opening length d 448.2000 mm.
 Normal to Vessel Wall (Thickness Limit), pad side Tlwp 15.0000 mm.

Reinforcement Areas for Large Nozzle (Per App 1-7(a)): (cm²)

AREA AVAILABLE, A1 to A6		No Pad	With Pad
Area Required [External Pressure]	AR	8.725	8.725
Area Available in Shell	A1	4.841	4.841
Area Available in Nozzle Wall	A2	1.474	1.474
Area Available in Inward Nozzle	A3	0.000	0.000
Area Available in Welds	A4	0.640	1.390
Area Available in Pad	A5	0.000	12.636
Area Available in Hub	A6	0.000	0.000
TOTAL AREA AVAILABLE	Atot	6.955	20.341

The area available without a pad is Insufficient.
 The area available with the given pad is Sufficient.

Note: The Nozzle does not fall within the scope of the diameter requirements of App. 1-7(b). Therefore, the Membrane and Bending stress checks are not required.

Weld Size Calculations, Description: M1 (24in)

Intermediate Calc. for nozzle/shell Welds Tmin 6.0000 mm.
 Intermediate Calc. for pad/shell Welds TminPad 6.0000 mm.

Results Per UW-16.1:

Required Thickness Actual Thickness

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 131 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o$ mm.
Pad Weld $3.0000 = 0.5 * T_{minPad}$ $7.0700 = 0.7 * W_p$ mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - t_r)) * S_v)$$

$$= \max(0, (13.0872 - 9.6815 + 2 * 6.0 * 1.0 * (1.0 * 6.0 - 4.3799)) * 138)$$

$$= 49641.30 \text{ N}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$= (A2 + A5 + A4 - (W_i - C_{an} / .707)^2 * f_{r2}) * S_v$$

$$= (1.474 + 12.636 + 1.39 - 0.0 * 1.0) * 138$$

$$= 213726.23 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (1.474 + 0.0 + 0.64 + (0.72)) * 138$$

$$= 39076.95 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (1.474 + 0.0 + 1.39 + 12.636 + (0.72)) * 138$$

$$= 223654.19 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 609.6 * 8.0 * 0.49 * 138$$

$$= 517581. \text{ N}$$

Shear, Pad Element Weld [Spew]:

$$= (\pi/2) * D_P * W_P * 0.49 * S_{EW}$$

$$= (3.1416/2.0) * 750.0 * 10.0 * 0.49 * 138$$

$$= 795984. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - C_{an}) * 0.7 * S_n$$

$$= (3.1416 * 301.8) * (12.0 - 6.0) * 0.7 * 138$$

$$= 549093. \text{ N}$$

Tension, Pad Groove Weld [Tpgw]:

$$= (\pi/2) * D_{lo} * W_{gpn} * 0.74 * S_{eg}$$

$$= (3.1416/2) * 609.6 * 12.0 * 0.74 * 138$$

$$= 1172479. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gnvi} - C_{as}) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 609.6 * (12.0 - 6.0) * 0.74 * 138$$

$$= 586240. \text{ N}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 132 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Strength of Failure Paths:

$$\begin{aligned} \text{PATH11} &= (\text{SPEW} + \text{SNW}) = (795984 + 549093) = 1345077 \text{ N} \\ \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\ &= (517581 + 1172479 + 586240 + 0) = 2276300 \text{ N} \\ \text{PATH33} &= (\text{Spew} + \text{Tngw} + \text{Sinw}) \\ &= (795984 + 586240 + 0) = 1382224 \text{ N} \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned} \text{Path 1-1} &= 1345077 \text{ N}, \text{ must exceed } W = 49641 \text{ N} \quad \text{or } W1 = 213726 \text{ N} \\ \text{Path 2-2} &= 2276299 \text{ N}, \text{ must exceed } W = 49641 \text{ N} \quad \text{or } W2 = 39076 \text{ N} \\ \text{Path 3-3} &= 1382224 \text{ N}, \text{ must exceed } W = 49641 \text{ N} \quad \text{or } W3 = 223654 \text{ N} \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 11 bars

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 92.1824 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 254.1824 mm.

Percent Elongation Calculations:

$$\% \text{ Elongation per Table UG-79-1 } (50 \cdot t_{nom} / R_f \cdot (1 - R_f / R_o)) \quad 2.008 \%$$

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 133 از 251																
	<table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>		پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01
	پروژه		بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه									
BK	GCS	MF	120	ME	CN	0003	V01											

Input, Nozzle Desc: K06 (2in)

From: 20

Pressure for Reinforcement Calculations	P	8.029	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Cylinder/Cone Centerline	L1	300.0000	mm.
Distance from Bottom/Left Tangent		250.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

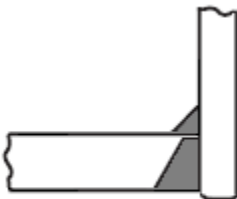
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		-32.26	deg
Diameter		2.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	16.7640	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	10.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		300	
Flange Grade		GR 1.1	

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 134 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Note : Checking Nozzle 90 degrees to the Longitudinal axis.

Reinforcement CALCULATION, Description: K06 (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.000 in.
Actual Thickness Used in Calculation	0.660 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.03 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.03)$$

$$= 3.2489 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.03 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.03)$$

$$= 0.1835 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3439 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	149.1862	mm.
Parallel to Vessel Wall, opening length	d	74.5931	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000	mm.

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5	Design	External	Mapnc
--------------------------	--------	----------	-------

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 135 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Area Required	Ar		1.212		1.634		NA
Area in Shell	A1		3.264		1.208		NA
Area in Nozzle Wall	A2		3.663		3.608		NA
Area in Inward Nozzle	A3		0.000		0.000		NA
Area in Welds A41+A42+A43			1.000		1.000		NA
Area in Element	A5		0.000		0.000		NA
TOTAL AREA AVAILABLE	Atot		7.927		5.816		NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 57.34 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d * tr * F + 2 * tn * tr * F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(74.5931 * 4.3799 * 1 + 2 * 10.764 * 4.3799 * 1(1 - 1.0))$$

$$= 1.634 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 * t - F * tr) - 2 * tn(E1 * t - F * tr) * (1 - fr1)$$

$$= 74.593(1.0 * 6.0 - 1.0 * 4.38) - 2 * 10.764$$

$$(1.0 * 6.0 - 1.0 * 4.3799) * (1 - 1.0)$$

$$= 1.208 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 * tlnp) (tn - trn) fr2 / \sin(\alpha3)$$

$$= (2 * 15.0) (10.76 - 0.34) 1.0 / \sin(60.0)$$

$$= 3.608 \text{ cm}^2$$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 * fr2 + (Wi - can / 0.707)^2 * fr2$$

$$= 10.0^2 * 1.0 + (0.0)^2 * 1.0$$

$$= 1.000 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.249, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.541, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	-3 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-30 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Gov. MDMT of the nozzle to shell joint welded assembly : -30 °C

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																									
شماره پیمان: 053 - 073 - 9184	<table><tr><th colspan="8">MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)</th></tr><tr><th>پروژه</th><th>بسته کاری</th><th>صادر کننده</th><th>تسهیلات</th><th>رشته</th><th>نوع مدرک</th><th>سریال</th><th>نسخه</th></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)								پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 136 از 251
MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)																										
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه																			
BK	GCS	MF	120	ME	CN	0003	V01																			

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -29 °C
 Flange MDMT with Temp reduction per UCS-66(b)(1)(-b) -104 °C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
 Design Pressure/Ambient Rating = 8.03/51.10 = 0.157

Weld Size Calculations, Description: K06 (2in)

Intermediate Calc. for nozzle/shell Welds T_{min} 6.0000 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	4.2000 = 0.7 * t _{min} .	7.0700 = 0.7 * W _o mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A - A_1 + 2 * t_n * f_{r1} * (E_1 * t - t_r)) * S_v) \\
 &= \max(0, (1.6336 - 1.2085 + 2 * 10.764 * 1.0 * (1.0 * 6.0 - 4.3799)) * 138) \\
 &= 10670.79 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A_2 + A_5 + A_4 - (W_i - C_{an} / .707)^2 * f_{r2}) * S_v \\
 &= (3.6079 + 0.0 + 1. - 0.0 * 1.0) * 138 \\
 &= 63537.97 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A_2 + A_3 + A_4 + (2 * t_n * t * f_{r1})) * S_v \\
 &= (3.6079 + 0.0 + 1. + (1.2917)) * 138 \\
 &= 81348.73 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A_2 + A_3 + A_4 + A_5 + (2 * t_n * t * f_{r1})) * S \\
 &= (3.6079 + 0.0 + 1. + 0.0 + (1.2917)) * 138 \\
 &= 81348.73 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi / 2) * D_{lo} * W_o * 0.49 * S_{nw} \\
 &= (3.1416 / 2.0) * 100.1638 * 10.0 * 0.49 * 138 \\
 &= 106305. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - C_{an}) * 0.7 * S_n \\
 &= (3.1416 * 43.6892) * (16.764 - 6.0) * 0.7 * 138 \\
 &= 142601. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 137 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$$\begin{aligned}
 &= (\pi/2) * D_{lo} * (W_{gvi} - C_{as}) * 0.74 * S_{ng} \\
 &= (3.1416/2.0) * 100.1638 * (12.0 - 6.0) * 0.74 * 138 \\
 &= 96325. \text{ N}
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 \text{PATH11} &= (\text{SONW} + \text{SNW}) = (106305 + 142601) = 248906 \text{ N} \\
 \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\
 &= (106305 + 0 + 96325 + 0) = 202631 \text{ N} \\
 \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\
 &= (106305 + 96325 + 0) = 202631 \text{ N}
 \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned}
 \text{Path 1-1} &= 248906 \text{ N}, \text{ must exceed } W = 10670 \text{ N} \quad \text{or } W1 = 63537 \text{ N} \\
 \text{Path 2-2} &= 202630 \text{ N}, \text{ must exceed } W = 10670 \text{ N} \quad \text{or } W2 = 81348 \text{ N} \\
 \text{Path 3-3} &= 202630 \text{ N}, \text{ must exceed } W = 10670 \text{ N} \quad \text{or } W3 = 81348 \text{ N}
 \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in plane parallel to the vessel axis.

Reinforcement CALCULATION, Description: K06 (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.000 in.
Actual Thickness Used in Calculation 0.660 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.03 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.03) \\
 &= 3.2489 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.03 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.03) \\
 &= 0.1835 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3439 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 125.6000 mm.
Parallel to Vessel Wall, opening length d 62.8000 mm.
Normal to Vessel Wall (Thickness Limit), no pad Tlnp 15.0000 mm.

Results of Nozzle Reinforcement Area Calculations: (cm²)

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 138 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

AREA AVAILABLE, A1 to A5	Design	External	Mapnc
Area Required Ar	2.040	1.375	NA
Area in Shell A1	1.728	1.017	NA
Area in Nozzle Wall A2	3.174	3.126	NA
Area in Inward Nozzle A3	0.000	0.000	NA
Area in Welds A41+A42+A43	1.000	1.000	NA
Area in Element A5	0.000	0.000	NA
TOTAL AREA AVAILABLE Atot	5.902	5.143	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5 (d * tr * F + 2 * tn * tr * F (1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5 (62.8 * 4.3799 * 1 + 2 * 10.764 * 4.3799 * 1 (1 - 1.0))$$

$$= 1.375 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d (E1 * t - F * tr) - 2 * tn (E1 * t - F * tr) * (1 - fr1)$$

$$= 62.8 (1.0 * 6.0 - 1.0 * 4.38) - 2 * 10.764$$

$$(1.0 * 6.0 - 1.0 * 4.3799) * (1 - 1.0)$$

$$= 1.017 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 * tlnp) (tn - trn) fr2$$

$$= (2 * 15.0) (10.76 - 0.34) 1.0$$

$$= 3.126 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 * fr2 + (Wi - can / 0.707)^2 * fr2$$

$$= 10.0^2 * 1.0 + (0.0)^2 * 1.0$$

$$= 1.000 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures	ta = 6.3439 mm.
Wall Thickness per UG16(b),	tr16b = 7.5000 mm.
Wall Thickness, shell/head, internal pressure	trb1 = 9.2489 mm.
Wall Thickness	tb1 = max(trb1, tr16b) = 9.2489 mm.
Wall Thickness, shell/head, external pressure	trb2 = 6.4171 mm.
Wall Thickness	tb2 = max(trb2, tr16b) = 7.5000 mm.
Wall Thickness per table UG-45	tb3 = 10.8000 mm.

Determine Nozzle Thickness candidate [tb]:

$$= \min[tb3, \max(tb1, tb2)]$$

$$= \min[10.8, \max(9.2489, 7.5)]$$

$$= 9.2489 \text{ mm.}$$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(ta, tb)$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 139 از 251
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه										
V01	0003	CN	ME	120	MF	GCS	BK											

$$= \max(6.3439, 9.2489)$$

$$= 9.2489 \text{ mm.}$$

Available Nozzle Neck Thickness = 16.7640 mm. --> OK

Weld Size Calculations, Description: K06 (2in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$4.2000 = 0.7 * t_{min.}$	$7.0700 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - t_r)) * S_v)$$

$$= \max(0, (1.3753 - 1.0174 + 2 * 10.764 * 1.0 * (1.0 * 6.0 - 4.3799)) * 138)$$

$$= 9744.06 \text{ N}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$= (A2 + A5 + A4 - (W_i - C_{an} / .707)^2 * f_{r2}) * S_v$$

$$= (3.126 + 0.0 + 1. - 0.0 * 1.0) * 138$$

$$= 56893.27 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (3.126 + 0.0 + 1. + (1.2917)) * 138$$

$$= 74704.02 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (3.126 + 0.0 + 1. + 0.0 + (1.2917)) * 138$$

$$= 74704.02 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi / 2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416 / 2.0) * 84.328 * 10.0 * 0.49 * 138$$

$$= 89498. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - C_{an}) * 0.7 * S_n$$

$$= (3.1416 * 36.782) * (16.764 - 6.0) * 0.7 * 138$$

$$= 120056. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi / 2) * D_{lo} * (W_{gnvi} - C_{as}) * 0.74 * S_{ng}$$

$$= (3.1416 / 2.0) * 84.328 * (12.0 - 6.0) * 0.74 * 138$$

$$= 81096. \text{ N}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 140 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Strength of Failure Paths:

$$\begin{aligned} \text{PATH11} &= (\text{SONW} + \text{SNW}) = (89498 + 120056) = 209554 \text{ N} \\ \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\ &= (89498 + 0 + 81096 + 0) = 170595 \text{ N} \\ \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\ &= (89498 + 81096 + 0) = 170595 \text{ N} \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned} \text{Path 1-1} &= 209554 \text{ N} , \text{ must exceed } W = 9744 \text{ N} \quad \text{or } W1 = 56893 \text{ N} \\ \text{Path 2-2} &= 170594 \text{ N} , \text{ must exceed } W = 9744 \text{ N} \quad \text{or } W2 = 74704 \text{ N} \\ \text{Path 3-3} &= 170594 \text{ N} , \text{ must exceed } W = 9744 \text{ N} \quad \text{or } W3 = 74704 \text{ N} \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 30.3686 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 194.6218 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 141 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: N02 (1in)

From: 30

Pressure for Reinforcement Calculations	P	8.055	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		3250.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

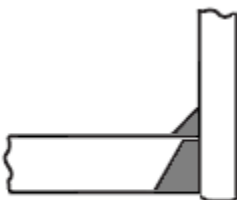
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		270.00	deg
Diameter		1.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.7000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 142 از 251
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه										
V01	0003	CN	ME	120	MF	GCS	BK											

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N02 (1in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	1.000 in.
Actual Thickness Used in Calculation	0.500 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 3.2593 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 18.7) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 0.1096 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.2564 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	74.8000 mm.
Parallel to Vessel Wall, opening length	d	37.4000 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000 mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 143 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.219	0.819	NA
Area in Shell	A1	1.025	0.606	NA
Area in Nozzle Wall	A2	1.977	1.933	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	3.642	3.179	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(37.4 \cdot 4.3799 \cdot 1 + 2 \cdot 6.7 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 0.819 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 37.4(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 6.7$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 0.606 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2$$

$$= (2 \cdot 15.0)(6.7 - 0.26)1.0$$

$$= 1.933 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.2564 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2593 \text{ mm.}$

Wall Thickness $tbl = \max(trb1, tr16b) = 9.2593 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 144 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Wall Thickness $tb2 = \max(tb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 9.4200 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$= \min[tb3, \max(tb1, tb2)]$
 $= \min[9.42, \max(9.2593, 7.5)]$
 $= 9.2593 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$= \max(ta, tb)$
 $= \max(6.2564, 9.2593)$
 $= 9.2593 \text{ mm.}$

Available Nozzle Neck Thickness = 12.7000 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.259$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio $= tr * (E^*) / (tg - c) = 0.543$, Temp. Reduction = 27 °C

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^{\circ}\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^{\circ}\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^{\circ}\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^{\circ}\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-18 \text{ }^{\circ}\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-48 \text{ }^{\circ}\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.05/19.60 = 0.411$

Weld Size Calculations, Description: N02 (1in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (0.819 - 0.6059 + 2 * 6.7 * 1.0 * (1.0 * 6.0 - 4.3799))138)$
 $= 5932.37 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 145 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Weld Load [W1]:

$$= (A2+A5+A4-(W_i-Can/.707)^2*fr2)*Sv$$

$$= (1.9331 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 35479.61 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv$$

$$= (1.9331 + 0.0 + 0.64 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*tn*t*fr1))*S$$

$$= (1.9331 + 0.0 + 0.64 + 0.0 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 50.8 * 8.0 * 0.49 * 138$$

$$= 43132. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo})/4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 22.05) * (12.7 - 6.0) * 0.7 * 138$$

$$= 44798. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gnvi}-Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 50.8 * (12.0 - 6.0) * 0.74 * 138$$

$$= 48853. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (43132 + 44798) = 87930 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (43132 + 0 + 48853 + 0) = 91985 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (43132 + 48853 + 0) = 91985 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 87929 N , must exceed W = 5932 N or W1 = 35479 N

Path 2-2 = 91985 N , must exceed W = 5932 N or W2 = 46565 N

Path 3-3 = 91985 N , must exceed W = 5932 N or W3 = 46565 N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 146 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 0.5868 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 162.5868 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 147 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Input, Nozzle Desc: N03 (1in)

From: 30

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516 70	
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		3150.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

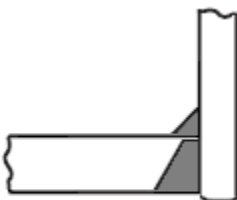
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		90.00	deg
Diameter		1.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.7000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 148 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N03 (1in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	1.000 in.
Actual Thickness Used in Calculation	0.500 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 18.7) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.1089 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.2564 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	74.8000 mm.
Parallel to Vessel Wall, opening length	d	37.4000 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000 mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 149 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.211	0.819	NA
Area in Shell	A1	1.033	0.606	NA
Area in Nozzle Wall	A2	1.977	1.933	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	3.651	3.179	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(37.4 \cdot 4.3799 \cdot 1 + 2 \cdot 6.7 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 0.819 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 37.4(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 6.7$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 0.606 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2$$

$$= (2 \cdot 15.0)(6.7 - 0.26)1.0$$

$$= 1.933 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.2564 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2370 \text{ mm.}$

Wall Thickness $tbl = \max(trb1, tr16b) = 9.2370 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 150 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Wall Thickness $tb2 = \max(tb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 9.4200 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$= \min[tb3, \max(tb1, tb2)]$
 $= \min[9.42, \max(9.237, 7.5)]$
 $= 9.2370 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$= \max(ta, tb)$
 $= \max(6.2564, 9.237)$
 $= 9.2370 \text{ mm.}$

Available Nozzle Neck Thickness = 12.7000 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.237$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = $28 \text{ }^{\circ}\text{C}$

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^{\circ}\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^{\circ}\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^{\circ}\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^{\circ}\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-18 \text{ }^{\circ}\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-48 \text{ }^{\circ}\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.00/19.60 = 0.408$

Weld Size Calculations, Description: N03 (1in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (0.819 - 0.6059 + 2 * 6.7 * 1.0 * (1.0 * 6.0 - 4.3799))138)$
 $= 5932.37 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 151 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Weld Load [W1]:

$$= (A2+A5+A4 - (W_i - Can / .707)^2 * fr2) * Sv$$

$$= (1.9331 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 35479.61 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * fr1)) * Sv$$

$$= (1.9331 + 0.0 + 0.64 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*t_n*t*fr1))*S$$

$$= (1.9331 + 0.0 + 0.64 + 0.0 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 50.8 * 8.0 * 0.49 * 138$$

$$= 43132. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 22.05) * (12.7 - 6.0) * 0.7 * 138$$

$$= 44798. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gvi} - Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 50.8 * (12.0 - 6.0) * 0.74 * 138$$

$$= 48853. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (43132 + 44798) = 87930 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (43132 + 0 + 48853 + 0) = 91985 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (43132 + 48853 + 0) = 91985 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 87929 N , must exceed W = 5932 N or W1 = 35479 N

Path 2-2 = 91985 N , must exceed W = 5932 N or W2 = 46565 N

Path 3-3 = 91985 N , must exceed W = 5932 N or W3 = 46565 N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 152 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 0.5868 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 162.5868 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 153 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Input, Nozzle Desc: N04 (1in)

From: 30

Pressure for Reinforcement Calculations	P	8.055	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		2126.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

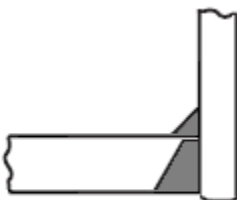
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		270.00	deg
Diameter		1.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.7000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 154 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N04 (1in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	1.000 in.
Actual Thickness Used in Calculation	0.500 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 3.2593 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 18.7) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 0.1096 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.2564 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	74.8000 mm.
Parallel to Vessel Wall, opening length	d	37.4000 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000 mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 155 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.219	0.819	NA
Area in Shell	A1	1.025	0.606	NA
Area in Nozzle Wall	A2	1.977	1.933	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	3.642	3.179	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(37.4 \cdot 4.3799 \cdot 1 + 2 \cdot 6.7 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 0.819 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 37.4(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 6.7$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 0.606 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2$$

$$= (2 \cdot 15.0)(6.7 - 0.26)1.0$$

$$= 1.933 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.2564 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2593 \text{ mm.}$

Wall Thickness $tbl = \max(trb1, tr16b) = 9.2593 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 156 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Wall Thickness $tb2 = \max(tb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 9.4200 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:
 $= \min[tb3, \max(tb1, tb2)]$
 $= \min[9.42, \max(9.2593, 7.5)]$
 $= 9.2593 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:
 $= \max(ta, tb)$
 $= \max(6.2564, 9.2593)$
 $= 9.2593 \text{ mm.}$

Available Nozzle Neck Thickness = 12.7000 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.259$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.543$, Temp. Reduction = $27 \text{ }^{\circ}\text{C}$

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^{\circ}\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^{\circ}\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^{\circ}\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^{\circ}\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-18 \text{ }^{\circ}\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-48 \text{ }^{\circ}\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
Design Pressure/Ambient Rating = $8.05/19.60 = 0.411$

Weld Size Calculations, Description: N04 (1in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min.}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:
 $= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (0.819 - 0.6059 + 2 * 6.7 * 1.0 * (1.0 * 6.0 - 4.3799))138)$
 $= 5932.37 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 157 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Weld Load [W1]:

$$= (A2+A5+A4 - (W_i - Can / .707)^2 * fr2) * Sv$$

$$= (1.9331 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 35479.61 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * fr1)) * Sv$$

$$= (1.9331 + 0.0 + 0.64 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*t_n*t*fr1))*S$$

$$= (1.9331 + 0.0 + 0.64 + 0.0 + (0.804)) * 138$$

$$= 46565.82 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 50.8 * 8.0 * 0.49 * 138$$

$$= 43132. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 22.05) * (12.7 - 6.0) * 0.7 * 138$$

$$= 44798. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gvi} - Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 50.8 * (12.0 - 6.0) * 0.74 * 138$$

$$= 48853. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (43132 + 44798) = 87930 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (43132 + 0 + 48853 + 0) = 91985 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (43132 + 48853 + 0) = 91985 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 87929 N , must exceed W = 5932 N or W1 = 35479 N

Path 2-2 = 91985 N , must exceed W = 5932 N or W2 = 46565 N

Path 3-3 = 91985 N , must exceed W = 5932 N or W3 = 46565 N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 158 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 0.5868 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 162.5868 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 159 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Input, Nozzle Desc: N05B (1.5in)

From: 30

Pressure for Reinforcement Calculations	P	8.055	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		3050.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

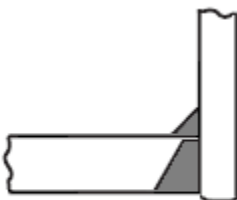
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		270.00	deg
Diameter		1.5000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	14.4500	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		150	
Flange Grade		GR 1.1	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 160 از 251
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه										
V01	0003	CN	ME	120	MF	GCS	BK											

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N05B (1.5in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	1.500 in.
Actual Thickness Used in Calculation	0.569 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 3.2593 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 25.05) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 0.1468 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3000 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	100.2000	mm.
Parallel to Vessel Wall, opening length	d	50.1000	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000	mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9)
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 161 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.633	1.097	NA
Area in Shell	A1	1.373	0.812	NA
Area in Nozzle Wall	A2	2.491	2.445	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	4.504	3.897	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(50.1 \cdot 4.3799 \cdot 1 + 2 \cdot 8.45 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 1.097 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 50.1(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 8.45$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 0.812 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2$$

$$= (2 \cdot 15.0)(8.45 - 0.3)1.0$$

$$= 2.445 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.3000 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2593 \text{ mm.}$

Wall Thickness $tbl = \max(trb1, tr16b) = 9.2593 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 162 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Wall Thickness $tb2 = \max(tb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 10.5200 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$= \min[tb3, \max(tb1, tb2)]$
 $= \min[10.52, \max(9.2593, 7.5)]$
 $= 9.2593 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$= \max(ta, tb)$
 $= \max(6.3, 9.2593)$
 $= 9.2593 \text{ mm.}$

Available Nozzle Neck Thickness = 14.4500 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.259$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.543$, Temp. Reduction = $27 \text{ }^\circ\text{C}$

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^\circ\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^\circ\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^\circ\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^\circ\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-18 \text{ }^\circ\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-48 \text{ }^\circ\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.05/19.60 = 0.411$

Weld Size Calculations, Description: N05B (1.5in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv)$
 $= \max(0, (1.0972 - 0.8117 + 2 * 8.45 * 1.0 * (1.0 * 6.0 - 4.3799))138)$
 $= 7712.23 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 163 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Weld Load [W1]:

$$= (A2+A5+A4-(W_i-Can/.707)^2*fr2)*Sv$$

$$= (2.445 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 42538.47 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv$$

$$= (2.445 + 0.0 + 0.64 + (1.014)) * 138$$

$$= 56520.34 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*tn*t*fr1))*S$$

$$= (2.445 + 0.0 + 0.64 + 0.0 + (1.014)) * 138$$

$$= 56520.34 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * Snw$$

$$= (3.1416/2.0) * 67.0 * 8.0 * 0.49 * 138$$

$$= 56886. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo})/4) * (Thk - Can) * 0.7 * Sn$$

$$= (3.1416 * 29.275) * (14.45 - 6.0) * 0.7 * 138$$

$$= 75012. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gnvi}-Cas) * 0.74 * Sng$$

$$= (3.1416/2.0) * 67.0 * (12.0 - 6.0) * 0.74 * 138$$

$$= 64433. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (56886 + 75012) = 131898 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (56886 + 0 + 64433 + 0) = 121319 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (56886 + 64433 + 0) = 121319 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 131898 N , must exceed W = 7712 N or W1 = 42538 N

Path 2-2 = 121318 N , must exceed W = 7712 N or W2 = 56520 N

Path 3-3 = 121318 N , must exceed W = 7712 N or W3 = 56520 N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 164 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 1.0212 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 163.0211 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 165 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: K3A (3in)

From: 30

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516 70	
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		2126.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

Type of Element Connected to the Shell : Nozzle

Material		SA-106 B	
Material UNS Number		K03006	
Material Specification/Type		Smls. pipe	
Allowable Stress at Temperature	Sn	117.90	N./mm ²
Allowable Stress At Ambient	Sna	117.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		0.00	deg
Diameter		3.0000	in.
Size and Thickness Basis		Minimum	
Nominal Thickness	tn	XXS	
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material		SA-516 70	
Pad Allowable Stress at Temperature	Sp	137.90	N./mm ²
Pad Allowable Stress At Ambient	Spa	137.90	N./mm ²
Diameter of Pad along vessel surface	Dp	180.0000	mm.
Thickness of Pad	te	12.0000	mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 167 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادرکننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Note: The Pad diameter is greater than the Diameter Limit. The excess will not be considered.

Weld Strength Reduction Factor [fr1]:

$$= \min(1, S_n/S_v)$$

$$= \min(1, 117.9/137.9)$$

$$= 0.855$$

Weld Strength Reduction Factor [fr2]:

$$= \min(1, S_n/S_v)$$

$$= \min(1, 117.9/137.9)$$

$$= 0.855$$

Weld Strength Reduction Factor [fr4]:

$$= \min(1, S_p/S_v)$$

$$= \min(1, 137.9/137.9)$$

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(0.855, 1.0)$$

$$= 0.855$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.472	1.672	NA
Area in Shell	A1	1.992	1.168	NA
Area in Nozzle Wall	A2	1.817	1.790	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.333	0.333	NA
Area in Element	A5	7.147	7.147	NA
TOTAL AREA AVAILABLE	Atot	11.289	10.439	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

The area available with the given pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot t_n \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(74.23 \cdot 4.3799 \cdot 1 + 2 \cdot 7.335 \cdot 4.3799 \cdot 1(1 - 0.86))$$

$$= 1.672 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot t_n(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 74.23(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 7.335$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 0.855)$$

$$= 1.168 \text{ cm}^2$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 168 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Area Available in Nozzle Wall Projecting Outward [A2]:

$$= (2 * T_{lwp}) * (t_n - t_{rn}) * fr_2$$

$$= (2 * 15.0) * (7.34 - 0.36) * 0.855$$

$$= 1.790 \text{ cm}^2$$

Area Available in Welds [A41 + A42 + A43]:

$$= (W_o^2 - A_r \text{ Lost}) * Fr_3 + ((W_i - can / 0.707)^2 - A_r \text{ Lost}) * fr_2 + W_p^2 * fr_4$$

$$= (0.39) * 0.86 + (0.0) * 0.86 + 0.0^2 * 1.0$$

$$= 0.333 \text{ cm}^2$$

Area Available in Element [A5]:

$$= (\min(D_p, DL) - (\text{Nozzle OD})) * (\min(t_p, T_{lwp}, t_e)) * fr_4$$

$$= (148.46 - 88.9) * 12.0 * 1.0$$

$$= 7.147 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures	$t_a = 6.3552 \text{ mm.}$
Wall Thickness per UG16(b),	$tr_{16b} = 7.5000 \text{ mm.}$
Wall Thickness, shell/head, internal pressure	$tr_{b1} = 9.2370 \text{ mm.}$
Wall Thickness	$tb_1 = \max(tr_{b1}, tr_{16b}) = 9.2370 \text{ mm.}$
Wall Thickness, shell/head, external pressure	$tr_{b2} = 6.4171 \text{ mm.}$
Wall Thickness	$tb_2 = \max(tr_{b2}, tr_{16b}) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45	$tb_3 = 10.8000 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$$= \min[tb_3, \max(tb_1, tb_2)]$$

$$= \min[10.8, \max(9.237, 7.5)]$$

$$= 9.2370 \text{ mm.}$$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(t_a, t_b)$$

$$= \max(6.3552, 9.237)$$

$$= 9.2370 \text{ mm.}$$

Available Nozzle Neck Thickness = 13.3350 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle Neck to Flange Weld, min(Curve:B, Curve:A)

Govrn. thk, $t_g = 13.335$, $tr = 0.253$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio = $tr * (E^*) / (t_g - c) = 0.034$, Temp. Reduction = 78 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	0 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-104 °C

Nozzle Neck to Pad Weld for the Nozzle, Curve: B

Govrn. thk, $t_g = 12.0$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio = $tr * (E^*) / (t_g - c) = 0.539$, Temp. Reduction = 28 °C
Pad governing, Conservatively assuming Pad stress = Shell stress(Div. 1 L-9.3).

Min Metal Temp. w/o impact per UCS-66, Curve B	-23 °C
--	--------

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 169 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Min Metal Temp. at Required thickness (UCS 66.1) -48 °C
Min Metal Temp. w/o impact per UG-20(f) -29 °C

Nozzle Neck to Pad Weld for Reinforcement pad, Curve: B

Govrn. thk, tg = 12.0, c = 6.0 mm., E* = 1.0
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = 28 °C
Pad governing, Conservatively assuming Pad stress = Shell stress(Div. 1 L-9.3).

Min Metal Temp. w/o impact per UCS-66, Curve B -23 °C
Min Metal Temp. at Required thickness (UCS 66.1) -48 °C
Min Metal Temp. w/o impact per UG-20(f) -29 °C

Shell to Pad Weld Junction at Pad OD, min(Curve:B, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.237, c = 6.0 mm., E* = 1.0
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve B -23 °C
Min Metal Temp. at Required thickness (UCS 66.1) -48 °C
Min Metal Temp. w/o impact per UG-20(f) -29 °C

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:B, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.237, c = 6.0 mm., E* = 1.0
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve B -23 °C
Min Metal Temp. at Required thickness (UCS 66.1) -48 °C
Min Metal Temp. w/o impact per UG-20(f) -29 °C

Gov. MDMT of the Nozzle : -48 °C
Gov. MDMT of the Reinforcement Pad : -48 °C
Gov. MDMT of the nozzle to shell joint welded assembly : -48 °C

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -18 °C
Flange MDMT with Temp reduction per UCS-66(b)(1)(-b) -48 °C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
Design Pressure/Ambient Rating = $8.00 / 19.60 = 0.408$

Weld Size Calculations, Description: K3A (3in)

Intermediate Calc. for nozzle/shell Welds Tmin 7.3350 mm.
Intermediate Calc. for pad/shell Welds TminPad 6.0000 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$5.1345 = 0.7 * t_{min}$	$5.6560 = 0.7 * W_o$ mm.
Pad Weld	$3.0000 = 0.5 * T_{minPad}$	$4.2420 = 0.7 * W_p$ mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 170 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (1.6722 - 1.1681 + 2 * 7.335 * 0.855 * \\
 &\quad (1.0 * 6.0 - 4.3799)) 138) \\
 &= 9752.59 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (1.7903 + 7.1472 + 0.3335 - 0.0 * 0.86) * 138 \\
 &= 127835.91 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (1.7903 + 0.0 + 0.5472 + (0.7526)) * 138 \\
 &= 42608.86 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A2+A3+A4+A5+(2*tn*t*fr1))*S \\
 &= (1.7903 + 0.0 + 0.3335 + 7.1472 + (0.7526)) * 138 \\
 &= 138212.98 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416/2.0) * 88.9 * 8.0 * 0.49 * 118 \\
 &= 64536. \text{ N}
 \end{aligned}$$

Shear, Pad Element Weld [Spew]:

$$\begin{aligned}
 &= (\pi/2) * DP * WP * 0.49 * SEW \\
 &= (3.1416/2.0) * 180.0 * 6.0 * 0.49 * 138 \\
 &= 114622. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 40.7825) * (13.335 - 6.0) * 0.7 * 118 \\
 &= 77556. \text{ N}
 \end{aligned}$$

Tension, Pad Groove Weld [Tpgw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wgpn * 0.74 * Seg \\
 &= (3.1416/2) * 88.9 * 12.0 * 0.74 * 138 \\
 &= 170987. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng \\
 &= (3.1416/2.0) * 88.9 * (12.0 - 6.0) * 0.74 * 138 \\
 &= 85493. \text{ N}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 171 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Strength of Failure Paths:

$$\begin{aligned} \text{PATH11} &= (\text{SPEW} + \text{SNW}) = (114622 + 77556) = 192178 \text{ N} \\ \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\ &= (64536 + 170987 + 85493 + 0) = 321016 \text{ N} \\ \text{PATH33} &= (\text{Spew} + \text{Tngw} + \text{Sinw}) \\ &= (114622 + 85493 + 0) = 200115 \text{ N} \end{aligned}$$

Summary of Failure Path Calculations:

Path 1-1 = 192177 N , must exceed W = 9752 N or W1 = 127835 N
 Path 2-2 = 321015 N , must exceed W = 9752 N or W2 = 42608 N
 Path 3-3 = 200115 N , must exceed W = 9752 N or W3 = 138212 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 1.7991 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 163.7991 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 172 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: K3B (3in)

From: 30

Pressure for Reinforcement Calculations	P	8.051	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516 70	
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Cylinder/Cone Centerline	L1	200.0000	mm.
Distance from Bottom/Left Tangent		2126.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

Type of Element Connected to the Shell : Nozzle

Material		SA-106 B	
Material UNS Number		K03006	
Material Specification/Type		Smls. pipe	
Allowable Stress at Temperature	Sn	117.90	N./mm ²
Allowable Stress At Ambient	Sna	117.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		290.85	deg
Diameter		3.0000	in.
Size and Thickness Basis		Minimum	
Nominal Thickness	tn	XXS	
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	200.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material [Normalized]		SA-516 70	
Pad Allowable Stress at Temperature	Sp	137.90	N./mm ²
Pad Allowable Stress At Ambient	Spa	137.90	N./mm ²

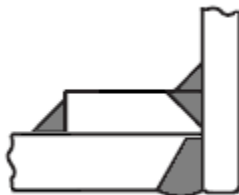
 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 173 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Diameter of Pad along vessel surface	Dp	180.0000	mm.
Thickness of Pad	te	12.0000	mm.
Weld leg size between Pad and Shell	Wp	6.0000	mm.
Groove weld depth between Pad and Nozzle	Wgpn	12.0000	mm.
Reinforcing Pad Width		45.5500	mm.

Flange Class	150
Flange Grade	GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle With Pad, no Inside projection

Note : Checking Nozzle 90 degrees to the Longitudinal axis.

Reinforcement CALCULATION, Description: K3B (3in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.450	in.
Actual Thickness Used in Calculation	0.525	in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 3.2578 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 37.11) / (118 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 0.2545 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3989 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 174 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	159.2125	mm.
Parallel to Vessel Wall, opening length	d	79.6062	mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp		15.0000	mm.

Note: The Pad diameter is greater than the Diameter Limit. The excess will not be considered.

Weld Strength Reduction Factor [fr1]:

$$= \min(1, S_n/S_v)$$

$$= \min(1, 117.9/137.9)$$

$$= 0.855$$

Weld Strength Reduction Factor [fr2]:

$$= \min(1, S_n/S_v)$$

$$= \min(1, 117.9/137.9)$$

$$= 0.855$$

Weld Strength Reduction Factor [fr4]:

$$= \min(1, S_p/S_v)$$

$$= \min(1, 137.9/137.9)$$

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(0.855, 1.0)$$

$$= 0.855$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.663	1.790	NA
Area in Shell	A1	2.125	1.255	NA
Area in Nozzle Wall	A2	1.911	1.872	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.333	0.333	NA
Area in Element	A5	7.665	7.665	NA
TOTAL AREA AVAILABLE	Atot	12.034	11.126	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 68.82 Degs.

The area available without a pad is Sufficient.

The area available with the given pad is Sufficient.

Area Required [A]:

$$= 0.5(d * tr * F + 2 * t_n * tr * F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(79.6062 * 4.3799 * 1 + 2 * 7.335 * 4.3799 * 1(1 - 0.86))$$

$$= 1.790 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 175 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 79.606(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 7.335$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 0.855)$$

$$= 1.255 \text{ cm}^2$$

Area Available in Nozzle Wall Projecting Outward [A2]:

$$= (2 \cdot Tlwp) \cdot (tn - trn) \cdot fr2 / \sin(\alpha3)$$

$$= (2 \cdot 15.0) \cdot (7.34 - 0.4) \cdot 0.855 / \sin(71.9)$$

$$= 1.872 \text{ cm}^2$$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Welds [A41 + A42 + A43]:

$$= (Wo^2 - Ar \text{ Lost}) \cdot Fr3 + (Wi - can / 0.707)^2 - Ar \text{ Lost} \cdot fr2 + Wp^2 \cdot fr4$$

$$= (0.39) \cdot 0.86 + (0.0) \cdot 0.86 + 0.0^2 \cdot 1.0$$

$$= 0.333 \text{ cm}^2$$

Area Available in Element [A5]:

$$= (\min(Dp, DL) - (Nozzle \text{ OD})) \cdot (\min(tp, Tlwp, te)) \cdot fr4$$

$$= (159.2125 - 95.3388) \cdot 12.0 \cdot 1.0$$

$$= 7.665 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle Neck to Flange Weld, min(Curve:B, Curve:A)

Govrn. thk, tg = 13.335, tr = 0.255, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.035, Temp. Reduction = 78 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	0 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-104 °C

Nozzle Neck to Pad Weld for the Nozzle, Curve: B

Govrn. thk, tg = 12.0, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.543, Temp. Reduction = 27 °C
Pad governing, Conservatively assuming Pad stress = Shell stress(Div. 1 L-9.3).

Min Metal Temp. w/o impact per UCS-66, Curve B	-23 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-48 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Nozzle Neck to Pad Weld for Reinforcement pad, Curve: D

Govrn. thk, tg = 12.0, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.543, Temp. Reduction = 27 °C
Pad governing, Conservatively assuming Pad stress = Shell stress(Div. 1 L-9.3).

Min Metal Temp. w/o impact per UCS-66, Curve D	-48 °C
--	--------

Shell to Pad Weld Junction at Pad OD, Curve: D

Govrn. thk, tg = 12.0, tr = 3.258, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.543, Temp. Reduction = 27 °C

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 176 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Min Metal Temp. w/o impact per UCS-66, Curve D -48 °C

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:B, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.258, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.543, Temp. Reduction = 27 °C

Min Metal Temp. w/o impact per UCS-66, Curve B -23 °C
Min Metal Temp. at Required thickness (UCS 66.1) -48 °C
Min Metal Temp. w/o impact per UG-20(f) -29 °C

Gov. MDMT of the Nozzle : -48 °C
Gov. MDMT of the Reinforcement Pad : -48 °C
Gov. MDMT of the nozzle to shell joint welded assembly : -48 °C

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -18 °C
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) -48 °C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
Design Pressure/Ambient Rating = 8.05/19.60 = 0.411

Weld Size Calculations, Description: K3B (3in)

Intermediate Calc. for nozzle/shell Welds Tmin 7.3350 mm.
Intermediate Calc. for pad/shell Welds TminPad 6.0000 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	5.1345 = 0.7 * tmin.	5.6560 = 0.7 * Wo mm.
Pad Weld	3.0000 = 0.5 * TminPad	4.2420 = 0.7 * Wp mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (1.7899 - 1.2552 + 2 * 7.335 * 0.855 * \\
 &\quad (1.0 * 6.0 - 4.3799)) 138) \\
 &= 10175.07 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (1.8721 + 7.6648 + 0.3335 - 0.0 * 0.86) * 138 \\
 &= 136100.61 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (1.8721 + 0.0 + 0.5472 + (0.7526)) * 138 \\
 &= 43735.78 \text{ N}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 177 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*tn*t*fr1))*S$$

$$= (1.8721 + 0.0 + 0.3335 + 7.6648 + (0.7526)) * 138$$

$$= 146477.67 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 95.3388 * 8.0 * 0.49 * 118$$

$$= 69210. \text{ N}$$

Shear, Pad Element Weld [Spew]:

$$= (\pi/2) * D_P * W_P * 0.49 * S_{EW}$$

$$= (3.1416/2.0) * 180.0 * 6.0 * 0.49 * 138$$

$$= 114622. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 43.7363) * (13.335 - 6.0) * 0.7 * 118$$

$$= 83173. \text{ N}$$

Tension, Pad Groove Weld [Tpgw]:

$$= (\pi/2) * D_{lo} * W_{gpn} * 0.74 * S_{eg}$$

$$= (3.1416/2) * 95.3388 * 12.0 * 0.74 * 138$$

$$= 183371. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gvi}-Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 95.3388 * (12.0 - 6.0) * 0.74 * 138$$

$$= 91685. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SPEW + SNW) = (114622 + 83173) = 197795 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (69210 + 183371 + 91685 + 0) = 344266 \text{ N}$$

$$PATH33 = (Spew + Tngw + Sinw)$$

$$= (114622 + 91685 + 0) = 206307 \text{ N}$$

Summary of Failure Path Calculations:

$$\text{Path 1-1} = 197794 \text{ N} , \text{ must exceed } W = 10175 \text{ N} \quad \text{or } W1 = 136100 \text{ N}$$

$$\text{Path 2-2} = 344265 \text{ N} , \text{ must exceed } W = 10175 \text{ N} \quad \text{or } W2 = 43735 \text{ N}$$

$$\text{Path 3-3} = 206307 \text{ N} , \text{ must exceed } W = 10175 \text{ N} \quad \text{or } W3 = 146477 \text{ N}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in plane parallel to the vessel axis.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 178 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Reinforcement CALCULATION, Description: K3B (3in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.450 in.
Actual Thickness Used in Calculation 0.525 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05)$$

$$= 3.2578 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.05 \cdot 37.11) / (118 \cdot 1.0 - 0.6 \cdot 8.05)$$

$$= 0.2545 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3989 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 148.4600 mm.
Parallel to Vessel Wall, opening length d 74.2300 mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp 15.0000 mm.

Note: The Pad diameter is greater than the Diameter Limit. The excess will not be considered.

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.488	1.672	NA
Area in Shell	A1	1.977	1.168	NA
Area in Nozzle Wall	A2	1.816	1.779	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.333	0.333	NA
Area in Element	A5	7.147	7.147	NA
TOTAL AREA AVAILABLE	Atot	11.274	10.428	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

The area available with the given pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F (1 - fr1)) \text{ per UG-37 (d)}$$

$$= 0.5 (74.23 \cdot 4.3799 \cdot 1 + 2 \cdot 7.335 \cdot 4.3799 \cdot 1 (1 - 0.86))$$

$$= 1.672 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)	 							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 179 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot t_r) - 2 \cdot t_n (E1 \cdot t - F \cdot t_r) \cdot (1 - f_{r1})$$

$$= 74.23 (1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 7.335$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 0.855)$$

$$= 1.168 \text{ cm}^2$$

Area Available in Nozzle Wall Projecting Outward [A2]:

$$= (2 \cdot T_{lwp}) \cdot (t_n - t_{rn}) \cdot f_{r2}$$

$$= (2 \cdot 15.0) \cdot (7.34 - 0.4) \cdot 0.855$$

$$= 1.779 \text{ cm}^2$$

Area Available in Welds [A41 + A42 + A43]:

$$= (W_o^2 - A_r \text{ Lost}) \cdot F_{r3} + ((W_i - c_{an}/0.707)^2 - A_r \text{ Lost}) \cdot f_{r2} + W_p^2 \cdot f_{r4}$$

$$= (0.39) \cdot 0.86 + (0.0) \cdot 0.86 + 0.0^2 \cdot 1.0$$

$$= 0.333 \text{ cm}^2$$

Area Available in Element [A5]:

$$= (\min(D_p, D_L) - (\text{Nozzle OD})) \cdot (\min(t_p, T_{lwp}, t_e)) \cdot f_{r4}$$

$$= (148.46 - 88.9) \cdot 12.0 \cdot 1.0$$

$$= 7.147 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $t_a = 6.3989 \text{ mm.}$

Wall Thickness per UG16(b), $t_{r16b} = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $t_{rb1} = 9.2578 \text{ mm.}$

Wall Thickness $t_{b1} = \max(t_{rb1}, t_{r16b}) = 9.2578 \text{ mm.}$

Wall Thickness, shell/head, external pressure $t_{rb2} = 6.4171 \text{ mm.}$

Wall Thickness $t_{b2} = \max(t_{rb2}, t_{r16b}) = 7.5000 \text{ mm.}$

Wall Thickness per table UG-45 $t_{b3} = 10.8000 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$$= \min[t_{b3}, \max(t_{b1}, t_{b2})]$$

$$= \min[10.8, \max(9.2578, 7.5)]$$

$$= 9.2578 \text{ mm.}$$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(t_a, t_b)$$

$$= \max(6.3989, 9.2578)$$

$$= 9.2578 \text{ mm.}$$

Available Nozzle Neck Thickness = 13.3350 mm. --> OK

Weld Size Calculations, Description: K3B (3in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 7.3350 \text{ mm.}$

Intermediate Calc. for pad/shell Welds $T_{minPad} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$5.1345 = 0.7 \cdot t_{min.}$	$5.6560 = 0.7 \cdot W_o \text{ mm.}$
Pad Weld	$3.0000 = 0.5 \cdot T_{minPad}$	$4.2420 = 0.7 \cdot W_p \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 180 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (1.6722 - 1.1681 + 2 * 7.335 * 0.855 * \\
 &\quad (1.0 * 6.0 - 4.3799))138) \\
 &= 9752.59 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (1.7791 + 7.1472 + 0.3335 - 0.0 * 0.86) * 138 \\
 &= 127681.20 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (1.7791 + 0.0 + 0.5472 + (0.7526)) * 138 \\
 &= 42454.14 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A2+A3+A4+A5+(2*tn*t*fr1))*S \\
 &= (1.7791 + 0.0 + 0.3335 + 7.1472 + (0.7526)) * 138 \\
 &= 138058.28 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416/2.0) * 88.9 * 8.0 * 0.49 * 118 \\
 &= 64536. \text{ N}
 \end{aligned}$$

Shear, Pad Element Weld [Spew]:

$$\begin{aligned}
 &= (\pi/2) * DP * WP * 0.49 * SEW \\
 &= (3.1416/2.0) * 180.0 * 6.0 * 0.49 * 138 \\
 &= 114622. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 40.7825) * (13.335 - 6.0) * 0.7 * 118 \\
 &= 77556. \text{ N}
 \end{aligned}$$

Tension, Pad Groove Weld [Tpgw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wgp * 0.74 * Seg \\
 &= (3.1416/2) * 88.9 * 12.0 * 0.74 * 138 \\
 &= 170987. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * (Wgnv-Cas) * 0.74 * Sng \\
 &= (3.1416/2.0) * 88.9 * (12.0 - 6.0) * 0.74 * 138 \\
 &= 85493. \text{ N}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 181 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Strength of Failure Paths:

$$\begin{aligned} \text{PATH11} &= (\text{SPEW} + \text{SNW}) = (114622 + 77556) = 192178 \text{ N} \\ \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\ &= (64536 + 170987 + 85493 + 0) = 321016 \text{ N} \\ \text{PATH33} &= (\text{Spew} + \text{Tngw} + \text{Sinw}) \\ &= (114622 + 85493 + 0) = 200115 \text{ N} \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned} \text{Path 1-1} &= 192177 \text{ N} , \text{ must exceed } W = 9752 \text{ N} \quad \text{or } W1 = 127681 \text{ N} \\ \text{Path 2-2} &= 321015 \text{ N} , \text{ must exceed } W = 9752 \text{ N} \quad \text{or } W2 = 42454 \text{ N} \\ \text{Path 3-3} &= 200115 \text{ N} , \text{ must exceed } W = 9752 \text{ N} \quad \text{or } W3 = 138058 \text{ N} \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 19.6568 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 232.5178 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 182 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Input, Nozzle Desc: K05 (2in)

From: 30

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		1850.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

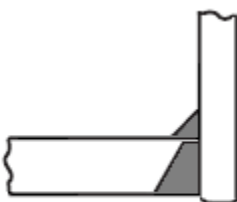
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		90.00	deg
Diameter		2.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	16.7640	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		300	
Flange Grade		GR 1.1	
Flange Series	Series	@	

The Pressure Design option was Design Pressure + static head.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 183 از 251
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه										
V01	0003	CN	ME	120	MF	GCS	BK											

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: K05 (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.000 in.
Actual Thickness Used in Calculation	0.660 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.1828 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3439 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	125.6000 mm.
Parallel to Vessel Wall, opening length	d	62.8000 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000 mm.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n / S_v) \\
 &= \min(1, 137.9 / 137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$= \min(1, S_n / S_v)$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)							
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 184 از 251
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	
	BK	GCS	MF	120	ME	CN	0003	
							V01	

$$= \min(1, 137.9/137.9)$$

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(1.0, 1.0)$$

$$= 1.000$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.033	1.375	NA
Area in Shell	A1	1.735	1.017	NA
Area in Nozzle Wall	A2	3.174	3.126	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds	A41+A42+A43	0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	5.550	4.783	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(62.8 \cdot 4.3799 \cdot 1 + 2 \cdot 10.764 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 1.375 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 62.8(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.764$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.017 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2$$

$$= (2 \cdot 15.0)(10.76 - 0.34)1.0$$

$$= 3.126 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.3439 \text{ mm.}$
 Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$
 Wall Thickness, shell/head, internal pressure $trb1 = 9.2370 \text{ mm.}$
 Wall Thickness $tb1 = \max(trb1, tr16b) = 9.2370 \text{ mm.}$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 185 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$
Wall Thickness $tb2 = \max(trb2, tr16b) = 7.5000 \text{ mm.}$
Wall Thickness per table UG-45 $tb3 = 10.8000 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$= \min[tb3, \max(tb1, tb2)]$
 $= \min[10.8, \max(9.237, 7.5)]$
 $= 9.2370 \text{ mm.}$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$= \max(ta, tb)$
 $= \max(6.3439, 9.237)$
 $= 9.2370 \text{ mm.}$

Available Nozzle Neck Thickness = 16.7640 mm. --> OK

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, $tg = 12.0$, $tr = 3.237$, $c = 6.0 \text{ mm.}$, $E^* = 1.0$
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = $28 \text{ }^\circ\text{C}$

Min Metal Temp. w/o impact per UCS-66, Curve A $-3 \text{ }^\circ\text{C}$
Min Metal Temp. at Required thickness (UCS 66.1) $-30 \text{ }^\circ\text{C}$
Min Metal Temp. w/o impact per UG-20(f) $-29 \text{ }^\circ\text{C}$

Gov. MDMT of the nozzle to shell joint welded assembly : $-30 \text{ }^\circ\text{C}$

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) $-18 \text{ }^\circ\text{C}$
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) $-104 \text{ }^\circ\text{C}$

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.00/51.10 = 0.157$

Weld Size Calculations, Description: K05 (2in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
Nozzle Weld $4.2000 = 0.7 * t_{min}$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - tr)) S_v)$
 $= \max(0, (1.3753 - 1.0174 + 2 * 10.764 * 1.0 * (1.0 * 6.0 - 4.3799)) 138)$
 $= 9744.06 \text{ N}$

Note: F is always set to 1.0 throughout the calculation.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 186 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Weld Load [W1]:

$$= (A2+A5+A4 - (W_i - Can / .707)^2 * fr2) * Sv$$

$$= (3.126 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 51929.30 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * fr1)) * Sv$$

$$= (3.126 + 0.0 + 0.64 + (1.2917)) * 138$$

$$= 69740.05 \text{ N}$$

Weld Load [W3]:

$$= (A2+A3+A4+A5 + (2 * t_n * t * fr1)) * S$$

$$= (3.126 + 0.0 + 0.64 + 0.0 + (1.2917)) * 138$$

$$= 69740.05 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 84.328 * 8.0 * 0.49 * 138$$

$$= 71599. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 36.782) * (16.764 - 6.0) * 0.7 * 138$$

$$= 120056. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (pi/2) * D_{lo} * (W_{gvi} - Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 84.328 * (12.0 - 6.0) * 0.74 * 138$$

$$= 81096. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (71599 + 120056) = 191655 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (71599 + 0 + 81096 + 0) = 152695 \text{ N}$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (71599 + 81096 + 0) = 152695 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 191654 N , must exceed W = 9744 N or W1 = 51929 N

Path 2-2 = 152695 N , must exceed W = 9744 N or W2 = 69740 N

Path 3-3 = 152695 N , must exceed W = 9744 N or W3 = 69740 N

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 187 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 1.6186 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 163.6185 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 188 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: K4B (2in)

From: 30

Pressure for Reinforcement Calculations	P	8.046	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Cylinder/Cone Centerline	L1	470.0000	mm.
Distance from Bottom/Left Tangent		2400.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

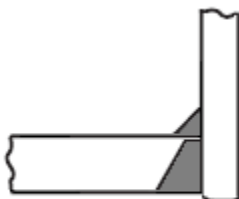
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		-56.75	deg
Diameter		2.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	16.6000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	350.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		300	
Flange Grade		GR 1.1	

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 189 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Note : Checking Nozzle 90 degrees to the Longitudinal axis.

Reinforcement CALCULATION, Description: K4B (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.000 in.
Actual Thickness Used in Calculation	0.654 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 3.2557 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.05 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.05) \\
 &= 0.1839 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.4877 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	236.5397	mm.
Parallel to Vessel Wall, opening length	d	118.2699	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000	mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 190 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.925	2.590	NA
Area in Shell	A1	5.171	1.916	NA
Area in Nozzle Wall	A2	5.229	5.076	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	11.040	7.632	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 32.07 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(118.2699 \cdot 4.3799 \cdot 1 + 2 \cdot 10.6 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 2.590 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 118.27(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.6(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.916 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2/\sin(\alpha3)$$

$$= (2 \cdot 15.0)(10.6 - 0.49)1.0/\sin(36.7)$$

$$= 5.076 \text{ cm}^2$$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.256, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.543, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	-3 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-30 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 191 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Gov. MDMT of the nozzle to shell joint welded assembly : -30 °C

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -18 °C
 Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) -104 °C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = 8.05/51.10 = 0.157

Weld Size Calculations, Description: K4B (2in)

Intermediate Calc. for nozzle/shell Welds Tmin 6.0000 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	4.2000 = 0.7 * tmin.	5.6560 = 0.7 * Wo mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (2.5901 - 1.9161 + 2 * 10.6 * 1.0 * \\
 &\quad (1.0 * 6.0 - 4.3799)) 138) \\
 &= 14029.72 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (5.0763 + 0.0 + 0.64 - 0.0 * 1.0) * 138 \\
 &= 78820.64 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (5.0763 + 0.0 + 0.64 + (1.272)) * 138 \\
 &= 96360.04 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A2+A3+A4+A5+(2*tn*t*fr1))*S \\
 &= (5.0763 + 0.0 + 0.64 + 0.0 + (1.272)) * 138 \\
 &= 96360.04 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416/2.0) * 158.1954 * 8.0 * 0.49 * 138 \\
 &= 134316. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 69.1163) * (16.6 - 6.0) * 0.7 * 138 \\
 &= 222158. \text{ N}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 192 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gwnvi} - C_{as}) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 158.1954 * (12.0 - 6.0) * 0.74 * 138$$

$$= 152133. \text{ N}$$

Strength of Failure Paths:

$$\text{PATH11} = (\text{SONW} + \text{SNW}) = (134316 + 222158) = 356474 \text{ N}$$

$$\text{PATH22} = (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw})$$

$$= (134316 + 0 + 152133 + 0) = 286449 \text{ N}$$

$$\text{PATH33} = (\text{Sonw} + \text{Tngw} + \text{Sinw})$$

$$= (134316 + 152133 + 0) = 286449 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 356473 N , must exceed W = 14029 N or W1 = 78820 N

Path 2-2 = 286448 N , must exceed W = 14029 N or W2 = 96360 N

Path 3-3 = 286448 N , must exceed W = 14029 N or W3 = 96360 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in plane parallel to the vessel axis.

Reinforcement CALCULATION, Description: K4B (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.000 in.

Actual Thickness Used in Calculation 0.654 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05)$$

$$= 3.2557 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.05 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.05)$$

$$= 0.1839 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.4877 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 125.6000 mm.

Parallel to Vessel Wall, opening length d 62.8000 mm.

Normal to Vessel Wall (Thickness Limit), no pad Tlnp 15.0000 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 193 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5	Design	External	Mapnc
Area Required Ar	2.045	1.375	NA
Area in Shell A1	1.723	1.017	NA
Area in Nozzle Wall A2	3.125	3.034	NA
Area in Inward Nozzle A3	0.000	0.000	NA
Area in Welds A41+A42+A43	0.640	0.640	NA
Area in Element A5	0.000	0.000	NA
TOTAL AREA AVAILABLE Atot	5.488	4.691	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F (1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5 (62.8 \cdot 4.3799 \cdot 1 + 2 \cdot 10.6 \cdot 4.3799 \cdot 1 (1 - 1.0))$$

$$= 1.375 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot tr) - 2 \cdot tn (E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 62.8 (1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.6 (1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.017 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp) (tn - trn) fr2$$

$$= (2 \cdot 15.0) (10.6 - 0.49) 1.0$$

$$= 3.034 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can / 0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures	ta = 6.4877 mm.
Wall Thickness per UG16(b),	tr16b = 7.5000 mm.
Wall Thickness, shell/head, internal pressure	trb1 = 9.2557 mm.
Wall Thickness	tb1 = max(trb1, tr16b) = 9.2557 mm.
Wall Thickness, shell/head, external pressure	trb2 = 6.4171 mm.
Wall Thickness	tb2 = max(trb2, tr16b) = 7.5000 mm.
Wall Thickness per table UG-45	tb3 = 10.8000 mm.

Determine Nozzle Thickness candidate [tb]:

$$= \min [tb3, \max (tb1, tb2)]$$

$$= \min [10.8, \max (9.2557, 7.5)]$$

$$= 9.2557 \text{ mm.}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 194 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(t_a, t_b)$$

$$= \max(6.4877, 9.2557)$$

$$= 9.2557 \text{ mm.}$$

Available Nozzle Neck Thickness = 16.6000 mm. --> OK

Weld Size Calculations, Description: K4B (2in)

Intermediate Calc. for nozzle/shell Welds T_{min} 6.0000 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$4.2000 = 0.7 * t_{min}$	$5.6560 = 0.7 * W_o$ mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - t_r)) S_v)$$

$$= \max(0, (1.3753 - 1.0174 + 2 * 10.6 * 1.0 * (1.0 * 6.0 - 4.3799)) 138)$$

$$= 9670.79 \text{ N}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$= (A2 + A5 + A4 - (W_i - Can / .707)^2 * f_{r2}) * S_v$$

$$= (3.0337 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 50655.74 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (3.0337 + 0.0 + 0.64 + (1.272)) * 138$$

$$= 68195.13 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (3.0337 + 0.0 + 0.64 + 0.0 + (1.272)) * 138$$

$$= 68195.13 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi / 2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416 / 2.0) * 84.0 * 8.0 * 0.49 * 138$$

$$= 71320. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 36.7) * (16.6 - 6.0) * 0.7 * 138$$

$$= 117963. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 195 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$\begin{aligned}
 &= (\pi/2) * D_{lo} * (W_{gvi-Cas}) * 0.74 * S_{ng} \\
 &= (3.1416/2.0) * 84.0 * (12.0 - 6.0) * 0.74 * 138 \\
 &= 80781. N
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 PATH11 &= (SONW + SNW) = (71320 + 117963) = 189284 \text{ N} \\
 PATH22 &= (Sonw + Tpgw + Tngw + Sinw) \\
 &= (71320 + 0 + 80781 + 0) = 152101 \text{ N} \\
 PATH33 &= (Sonw + Tngw + Sinw) \\
 &= (71320 + 80781 + 0) = 152101 \text{ N}
 \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned}
 \text{Path 1-1} &= 189283 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W1 = 50655 \text{ N} \\
 \text{Path 2-2} &= 152101 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W2 = 68195 \text{ N} \\
 \text{Path 3-3} &= 152101 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W3 = 68195 \text{ N}
 \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 84.7691 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 457.2418 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 196 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Input, Nozzle Desc: K4A (2in)

From: 30

Pressure for Reinforcement Calculations	P	8.011	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Cylinder/Cone Centerline	L1	114.0000	mm.
Distance from Bottom/Left Tangent		2400.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

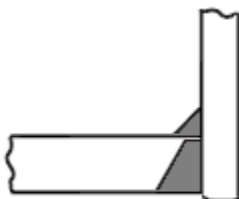
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		-11.70	deg
Diameter		2.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	16.6000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		300	
Flange Grade		GR 1.1	

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 197 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Note : Checking Nozzle 90 degrees to the Longitudinal axis.

Reinforcement CALCULATION, Description: K4A (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.000 in.
Actual Thickness Used in Calculation	0.654 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.01 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.01) \\
 &= 3.2415 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.01 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.01) \\
 &= 0.1831 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3430 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	128.3842	mm.
Parallel to Vessel Wall, opening length	d	64.1921	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000	mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 198 از 251
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه										
V01	0003	CN	ME	120	MF	GCS	BK											

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	1.040	1.406	NA
Area in Shell	A1	2.811	1.040	NA
Area in Nozzle Wall	A2	3.170	3.122	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	6.621	4.802	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 78.05 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5 (64.1921 \cdot 4.3799 \cdot 1 + 2 \cdot 10.6 \cdot 4.3799 \cdot 1 (1 - 1.0))$$

$$= 1.406 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot tr) - 2 \cdot tn (E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 64.192 (1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.6$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.040 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp) (tn - trn) fr2 / \sin(\alpha3)$$

$$= (2 \cdot 15.0) (10.6 - 0.34) 1.0 / \sin(80.3)$$

$$= 3.122 \text{ cm}^2$$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can / 0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.242, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.54, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	-3 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-30 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 199 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Gov. MDMT of the nozzle to shell joint welded assembly : -30°C

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -18°C
 Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) -104°C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.01/51.10 = 0.157$

Weld Size Calculations, Description: K4A (2in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

Required Thickness Actual Thickness
 Nozzle Weld $4.2000 = 0.7 * t_{min}.$ $5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - t_r)) * S_v)$$

$$= \max(0, (1.4058 - 1.04 + 2 * 10.6 * 1.0 * (1.0 * 6.0 - 4.3799)) * 138)$$

$$= 9780.18 \text{ N}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$= (A2 + A5 + A4 - (W_i - Can / .707)^2 * f_{r2}) * S_v$$

$$= (3.1216 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 51868.46 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (3.1216 + 0.0 + 0.64 + (1.272)) * 138$$

$$= 69407.84 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (3.1216 + 0.0 + 0.64 + 0.0 + (1.272)) * 138$$

$$= 69407.84 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi / 2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416 / 2.0) * 85.8621 * 8.0 * 0.49 * 138$$

$$= 72901. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 37.5135) * (16.6 - 6.0) * 0.7 * 138$$

$$= 120578. \text{ N}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 200 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gwnvi} - C_{as}) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 85.8621 * (12.0 - 6.0) * 0.74 * 138$$

$$= 82572. N$$

Strength of Failure Paths:

$$PATH11 = (SONW + SNW) = (72901 + 120578) = 193480 N$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (72901 + 0 + 82572 + 0) = 155473 N$$

$$PATH33 = (Sonw + Tngw + Sinw)$$

$$= (72901 + 82572 + 0) = 155473 N$$

Summary of Failure Path Calculations:

Path 1-1 = 193479 N , must exceed W = 9780 N or W1 = 51868 N

Path 2-2 = 155472 N , must exceed W = 9780 N or W2 = 69407 N

Path 3-3 = 155472 N , must exceed W = 9780 N or W3 = 69407 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in plane parallel to the vessel axis.

Reinforcement CALCULATION, Description: K4A (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.000 in.

Actual Thickness Used in Calculation 0.654 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.01 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.01)$$

$$= 3.2415 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.01 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.01)$$

$$= 0.1831 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3430 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 125.6000 mm.

Parallel to Vessel Wall, opening length d 62.8000 mm.

Normal to Vessel Wall (Thickness Limit), no pad Tlnp 15.0000 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 201 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.036	1.375	NA
Area in Shell	A1	1.732	1.017	NA
Area in Nozzle Wall	A2	3.125	3.077	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.640	0.640	NA
Area in Element	A5	0.000	0.000	NA
TOTAL AREA AVAILABLE	Atot	5.497	4.734	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5(d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(62.8 \cdot 4.3799 \cdot 1 + 2 \cdot 10.6 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 1.375 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 62.8(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.6(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.017 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp)(tn - trn)fr2$$

$$= (2 \cdot 15.0)(10.6 - 0.34)1.0$$

$$= 3.077 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can/0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures	ta = 6.3430 mm.
Wall Thickness per UG16(b),	tr16b = 7.5000 mm.
Wall Thickness, shell/head, internal pressure	trb1 = 9.2415 mm.
Wall Thickness	tb1 = max(trb1, tr16b) = 9.2415 mm.
Wall Thickness, shell/head, external pressure	trb2 = 6.4171 mm.
Wall Thickness	tb2 = max(trb2, tr16b) = 7.5000 mm.
Wall Thickness per table UG-45	tb3 = 10.8000 mm.

Determine Nozzle Thickness candidate [tb]:

$$= \min[tb3, \max(tb1, tb2)]$$

$$= \min[10.8, \max(9.2415, 7.5)]$$

$$= 9.2415 \text{ mm.}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 202 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(t_a, t_b)$$

$$= \max(6.343, 9.2415)$$

$$= 9.2415 \text{ mm.}$$

Available Nozzle Neck Thickness = 16.6000 mm. --> OK

Weld Size Calculations, Description: K4A (2in)

Intermediate Calc. for nozzle/shell Welds T_{min} 6.0000 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$4.2000 = 0.7 * t_{min}.$	$5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - t_r)) S_v)$$

$$= \max(0, (1.3753 - 1.0174 + 2 * 10.6 * 1.0 * (1.0 * 6.0 - 4.3799)) 138)$$

$$= 9670.79 \text{ N}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$= (A2 + A5 + A4 - (W_i - Can / .707)^2 * f_{r2}) * S_v$$

$$= (3.0771 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 51254.27 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (3.0771 + 0.0 + 0.64 + (1.272)) * 138$$

$$= 68793.66 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (3.0771 + 0.0 + 0.64 + 0.0 + (1.272)) * 138$$

$$= 68793.66 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi / 2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416 / 2.0) * 84.0 * 8.0 * 0.49 * 138$$

$$= 71320. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 36.7) * (16.6 - 6.0) * 0.7 * 138$$

$$= 117963. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 203 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$\begin{aligned}
 &= (\pi/2) * D_{lo} * (W_{gvi} - C_{as}) * 0.74 * S_{ng} \\
 &= (3.1416/2.0) * 84.0 * (12.0 - 6.0) * 0.74 * 138 \\
 &= 80781. N
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 PATH11 &= (SONW + SNW) = (71320 + 117963) = 189284 \text{ N} \\
 PATH22 &= (Sonw + Tpgw + Tngw + Sinw) \\
 &= (71320 + 0 + 80781 + 0) = 152101 \text{ N} \\
 PATH33 &= (Sonw + Tngw + Sinw) \\
 &= (71320 + 80781 + 0) = 152101 \text{ N}
 \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned}
 \text{Path 1-1} &= 189283 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W1 = 51254 \text{ N} \\
 \text{Path 2-2} &= 152101 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W2 = 68793 \text{ N} \\
 \text{Path 3-3} &= 152101 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W3 = 68793 \text{ N}
 \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 10.6432 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 172.9037 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 204 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: K2B (2in)

From: 30

Pressure for Reinforcement Calculations	P	8.027	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Cylinder/Cone Centerline	L1	280.0000	mm.
Distance from Bottom/Left Tangent		2650.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

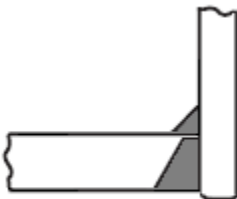
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		-29.88	deg
Diameter		2.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	16.6000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	200.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		300	
Flange Grade		GR 1.1	

	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 205 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Note : Checking Nozzle 90 degrees to the Longitudinal axis.

Reinforcement CALCULATION, Description: K2B (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.000 in.
Actual Thickness Used in Calculation	0.654 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.03 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.03) \\
 &= 3.2481 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.03 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.03) \\
 &= 0.1834 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3862 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	145.3943 mm.
Parallel to Vessel Wall, opening length	d	72.6972 mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000 mm.

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5	Design	External	Mapnc

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 206 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Area Required	Ar		1.181		1.592		NA
Area in Shell	A1		3.181		1.178		NA
Area in Nozzle Wall	A2		3.527		3.458		NA
Area in Inward Nozzle	A3		0.000		0.000		NA
Area in Welds	A41+A42+A43		0.640		0.640		NA
Area in Element	A5		0.000		0.000		NA
TOTAL AREA AVAILABLE	Atot		7.348		5.276		NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 59.75 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F (1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5 (72.6972 \cdot 4.3799 \cdot 1 + 2 \cdot 10.6 \cdot 4.3799 \cdot 1 (1 - 1.0))$$

$$= 1.592 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot tr) - 2 \cdot tn (E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 72.697 (1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.6$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.178 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp) (tn - trn) fr2 / \sin(\alpha3)$$

$$= (2 \cdot 15.0) (10.6 - 0.39) 1.0 / \sin(62.4)$$

$$= 3.458 \text{ cm}^2$$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can / 0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.248, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.541, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	-3 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-30 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Gov. MDMT of the nozzle to shell joint welded assembly : -30 °C

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 207 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -18 °C
 Flange MDMT with Temp reduction per UCS-66(b)(1)(-b) -104 °C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
 Design Pressure/Ambient Rating = 8.03/51.10 = 0.157

Weld Size Calculations, Description: K2B (2in)

Intermediate Calc. for nozzle/shell Welds Tmin 6.0000 mm.

Results Per UW-16.1:

Required Thickness Actual Thickness
 Nozzle Weld 4.2000 = 0.7 * tmin. 5.6560 = 0.7 * Wo mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (1.592 - 1.1777 + 2 * 10.6 * 1.0 * \\
 &\quad (1.0 * 6.0 - 4.3799)) 138) \\
 &= 10448.53 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (3.4584 + 0.0 + 0.64 - 0.0 * 1.0) * 138 \\
 &= 56512.66 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (3.4584 + 0.0 + 0.64 + (1.272)) * 138 \\
 &= 74052.05 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A2+A3+A4+A5+(2*tn*t*fr1))*S \\
 &= (3.4584 + 0.0 + 0.64 + 0.0 + (1.272)) * 138 \\
 &= 74052.05 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416/2.0) * 97.2382 * 8.0 * 0.49 * 138 \\
 &= 82560. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 42.4838) * (16.6 - 6.0) * 0.7 * 138 \\
 &= 136554. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 208 از 251
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه										
BK	GCS	MF	120	ME	CN	0003	V01											

$$= (\pi/2) * D_{lo} * (W_{gvi} - C_{as}) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 97.2382 * (12.0 - 6.0) * 0.74 * 138$$

$$= 93512. \text{ N}$$

Strength of Failure Paths:

$$\text{PATH11} = (\text{SONW} + \text{SNW}) = (82560 + 136554) = 219114 \text{ N}$$

$$\text{PATH22} = (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw})$$

$$= (82560 + 0 + 93512 + 0) = 176072 \text{ N}$$

$$\text{PATH33} = (\text{Sonw} + \text{Tngw} + \text{Sinw})$$

$$= (82560 + 93512 + 0) = 176072 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 219114 N , must exceed W = 10448 N or W1 = 56512 N

Path 2-2 = 176072 N , must exceed W = 10448 N or W2 = 74052 N

Path 3-3 = 176072 N , must exceed W = 10448 N or W3 = 74052 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in plane parallel to the vessel axis.

Reinforcement CALCULATION, Description: K2B (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.000 in.

Actual Thickness Used in Calculation 0.654 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.03 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.03)$$

$$= 3.2481 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.03 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.03)$$

$$= 0.1834 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3862 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 125.6000 mm.

Parallel to Vessel Wall, opening length d 62.8000 mm.

Normal to Vessel Wall (Thickness Limit), no pad Tlnp 15.0000 mm.

Results of Nozzle Reinforcement Area Calculations: (cm²)

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 209 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

AREA AVAILABLE, A1 to A5	Design	External	Mapnc
Area Required Ar	2.040	1.375	NA
Area in Shell A1	1.728	1.017	NA
Area in Nozzle Wall A2	3.125	3.064	NA
Area in Inward Nozzle A3	0.000	0.000	NA
Area in Welds A41+A42+A43	0.640	0.640	NA
Area in Element A5	0.000	0.000	NA
TOTAL AREA AVAILABLE Atot	5.493	4.722	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5 (62.8 \cdot 4.3799 \cdot 1 + 2 \cdot 10.6 \cdot 4.3799 \cdot 1(1 - 1.0))$$

$$= 1.375 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot tr) - 2 \cdot tn (E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 62.8 (1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.6 (1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.017 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp) (tn - trn) fr2$$

$$= (2 \cdot 15.0) (10.6 - 0.39) 1.0$$

$$= 3.064 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can / 0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures	ta = 6.3862 mm.
Wall Thickness per UG16(b),	tr16b = 7.5000 mm.
Wall Thickness, shell/head, internal pressure	trb1 = 9.2481 mm.
Wall Thickness	tb1 = max(trb1, tr16b) = 9.2481 mm.
Wall Thickness, shell/head, external pressure	trb2 = 6.4171 mm.
Wall Thickness	tb2 = max(trb2, tr16b) = 7.5000 mm.
Wall Thickness per table UG-45	tb3 = 10.8000 mm.

Determine Nozzle Thickness candidate [tb]:

$$= \min[tb3, \max(tb1, tb2)]$$

$$= \min[10.8, \max(9.2481, 7.5)]$$

$$= 9.2481 \text{ mm.}$$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(ta, tb)$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 210 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

$$= \max(6.3862, 9.2481)$$

$$= 9.2481 \text{ mm.}$$

Available Nozzle Neck Thickness = 16.6000 mm. --> OK

Weld Size Calculations, Description: K2B (2in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$4.2000 = 0.7 * t_{min.}$	$5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - t_r)) * S_v)$$

$$= \max(0, (1.3753 - 1.0174 + 2 * 10.6 * 1.0 * (1.0 * 6.0 - 4.3799)) * 138)$$

$$= 9670.79 \text{ N}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$= (A2 + A5 + A4 - (W_i - Can / .707)^2 * f_{r2}) * S_v$$

$$= (3.0641 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 51075.85 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (3.0641 + 0.0 + 0.64 + (1.272)) * 138$$

$$= 68615.23 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (3.0641 + 0.0 + 0.64 + 0.0 + (1.272)) * 138$$

$$= 68615.23 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi / 2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416 / 2.0) * 84.0 * 8.0 * 0.49 * 138$$

$$= 71320. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 36.7) * (16.6 - 6.0) * 0.7 * 138$$

$$= 117963. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi / 2) * D_{lo} * (W_{gnvi} - Cas) * 0.74 * S_{ng}$$

$$= (3.1416 / 2.0) * 84.0 * (12.0 - 6.0) * 0.74 * 138$$

$$= 80781. \text{ N}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 211 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Strength of Failure Paths:

$$\begin{aligned} \text{PATH11} &= (\text{SONW} + \text{SNW}) = (71320 + 117963) = 189284 \text{ N} \\ \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\ &= (71320 + 0 + 80781 + 0) = 152101 \text{ N} \\ \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\ &= (71320 + 80781 + 0) = 152101 \text{ N} \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned} \text{Path 1-1} &= 189283 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W1 = 51075 \text{ N} \\ \text{Path 2-2} &= 152101 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W2 = 68615 \text{ N} \\ \text{Path 3-3} &= 152101 \text{ N} , \text{ must exceed } W = 9670 \text{ N} \quad \text{or } W3 = 68615 \text{ N} \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 27.5041 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 241.3944 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 212 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: K2A (2in)

From: 30

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516	70
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Cylinder/Cone Centerline	L1	76.0000	mm.
Distance from Bottom/Left Tangent		2650.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

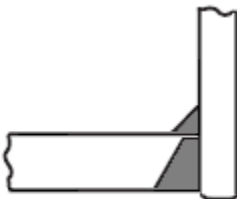
Type of Element Connected to the Shell : Nozzle

Material		SA-105	
Material UNS Number		K03504	
Material Specification/Type		Forgings	
Allowable Stress at Temperature	Sn	137.90	N./mm ²
Allowable Stress At Ambient	Sna	137.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		7.77	deg
Diameter		2.0000	in.
Size and Thickness Basis		Actual	
Actual Thickness	tn	16.6000	mm.
Flange Material		SA-105	
Flange Type		Long Weld Neck	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Flange Class		300	
Flange Grade		GR 1.1	

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 213 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Note : Checking Nozzle 90 degrees to the Longitudinal axis.

Reinforcement CALCULATION, Description: K2A (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.000 in.
Actual Thickness Used in Calculation	0.654 in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.1828 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3430 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	126.8527	mm.
Parallel to Vessel Wall, opening length	d	63.4264	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000	mm.

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design		External		Mapnc
--------------------------	--	--------	--	----------	--	-------

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 214 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Area Required	Ar		1.027		1.389		NA
Area in Shell	A1		2.779		1.028		NA
Area in Nozzle Wall	A2		3.141		3.093		NA
Area in Inward Nozzle	A3		0.000		0.000		NA
Area in Welds	A41+A42+A43		0.640		0.640		NA
Area in Element	A5		0.000		0.000		NA
TOTAL AREA AVAILABLE	Atot		6.560		4.760		NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 81.94 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F (1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5 (63.4264 \cdot 4.3799 \cdot 1 + 2 \cdot 10.6 \cdot 4.3799 \cdot 1 (1 - 1.0))$$

$$= 1.389 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot tr) - 2 \cdot tn (E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 63.426 (1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.6$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.028 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp) (tn - trn) fr2 / \sin(\alpha3)$$

$$= (2 \cdot 15.0) (10.6 - 0.34) 1.0 / \sin(84.2)$$

$$= 3.093 \text{ cm}^2$$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can / 0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:A, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.237, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.539, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	-3 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-30 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Gov. MDMT of the nozzle to shell joint welded assembly : -30 °C

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 215 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -18 °C
 Flange MDMT with Temp reduction per UCS-66(b)(1)(-b) -104 °C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
 Design Pressure/Ambient Rating = 8.00/51.10 = 0.157

Weld Size Calculations, Description: K2A (2in)

Intermediate Calc. for nozzle/shell Welds Tmin 6.0000 mm.

Results Per UW-16.1:

Required Thickness Actual Thickness
 Nozzle Weld 4.2000 = 0.7 * tmin. 5.6560 = 0.7 * Wo mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (1.389 - 1.0276 + 2 * 10.6 * 1.0 * \\
 &\quad (1.0 * 6.0 - 4.3799)) 138) \\
 &= 9720.01 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (3.0928 + 0.0 + 0.64 - 0.0 * 1.0) * 138 \\
 &= 51471.10 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (3.0928 + 0.0 + 0.64 + (1.272)) * 138 \\
 &= 69010.49 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A2+A3+A4+A5+(2*tn*t*fr1))*S \\
 &= (3.0928 + 0.0 + 0.64 + 0.0 + (1.272)) * 138 \\
 &= 69010.49 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416/2.0) * 84.8378 * 8.0 * 0.49 * 138 \\
 &= 72032. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 37.066) * (16.6 - 6.0) * 0.7 * 138 \\
 &= 119140. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 216 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

$$\begin{aligned}
 &= (\pi/2) * D_{lo} * (W_{gvi} - C_{as}) * 0.74 * S_{ng} \\
 &= (3.1416/2.0) * 84.8378 * (12.0 - 6.0) * 0.74 * 138 \\
 &= 81587. \text{ N}
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 \text{PATH11} &= (\text{SONW} + \text{SNW}) = (72032 + 119140) = 191171 \text{ N} \\
 \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\
 &= (72032 + 0 + 81587 + 0) = 153618 \text{ N} \\
 \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\
 &= (72032 + 81587 + 0) = 153618 \text{ N}
 \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned}
 \text{Path 1-1} &= 191171 \text{ N}, \text{ must exceed } W = 9720 \text{ N} \quad \text{or } W1 = 51471 \text{ N} \\
 \text{Path 2-2} &= 153618 \text{ N}, \text{ must exceed } W = 9720 \text{ N} \quad \text{or } W2 = 69010 \text{ N} \\
 \text{Path 3-3} &= 153618 \text{ N}, \text{ must exceed } W = 9720 \text{ N} \quad \text{or } W3 = 69010 \text{ N}
 \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in plane parallel to the vessel axis.

Reinforcement CALCULATION, Description: K2A (2in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.000 in.
Actual Thickness Used in Calculation 0.654 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 31.4) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.1828 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3430 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	125.6000	mm.
Parallel to Vessel Wall, opening length	d	62.8000	mm.
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	15.0000	mm.

Results of Nozzle Reinforcement Area Calculations: (cm²)

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 217 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

AREA AVAILABLE, A1 to A5	Design	External	Mapnc
Area Required Ar	2.033	1.375	NA
Area in Shell A1	1.735	1.017	NA
Area in Nozzle Wall A2	3.125	3.077	NA
Area in Inward Nozzle A3	0.000	0.000	NA
Area in Welds A41+A42+A43	0.640	0.640	NA
Area in Element A5	0.000	0.000	NA
TOTAL AREA AVAILABLE Atot	5.500	4.734	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F (1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5 (62.8 \cdot 4.3799 \cdot 1 + 2 \cdot 10.6 \cdot 4.3799 \cdot 1 (1 - 1.0))$$

$$= 1.375 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot tr) - 2 \cdot tn (E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 62.8 (1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 10.6 (1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 1.0)$$

$$= 1.017 \text{ cm}^2$$

Area Available in Nozzle Projecting Outward [A2]:

$$= (2 \cdot tlnp) (tn - trn) fr2$$

$$= (2 \cdot 15.0) (10.6 - 0.34) 1.0$$

$$= 3.077 \text{ cm}^2$$

Area Available in Inward Weld + Outward Weld [A41 + A43]:

$$= Wo^2 \cdot fr2 + (Wi - can / 0.707)^2 \cdot fr2$$

$$= 8.0^2 \cdot 1.0 + (0.0)^2 \cdot 1.0$$

$$= 0.640 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures	ta = 6.3430 mm.
Wall Thickness per UG16(b),	tr16b = 7.5000 mm.
Wall Thickness, shell/head, internal pressure	trb1 = 9.2370 mm.
Wall Thickness	tb1 = max(trb1, tr16b) = 9.2370 mm.
Wall Thickness, shell/head, external pressure	trb2 = 6.4171 mm.
Wall Thickness	tb2 = max(trb2, tr16b) = 7.5000 mm.
Wall Thickness per table UG-45	tb3 = 10.8000 mm.

Determine Nozzle Thickness candidate [tb]:

$$= \min[tb3, \max(tb1, tb2)]$$

$$= \min[10.8, \max(9.237, 7.5)]$$

$$= 9.2370 \text{ mm.}$$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(ta, tb)$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 218 از 251
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه										
BK	GCS	MF	120	ME	CN	0003	V01											

$$= \max(6.343, 9.237)$$

$$= 9.2370 \text{ mm.}$$

Available Nozzle Neck Thickness = 16.6000 mm. --> OK

Weld Size Calculations, Description: K2A (2in)

Intermediate Calc. for nozzle/shell Welds $T_{min} = 6.0000 \text{ mm.}$

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$4.2000 = 0.7 * t_{min.}$	$5.6560 = 0.7 * W_o \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - t_r)) * S_v)$$

$$= \max(0, (1.3753 - 1.0174 + 2 * 10.6 * 1.0 * (1.0 * 6.0 - 4.3799)) * 138)$$

$$= 9670.79 \text{ N}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$= (A2 + A5 + A4 - (W_i - C_{an} / .707)^2 * f_{r2}) * S_v$$

$$= (3.0771 + 0.0 + 0.64 - 0.0 * 1.0) * 138$$

$$= 51254.27 \text{ N}$$

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (3.0771 + 0.0 + 0.64 + (1.272)) * 138$$

$$= 68793.66 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (3.0771 + 0.0 + 0.64 + 0.0 + (1.272)) * 138$$

$$= 68793.66 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi / 2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416 / 2.0) * 84.0 * 8.0 * 0.49 * 138$$

$$= 71320. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - C_{an}) * 0.7 * S_n$$

$$= (3.1416 * 36.7) * (16.6 - 6.0) * 0.7 * 138$$

$$= 117963. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi / 2) * D_{lo} * (W_{gnvi} - C_{as}) * 0.74 * S_{ng}$$

$$= (3.1416 / 2.0) * 84.0 * (12.0 - 6.0) * 0.74 * 138$$

$$= 80781. \text{ N}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 219 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Strength of Failure Paths:

$$\begin{aligned} \text{PATH11} &= (\text{SONW} + \text{SNW}) = (71320 + 117963) = 189284 \text{ N} \\ \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\ &= (71320 + 0 + 80781 + 0) = 152101 \text{ N} \\ \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\ &= (71320 + 80781 + 0) = 152101 \text{ N} \end{aligned}$$

Summary of Failure Path Calculations:

Path 1-1 = 189283 N , must exceed W = 9670 N or W1 = 51254 N
 Path 2-2 = 152101 N , must exceed W = 9670 N or W2 = 68793 N
 Path 3-3 = 152101 N , must exceed W = 9670 N or W3 = 68793 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 7.5311 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 169.6448 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 220 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Input, Nozzle Desc: K1B (3in)

From: 30

Pressure for Reinforcement Calculations	P	8.051	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516 70	
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Cylinder/Cone Centerline	L1	200.0000	mm.
Distance from Bottom/Left Tangent		3150.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

Type of Element Connected to the Shell : Nozzle

Material		SA-106 B	
Material UNS Number		K03006	
Material Specification/Type		Smls. pipe	
Allowable Stress at Temperature	Sn	117.90	N./mm ²
Allowable Stress At Ambient	Sna	117.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		290.85	deg
Diameter		3.0000	in.
Size and Thickness Basis		Minimum	
Nominal Thickness	tn	XXS	
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	200.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material [Normalized]		SA-516 70	
Pad Allowable Stress at Temperature	Sp	137.90	N./mm ²
Pad Allowable Stress At Ambient	Spa	137.90	N./mm ²

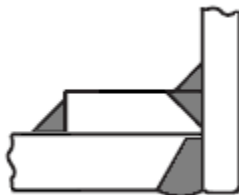
 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنيه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 221 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Diameter of Pad along vessel surface	Dp	180.0000	mm.
Thickness of Pad	te	12.0000	mm.
Weld leg size between Pad and Shell	Wp	6.0000	mm.
Groove weld depth between Pad and Nozzle	Wgpn	12.0000	mm.
Reinforcing Pad Width		45.5500	mm.

Flange Class	150
Flange Grade	GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle With Pad, no Inside projection

Note : Checking Nozzle 90 degrees to the Longitudinal axis.

Reinforcement CALCULATION, Description: K1B (3in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.450	in.
Actual Thickness Used in Calculation	0.525	in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05)$$

$$= 3.2578 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.05 \cdot 37.11) / (118 \cdot 1.0 - 0.6 \cdot 8.05)$$

$$= 0.2545 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3989 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 222 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	159.2125	mm.
Parallel to Vessel Wall, opening length	d	79.6062	mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp		15.0000	mm.

Note: The Pad diameter is greater than the Diameter Limit. The excess will not be considered.

Weld Strength Reduction Factor [fr1]:

$$\begin{aligned}
 &= \min(1, S_n/S_v) \\
 &= \min(1, 117.9/137.9) \\
 &= 0.855
 \end{aligned}$$

Weld Strength Reduction Factor [fr2]:

$$\begin{aligned}
 &= \min(1, S_n/S_v) \\
 &= \min(1, 117.9/137.9) \\
 &= 0.855
 \end{aligned}$$

Weld Strength Reduction Factor [fr4]:

$$\begin{aligned}
 &= \min(1, S_p/S_v) \\
 &= \min(1, 137.9/137.9) \\
 &= 1.000
 \end{aligned}$$

Weld Strength Reduction Factor [fr3]:

$$\begin{aligned}
 &= \min(fr2, fr4) \\
 &= \min(0.855, 1.0) \\
 &= 0.855
 \end{aligned}$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.663	1.790	NA
Area in Shell	A1	2.125	1.255	NA
Area in Nozzle Wall	A2	1.911	1.872	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.333	0.333	NA
Area in Element	A5	7.665	7.665	NA
TOTAL AREA AVAILABLE	Atot	12.034	11.126	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations	68.82 Degr.
--	-------------

The area available without a pad is Sufficient.

The area available with the given pad is Sufficient.

Area Required [A]:

$$\begin{aligned}
 &= 0.5(d * tr * F + 2 * t_n * tr * F(1 - fr1)) \text{ per UG-37(d)} \\
 &= 0.5(79.6062 * 4.3799 * 1 + 2 * 7.335 * 4.3799 * 1(1 - 0.86)) \\
 &= 1.790 \text{ cm}^2
 \end{aligned}$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 223 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 79.606(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 7.335$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 0.855)$$

$$= 1.255 \text{ cm}^2$$

Area Available in Nozzle Wall Projecting Outward [A2]:

$$= (2 \cdot Tlwp) \cdot (tn - trn) \cdot fr2 / \sin(\alpha3)$$

$$= (2 \cdot 15.0) \cdot (7.34 - 0.4) \cdot 0.855 / \sin(71.9)$$

$$= 1.872 \text{ cm}^2$$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Welds [A41 + A42 + A43]:

$$= (Wo^2 - Ar \text{ Lost}) \cdot Fr3 + (Wi - can / 0.707)^2 - Ar \text{ Lost} \cdot fr2 + Wp^2 \cdot fr4$$

$$= (0.39) \cdot 0.86 + (0.0) \cdot 0.86 + 0.0^2 \cdot 1.0$$

$$= 0.333 \text{ cm}^2$$

Area Available in Element [A5]:

$$= (\min(Dp, DL) - (Nozzle \text{ OD})) \cdot (\min(tp, Tlwp, te)) \cdot fr4$$

$$= (159.2125 - 95.3388) \cdot 12.0 \cdot 1.0$$

$$= 7.665 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle Neck to Flange Weld, min(Curve:B, Curve:A)

Govrn. thk, tg = 13.335, tr = 0.255, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.035, Temp. Reduction = 78 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	0 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-104 °C

Nozzle Neck to Pad Weld for the Nozzle, Curve: B

Govrn. thk, tg = 12.0, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.543, Temp. Reduction = 27 °C
Pad governing, Conservatively assuming Pad stress = Shell stress(Div. 1 L-9.3).

Min Metal Temp. w/o impact per UCS-66, Curve B	-23 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-48 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Nozzle Neck to Pad Weld for Reinforcement pad, Curve: D

Govrn. thk, tg = 12.0, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.543, Temp. Reduction = 27 °C
Pad governing, Conservatively assuming Pad stress = Shell stress(Div. 1 L-9.3).

Min Metal Temp. w/o impact per UCS-66, Curve D	-48 °C
--	--------

Shell to Pad Weld Junction at Pad OD, Curve: D

Govrn. thk, tg = 12.0, tr = 3.258, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.543, Temp. Reduction = 27 °C

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 224 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Min Metal Temp. w/o impact per UCS-66, Curve D -48 °C

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:B, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.258, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*)/(tg - c) = 0.543, Temp. Reduction = 27 °C

Min Metal Temp. w/o impact per UCS-66, Curve B -23 °C
Min Metal Temp. at Required thickness (UCS 66.1) -48 °C
Min Metal Temp. w/o impact per UG-20(f) -29 °C

Gov. MDMT of the Nozzle : -48 °C
Gov. MDMT of the Reinforcement Pad : -48 °C
Gov. MDMT of the nozzle to shell joint welded assembly : -48 °C

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -18 °C
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b) -48 °C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :
Design Pressure/Ambient Rating = 8.05/19.60 = 0.411

Weld Size Calculations, Description: K1B (3in)

Intermediate Calc. for nozzle/shell Welds Tmin 7.3350 mm.
Intermediate Calc. for pad/shell Welds TminPad 6.0000 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	5.1345 = 0.7 * tmin.	5.6560 = 0.7 * Wo mm.
Pad Weld	3.0000 = 0.5 * TminPad	4.2420 = 0.7 * Wp mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (1.7899 - 1.2552 + 2 * 7.335 * 0.855 * \\
 &\quad (1.0 * 6.0 - 4.3799)) 138) \\
 &= 10175.07 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (1.8721 + 7.6648 + 0.3335 - 0.0 * 0.86) * 138 \\
 &= 136100.61 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (1.8721 + 0.0 + 0.5472 + (0.7526)) * 138 \\
 &= 43735.78 \text{ N}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 225 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

Weld Load [W3]:

$$= (A2+A3+A4+A5+(2*tn*t*fr1))*S$$

$$= (1.8721 + 0.0 + 0.3335 + 7.6648 + (0.7526)) * 138$$

$$= 146477.67 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 95.3388 * 8.0 * 0.49 * 118$$

$$= 69210. \text{ N}$$

Shear, Pad Element Weld [Spew]:

$$= (\pi/2) * D_P * W_P * 0.49 * S_{EW}$$

$$= (3.1416/2.0) * 180.0 * 6.0 * 0.49 * 138$$

$$= 114622. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 43.7363) * (13.335 - 6.0) * 0.7 * 118$$

$$= 83173. \text{ N}$$

Tension, Pad Groove Weld [Tpgw]:

$$= (\pi/2) * D_{lo} * W_{gpn} * 0.74 * S_{eg}$$

$$= (3.1416/2) * 95.3388 * 12.0 * 0.74 * 138$$

$$= 183371. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gvi}-Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 95.3388 * (12.0 - 6.0) * 0.74 * 138$$

$$= 91685. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (SPEW + SNW) = (114622 + 83173) = 197795 \text{ N}$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (69210 + 183371 + 91685 + 0) = 344266 \text{ N}$$

$$PATH33 = (Spew + Tngw + Sinw)$$

$$= (114622 + 91685 + 0) = 206307 \text{ N}$$

Summary of Failure Path Calculations:

$$\text{Path 1-1} = 197794 \text{ N} , \text{ must exceed } W = 10175 \text{ N} \quad \text{or } W1 = 136100 \text{ N}$$

$$\text{Path 2-2} = 344265 \text{ N} , \text{ must exceed } W = 10175 \text{ N} \quad \text{or } W2 = 43735 \text{ N}$$

$$\text{Path 3-3} = 206307 \text{ N} , \text{ must exceed } W = 10175 \text{ N} \quad \text{or } W3 = 146477 \text{ N}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in plane parallel to the vessel axis.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 226 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Reinforcement CALCULATION, Description: K1B (3in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.450 in.
Actual Thickness Used in Calculation 0.525 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.05 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.05)$$

$$= 3.2578 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.05 \cdot 37.11) / (118 \cdot 1.0 - 0.6 \cdot 8.05)$$

$$= 0.2545 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3989 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 148.4600 mm.
Parallel to Vessel Wall, opening length d 74.2300 mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp 15.0000 mm.

Note: The Pad diameter is greater than the Diameter Limit. The excess will not be considered.

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.488	1.672	NA
Area in Shell	A1	1.977	1.168	NA
Area in Nozzle Wall	A2	1.816	1.779	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.333	0.333	NA
Area in Element	A5	7.147	7.147	NA
TOTAL AREA AVAILABLE	Atot	11.274	10.428	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

The area available with the given pad is Sufficient.

Area Required [A]:

$$= 0.5 (d \cdot tr \cdot F + 2 \cdot tn \cdot tr \cdot F (1 - fr1)) \text{ per UG-37 (d)}$$

$$= 0.5 (74.23 \cdot 4.3799 \cdot 1 + 2 \cdot 7.335 \cdot 4.3799 \cdot 1 (1 - 0.86))$$

$$= 1.672 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 227 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Area Available in Shell [A1]:

$$= d (E1 \cdot t - F \cdot tr) - 2 \cdot tn (E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 74.23 (1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 7.335$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 0.855)$$

$$= 1.168 \text{ cm}^2$$

Area Available in Nozzle Wall Projecting Outward [A2]:

$$= (2 \cdot Tlwp) \cdot (tn - trn) \cdot fr2$$

$$= (2 \cdot 15.0) \cdot (7.34 - 0.4) \cdot 0.855$$

$$= 1.779 \text{ cm}^2$$

Area Available in Welds [A41 + A42 + A43]:

$$= (Wo^2 - Ar \text{ Lost}) \cdot Fr3 + ((Wi - can / 0.707)^2 - Ar \text{ Lost}) \cdot fr2 + Wp^2 \cdot fr4$$

$$= (0.39) \cdot 0.86 + (0.0) \cdot 0.86 + 0.0^2 \cdot 1.0$$

$$= 0.333 \text{ cm}^2$$

Area Available in Element [A5]:

$$= (\min(Dp, DL) - (\text{Nozzle OD})) \cdot (\min(tp, Tlwp, te)) \cdot fr4$$

$$= (148.46 - 88.9) \cdot 12.0 \cdot 1.0$$

$$= 7.147 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures $ta = 6.3989 \text{ mm.}$

Wall Thickness per UG16(b), $tr16b = 7.5000 \text{ mm.}$

Wall Thickness, shell/head, internal pressure $trb1 = 9.2578 \text{ mm.}$

Wall Thickness $tb1 = \max(trb1, tr16b) = 9.2578 \text{ mm.}$

Wall Thickness, shell/head, external pressure $trb2 = 6.4171 \text{ mm.}$

Wall Thickness $tb2 = \max(trb2, tr16b) = 7.5000 \text{ mm.}$

Wall Thickness per table UG-45 $tb3 = 10.8000 \text{ mm.}$

Determine Nozzle Thickness candidate [tb]:

$$= \min[tb3, \max(tb1, tb2)]$$

$$= \min[10.8, \max(9.2578, 7.5)]$$

$$= 9.2578 \text{ mm.}$$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(ta, tb)$$

$$= \max(6.3989, 9.2578)$$

$$= 9.2578 \text{ mm.}$$

Available Nozzle Neck Thickness = 13.3350 mm. --> OK

Weld Size Calculations, Description: K1B (3in)

Intermediate Calc. for nozzle/shell Welds $Tmin = 7.3350 \text{ mm.}$

Intermediate Calc. for pad/shell Welds $TminPad = 6.0000 \text{ mm.}$

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$5.1345 = 0.7 \cdot Tmin.$	$5.6560 = 0.7 \cdot Wo \text{ mm.}$
Pad Weld	$3.0000 = 0.5 \cdot TminPad$	$4.2420 = 0.7 \cdot Wp \text{ mm.}$

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 228 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (1.6722 - 1.1681 + 2 * 7.335 * 0.855 * \\
 &\quad (1.0 * 6.0 - 4.3799))138) \\
 &= 9752.59 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (1.7791 + 7.1472 + 0.3335 - 0.0 * 0.86) * 138 \\
 &= 127681.20 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (1.7791 + 0.0 + 0.5472 + (0.7526)) * 138 \\
 &= 42454.14 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A2+A3+A4+A5+(2*tn*t*fr1))*S \\
 &= (1.7791 + 0.0 + 0.3335 + 7.1472 + (0.7526)) * 138 \\
 &= 138058.28 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416/2.0) * 88.9 * 8.0 * 0.49 * 118 \\
 &= 64536. \text{ N}
 \end{aligned}$$

Shear, Pad Element Weld [Spew]:

$$\begin{aligned}
 &= (\pi/2) * DP * WP * 0.49 * SEW \\
 &= (3.1416/2.0) * 180.0 * 6.0 * 0.49 * 138 \\
 &= 114622. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 40.7825) * (13.335 - 6.0) * 0.7 * 118 \\
 &= 77556. \text{ N}
 \end{aligned}$$

Tension, Pad Groove Weld [Tpgw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wgp * 0.74 * Seg \\
 &= (3.1416/2) * 88.9 * 12.0 * 0.74 * 138 \\
 &= 170987. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * (Wgnv-Cas) * 0.74 * Sng \\
 &= (3.1416/2.0) * 88.9 * (12.0 - 6.0) * 0.74 * 138 \\
 &= 85493. \text{ N}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 229 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Strength of Failure Paths:

$$\begin{aligned} \text{PATH11} &= (\text{SPEW} + \text{SNW}) = (114622 + 77556) = 192178 \text{ N} \\ \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\ &= (64536 + 170987 + 85493 + 0) = 321016 \text{ N} \\ \text{PATH33} &= (\text{Spew} + \text{Tngw} + \text{Sinw}) \\ &= (114622 + 85493 + 0) = 200115 \text{ N} \end{aligned}$$

Summary of Failure Path Calculations:

$$\begin{aligned} \text{Path 1-1} &= 192177 \text{ N}, \text{ must exceed } W = 9752 \text{ N} \quad \text{or } W1 = 127681 \text{ N} \\ \text{Path 2-2} &= 321015 \text{ N}, \text{ must exceed } W = 9752 \text{ N} \quad \text{or } W2 = 42454 \text{ N} \\ \text{Path 3-3} &= 200115 \text{ N}, \text{ must exceed } W = 9752 \text{ N} \quad \text{or } W3 = 138058 \text{ N} \end{aligned}$$

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 19.6568 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 232.5178 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 230 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Input, Nozzle Desc: K1A (3in)

From: 30

Pressure for Reinforcement Calculations	P	8.000	bars
Temperature for Internal Pressure	Temp	120	°C
Design External Pressure	Pext	1.03	bars
Temperature for External Pressure	Tempex	100	°C
Shell Material [Normalized]		SA-516 70	
Shell Allowable Stress at Temperature	Sv	137.90	N./mm ²
Shell Allowable Stress At Ambient	Sva	137.90	N./mm ²
Inside Diameter of Cylindrical Shell	D	1100.00	mm.
Design Length of Section	L	1791.6666	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	6.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Cylinder/Cone Centerline	L1	100.0000	mm.
Distance from Bottom/Left Tangent		3150.00	mm.
User Entered Minimum Design Metal Temperature		5.00	°C

Type of Element Connected to the Shell : Nozzle

Material		SA-106 B	
Material UNS Number		K03006	
Material Specification/Type		Smls. pipe	
Allowable Stress at Temperature	Sn	117.90	N./mm ²
Allowable Stress At Ambient	Sna	117.90	N./mm ²
Diameter Basis (for tr calc only)		ID	
Layout Angle		10.25	deg
Diameter		3.0000	in.
Size and Thickness Basis		Minimum	
Nominal Thickness	tn	XXS	
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	6.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	150.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	8.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material		SA-516 70	
Pad Allowable Stress at Temperature	Sp	137.90	N./mm ²
Pad Allowable Stress At Ambient	Spa	137.90	N./mm ²

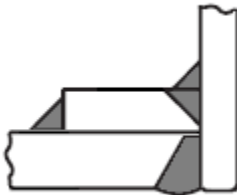
 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 231 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Diameter of Pad along vessel surface	Dp	180.0000	mm.
Thickness of Pad	te	12.0000	mm.
Weld leg size between Pad and Shell	Wp	6.0000	mm.
Groove weld depth between Pad and Nozzle	Wgpn	12.0000	mm.
Reinforcing Pad Width		45.5500	mm.

Flange Class	150
Flange Grade	GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle With Pad, no Inside projection

Note : Checking Nozzle 90 degrees to the Longitudinal axis.

Reinforcement CALCULATION, Description: K1A (3in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	2.450	in.
Actual Thickness Used in Calculation	0.525	in.

Note:

Post Weld Heat Treatment is required for this nozzle and it was specified as being heat treated.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 3.2370 \text{ mm.}
 \end{aligned}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$\begin{aligned}
 &= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)} \\
 &= (8.0 \cdot 37.11) / (118 \cdot 1.0 - 0.6 \cdot 8.0) \\
 &= 0.2529 \text{ mm.}
 \end{aligned}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3552 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 232 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادرکننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	D1	151.0280	mm.
Parallel to Vessel Wall, opening length	d	75.5140	mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp		15.0000	mm.

Note: The Pad diameter is greater than the Diameter Limit. The excess will not be considered.

Weld Strength Reduction Factor [fr1]:

$$= \min(1, S_n/S_v)$$

$$= \min(1, 117.9/137.9)$$

$$= 0.855$$

Weld Strength Reduction Factor [fr2]:

$$= \min(1, S_n/S_v)$$

$$= \min(1, 117.9/137.9)$$

$$= 0.855$$

Weld Strength Reduction Factor [fr4]:

$$= \min(1, S_p/S_v)$$

$$= \min(1, 137.9/137.9)$$

$$= 1.000$$

Weld Strength Reduction Factor [fr3]:

$$= \min(fr2, fr4)$$

$$= \min(0.855, 1.0)$$

$$= 0.855$$

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.513	1.700	NA
Area in Shell	A1	2.028	1.189	NA
Area in Nozzle Wall	A2	1.833	1.806	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.333	0.333	NA
Area in Element	A5	7.271	7.271	NA
TOTAL AREA AVAILABLE	Atot	11.465	10.600	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 79.42 Degs.

The area available without a pad is Sufficient.

The area available with the given pad is Sufficient.

Area Required [A]:

$$= 0.5(d * tr * F + 2 * t_n * tr * F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(75.514 * 4.3799 * 1 + 2 * 7.335 * 4.3799 * 1(1 - 0.86))$$

$$= 1.700 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 233 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= d(E1 \cdot t - F \cdot tr) - 2 \cdot tn(E1 \cdot t - F \cdot tr) \cdot (1 - fr1)$$

$$= 75.514(1.0 \cdot 6.0 - 1.0 \cdot 4.38) - 2 \cdot 7.335$$

$$(1.0 \cdot 6.0 - 1.0 \cdot 4.3799) \cdot (1 - 0.855)$$

$$= 1.189 \text{ cm}^2$$

Area Available in Nozzle Wall Projecting Outward [A2]:

$$= (2 \cdot Tlwp) \cdot (tn - trn) \cdot fr2 / \sin(\alpha3)$$

$$= (2 \cdot 15.0) \cdot (7.34 - 0.36) \cdot 0.855 / \sin(82.3)$$

$$= 1.806 \text{ cm}^2$$

Note: See ASME VIII-1 2011(a) Appendix L, L-7.7.7(b) for more information.

Area Available in Welds [A41 + A42 + A43]:

$$= (Wo^2 - Ar \text{ Lost}) \cdot Fr3 + (Wi - can / 0.707)^2 - Ar \text{ Lost} \cdot fr2 + Wp^2 \cdot fr4$$

$$= (0.39) \cdot 0.86 + (0.0) \cdot 0.86 + 0.0^2 \cdot 1.0$$

$$= 0.333 \text{ cm}^2$$

Area Available in Element [A5]:

$$= (\min(Dp, DL) - (Nozzle \text{ OD})) \cdot (\min(tp, Tlwp, te)) \cdot fr4$$

$$= (151.028 - 90.4378) \cdot 12.0 \cdot 1.0$$

$$= 7.271 \text{ cm}^2$$

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

Nozzle Neck to Flange Weld, min(Curve:B, Curve:A)

Govrn. thk, tg = 13.335, tr = 0.253, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.034, Temp. Reduction = 78 °C

Min Metal Temp. w/o impact per UCS-66, Curve A	0 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-104 °C

Nozzle Neck to Pad Weld for the Nozzle, Curve: B

Govrn. thk, tg = 12.0, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.539, Temp. Reduction = 28 °C
Pad governing, Conservatively assuming Pad stress = Shell stress(Div. 1 L-9.3).

Min Metal Temp. w/o impact per UCS-66, Curve B	-23 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-48 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Nozzle Neck to Pad Weld for Reinforcement pad, Curve: B

Govrn. thk, tg = 12.0, c = 6.0 mm., E* = 1.0
Thickness Ratio = tr * (E*) / (tg - c) = 0.539, Temp. Reduction = 28 °C
Pad governing, Conservatively assuming Pad stress = Shell stress(Div. 1 L-9.3).

Min Metal Temp. w/o impact per UCS-66, Curve B	-23 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-48 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 234 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Shell to Pad Weld Junction at Pad OD, min(Curve:B, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.237, c = 6.0 mm., E* = 1.0
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve B	-23 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-48 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Nozzle-Shell/Head Weld (UCS-66(a)1(b)), min(Curve:B, Curve:D)

Govrn. thk, tg = 12.0, tr = 3.237, c = 6.0 mm., E* = 1.0
Thickness Ratio = $tr * (E^*) / (tg - c) = 0.539$, Temp. Reduction = 28 °C

Min Metal Temp. w/o impact per UCS-66, Curve B	-23 °C
Min Metal Temp. at Required thickness (UCS 66.1)	-48 °C
Min Metal Temp. w/o impact per UG-20(f)	-29 °C

Gov. MDMT of the Nozzle	:	-48 °C
Gov. MDMT of the Reinforcement Pad	:	-48 °C
Gov. MDMT of the nozzle to shell joint welded assembly	:	-48 °C

ANSI Flange MDMT including Temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c)	-18 °C
Flange MDMT with Temp reduction per UCS-66(b) (1) (-b)	-48 °C

Where the Stress Reduction Ratio per UCS-66(b)(1)(-b) is :

Design Pressure/Ambient Rating = $8.00 / 19.60 = 0.408$

Weld Size Calculations, Description: K1A (3in)

Intermediate Calc. for nozzle/shell Welds	Tmin	7.3350 mm.
Intermediate Calc. for pad/shell Welds	TminPad	6.0000 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	$5.1345 = 0.7 * t_{min}$	$5.6560 = 0.7 * W_o$ mm.
Pad Weld	$3.0000 = 0.5 * T_{minPad}$	$4.2420 = 0.7 * W_p$ mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A - A1 + 2 * t_n * f_{r1} * (E1 * t - tr)) * S_v) \\
 &= \max(0, (1.7003 - 1.1889 + 2 * 7.335 * 0.855 * \\
 &\quad (1.0 * 6.0 - 4.3799)) * 138) \\
 &= 9853.49 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2 + A5 + A4 - (W_i - Can / .707)^2 * f_{r2}) * S_v \\
 &= (1.8064 + 7.2708 + 0.3335 - 0.0 * 0.86) * 138 \\
 &= 129762.75 \text{ N}
 \end{aligned}$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 235 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Weld Load [W2]:

$$= (A2 + A3 + A4 + (2 * t_n * t * f_{r1})) * S_v$$

$$= (1.8064 + 0.0 + 0.5472 + (0.7526)) * 138$$

$$= 42830.97 \text{ N}$$

Weld Load [W3]:

$$= (A2 + A3 + A4 + A5 + (2 * t_n * t * f_{r1})) * S$$

$$= (1.8064 + 0.0 + 0.3335 + 7.2708 + (0.7526)) * 138$$

$$= 140139.83 \text{ N}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$= (\pi/2) * D_{lo} * W_o * 0.49 * S_{nw}$$

$$= (3.1416/2.0) * 90.4378 * 8.0 * 0.49 * 118$$

$$= 65652. \text{ N}$$

Shear, Pad Element Weld [Spew]:

$$= (\pi/2) * D_P * W_P * 0.49 * S_{EW}$$

$$= (3.1416/2.0) * 180.0 * 6.0 * 0.49 * 138$$

$$= 114622. \text{ N}$$

Shear, Nozzle Wall [Snw]:

$$= (\pi * (D_{lr} + D_{lo}) / 4) * (Thk - Can) * 0.7 * S_n$$

$$= (3.1416 * 41.4879) * (13.335 - 6.0) * 0.7 * 118$$

$$= 78898. \text{ N}$$

Tension, Pad Groove Weld [Tpgw]:

$$= (\pi/2) * D_{lo} * W_{gpn} * 0.74 * S_{eg}$$

$$= (3.1416/2) * 90.4378 * 12.0 * 0.74 * 138$$

$$= 173944. \text{ N}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * D_{lo} * (W_{gvi} - Cas) * 0.74 * S_{ng}$$

$$= (3.1416/2.0) * 90.4378 * (12.0 - 6.0) * 0.74 * 138$$

$$= 86972. \text{ N}$$

Strength of Failure Paths:

$$PATH11 = (S_{PEW} + S_{NW}) = (114622 + 78898) = 193519 \text{ N}$$

$$PATH22 = (S_{onw} + T_{pgw} + T_{ngw} + S_{inw})$$

$$= (65652 + 173944 + 86972 + 0) = 326569 \text{ N}$$

$$PATH33 = (S_{pew} + T_{ngw} + S_{inw})$$

$$= (114622 + 86972 + 0) = 201594 \text{ N}$$

Summary of Failure Path Calculations:

Path 1-1 = 193519 N , must exceed W = 9853 N or W1 = 129762 N

Path 2-2 = 326568 N , must exceed W = 9853 N or W2 = 42830 N

Path 3-3 = 201593 N , must exceed W = 9853 N or W3 = 140139 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 236 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

Note : Checking Nozzle in plane parallel to the vessel axis.

Reinforcement CALCULATION, Description: K1A (3in)

ASME Code, Section VIII, Div. 1, 2019, UG-37 to UG-45

Actual Inside Diameter Used in Calculation 2.450 in.
Actual Thickness Used in Calculation 0.525 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Cylindrical Shell, Tr [Int. Press]

$$= (P \cdot R) / (S_v \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.0 \cdot 556.0) / (138 \cdot 1.0 - 0.6 \cdot 8.0)$$

$$= 3.2370 \text{ mm.}$$

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]

$$= (P \cdot R) / (S_n \cdot E - 0.6 \cdot P) \text{ per UG-27 (c) (1)}$$

$$= (8.0 \cdot 37.11) / (118 \cdot 1.0 - 0.6 \cdot 8.0)$$

$$= 0.2529 \text{ mm.}$$

Required Nozzle thickness under External Pressure per UG-28 : 0.3552 mm.

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit) D1 148.4600 mm.
Parallel to Vessel Wall, opening length d 74.2300 mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp 15.0000 mm.

Note: The Pad diameter is greater than the Diameter Limit. The excess will not be considered.

Results of Nozzle Reinforcement Area Calculations: (cm²)

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	2.472	1.672	NA
Area in Shell	A1	1.992	1.168	NA
Area in Nozzle Wall	A2	1.817	1.790	NA
Area in Inward Nozzle	A3	0.000	0.000	NA
Area in Welds A41+A42+A43		0.333	0.333	NA
Area in Element	A5	7.147	7.147	NA
TOTAL AREA AVAILABLE	Atot	11.289	10.439	NA

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

The area available with the given pad is Sufficient.

Area Required [A]:

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 237 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

$$= 0.5(d * tr * F + 2 * tn * tr * F(1 - fr1)) \text{ per UG-37(d)}$$

$$= 0.5(74.23 * 4.3799 * 1 + 2 * 7.335 * 4.3799 * 1(1 - 0.86))$$

$$= 1.672 \text{ cm}^2$$

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:

$$= d(E1 * t - F * tr) - 2 * tn(E1 * t - F * tr) * (1 - fr1)$$

$$= 74.23(1.0 * 6.0 - 1.0 * 4.38) - 2 * 7.335$$

$$(1.0 * 6.0 - 1.0 * 4.3799) * (1 - 0.855)$$

$$= 1.168 \text{ cm}^2$$

Area Available in Nozzle Wall Projecting Outward [A2]:

$$= (2 * Tlwp) * (tn - trn) * fr2$$

$$= (2 * 15.0) * (7.34 - 0.36) * 0.855$$

$$= 1.790 \text{ cm}^2$$

Area Available in Welds [A41 + A42 + A43]:

$$= (Wo^2 - Ar \text{ Lost}) * Fr3 + ((Wi - can / 0.707)^2 - Ar \text{ Lost}) * fr2 + Wp^2 * fr4$$

$$= (0.39) * 0.86 + (0.0) * 0.86 + 0.0^2 * 1.0$$

$$= 0.333 \text{ cm}^2$$

Area Available in Element [A5]:

$$= (min(Dp, DL) - (Nozzle OD)) * (min(tp, Tlwp, te)) * fr4$$

$$= (148.46 - 88.9) * 12.0 * 1.0$$

$$= 7.147 \text{ cm}^2$$

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness for Internal/External pressures	ta = 6.3552 mm.
Wall Thickness per UG16(b),	tr16b = 7.5000 mm.
Wall Thickness, shell/head, internal pressure	trb1 = 9.2370 mm.
Wall Thickness	tb1 = max(trb1, tr16b) = 9.2370 mm.
Wall Thickness, shell/head, external pressure	trb2 = 6.4171 mm.
Wall Thickness	tb2 = max(trb2, tr16b) = 7.5000 mm.
Wall Thickness per table UG-45	tb3 = 10.8000 mm.

Determine Nozzle Thickness candidate [tb]:

$$= \min[tb3, \max(tb1, tb2)]$$

$$= \min[10.8, \max(9.237, 7.5)]$$

$$= 9.2370 \text{ mm.}$$

Minimum Wall Thickness of Nozzle Necks [tUG-45]:

$$= \max(ta, tb)$$

$$= \max(6.3552, 9.237)$$

$$= 9.2370 \text{ mm.}$$

Available Nozzle Neck Thickness = 13.3350 mm. --> OK

Weld Size Calculations, Description: K1A (3in)

Intermediate Calc. for nozzle/shell Welds	Tmin	7.3350 mm.
Intermediate Calc. for pad/shell Welds	TminPad	6.0000 mm.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 238 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	5.1345 = 0.7 * tmin.	5.6560 = 0.7 * Wo mm.
Pad Weld	3.0000 = 0.5*TminPad	4.2420 = 0.7 * Wp mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

$$\begin{aligned}
 &= \max(0, (A-A1+2*tn*fr1*(E1*t-tr))Sv) \\
 &= \max(0, (1.6722 - 1.1681 + 2 * 7.335 * 0.855 * \\
 &\quad (1.0 * 6.0 - 4.3799))138) \\
 &= 9752.59 \text{ N}
 \end{aligned}$$

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

$$\begin{aligned}
 &= (A2+A5+A4-(Wi-Can/.707)^2*fr2)*Sv \\
 &= (1.7903 + 7.1472 + 0.3335 - 0.0 * 0.86) * 138 \\
 &= 127835.91 \text{ N}
 \end{aligned}$$

Weld Load [W2]:

$$\begin{aligned}
 &= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv \\
 &= (1.7903 + 0.0 + 0.5472 + (0.7526)) * 138 \\
 &= 42608.86 \text{ N}
 \end{aligned}$$

Weld Load [W3]:

$$\begin{aligned}
 &= (A2+A3+A4+A5+(2*tn*t*fr1))*S \\
 &= (1.7903 + 0.0 + 0.3335 + 7.1472 + (0.7526)) * 138 \\
 &= 138212.98 \text{ N}
 \end{aligned}$$

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416/2.0) * 88.9 * 8.0 * 0.49 * 118 \\
 &= 64536. \text{ N}
 \end{aligned}$$

Shear, Pad Element Weld [Spew]:

$$\begin{aligned}
 &= (\pi/2) * DP * WP * 0.49 * SEW \\
 &= (3.1416/2.0) * 180.0 * 6.0 * 0.49 * 138 \\
 &= 114622. \text{ N}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 40.7825) * (13.335 - 6.0) * 0.7 * 118 \\
 &= 77556. \text{ N}
 \end{aligned}$$

Tension, Pad Groove Weld [Tpgw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wgpn * 0.74 * Seg \\
 &= (3.1416/2) * 88.9 * 12.0 * 0.74 * 138 \\
 &= 170987. \text{ N}
 \end{aligned}$$

Tension, Shell Groove Weld [Tngw]:

$$= (\pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 239 از 251	
	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$= (3.1416/2.0) * 88.9 * (12.0 - 6.0) * 0.74 * 138$$

$$= 85493. N$$

Strength of Failure Paths:

$$PATH11 = (SPEW + SNW) = (114622 + 77556) = 192178 N$$

$$PATH22 = (Sonw + Tpgw + Tngw + Sinw)$$

$$= (64536 + 170987 + 85493 + 0) = 321016 N$$

$$PATH33 = (Spew + Tngw + Sinw)$$

$$= (114622 + 85493 + 0) = 200115 N$$

Summary of Failure Path Calculations:

Path 1-1 = 192177 N , must exceed W = 9752 N or W1 = 127835 N

Path 2-2 = 321015 N , must exceed W = 9752 N or W2 = 42608 N

Path 3-3 = 200115 N , must exceed W = 9752 N or W3 = 138212 N

Maximum Allowable Pressure for this Nozzle at this Location:

Converged Max. Allow. Pressure in Operating case 15 bars

Note: The MAWP of this junction was limited by the parent Shell/Head.

Nozzle is O.K. for the External Pressure 1 bars

The Drop for this Nozzle is : 10.1405 mm.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 172.3395 mm.

PV Elite is a trademark of Intergraph CADWorx & Analysis Solutions, Inc. 2020

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 - 073 - 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 240 از 251																
	<table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>		پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01
	پروژه		بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه									
BK	GCS	MF	120	ME	CN	0003	V01											

Lifting WRC

Input Echo, 107/537 Item 1, Description: New WRC 107/537

Diameter Basis for Vessel	Vbasis	ID	
Cylindrical or Spherical Vessel	Cylsph	Cylindrical	
Internal Corrosion Allowance	Cas	6.0000	mm.
Vessel Diameter	Dv	1100.000	mm.
Vessel Thickness	Tv	12.000	mm.
Design Temperature		85.00	C
Vessel Material		SA-516 70	
Vessel UNS Number		K02700	
Vessel Cold S.I. Allowable	Smc	137.90	N./mm ²
Vessel Hot S.I. Allowable	Smh	137.90	N./mm ²

*Note: Using 2 * Yield for Discontinuity Stress Allowable (UG-23(e)), Sps.*

Make sure that material properties at this temperature are not time-dependent for Material: SA-516 70

Attachment Type	Type	Rectangular	
Parameter C11	C11	16.00	mm.
Parameter C22	C22	250.00	mm.
Thickness of Reinforcing Pad	Tpad	12.000	mm.
Pad Parameter C11P	C11p	200.000	mm.
Pad Parameter C22P	C22p	350.000	mm.
Design Internal Pressure	Dp	0.000	bars
Include Pressure Thrust		No	

External Forces and Moments in WRC 107/537 Convention:

Radial Load (SUS)	P	-8086.0	N
Longitudinal Shear (SUS)	Vl	16768.0	N
Circumferential Shear (SUS)	Vc	15627.0	N
Circumferential Moment (SUS)	Mc	1677.0	N-m
Longitudinal Moment (SUS)	Ml	1563.0	N-m
Torsional Moment (SUS)	Mt	0.0	N-m

Use Interactive Control	No
WRC107 Version	Version March 1979 (B1 & B2)

Include Pressure Stress Indices per Div. 2	No
Compute Pressure Stress per WRC-368	No

Note:

WRC Bulletin 537 provides equations for the dimensionless curves found in bulletin 107. As noted in the foreword to bulletin 537, "537 is equivalent to WRC 107". Where 107 is printed in the results below, "537" can be interchanged with "107".

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 241 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

WRC 107 Stress Calculation for SUSained loads:

Radial Load	P	-8086.0	N
Circumferential Shear	VC	15627.0	N
Longitudinal Shear	VL	16768.0	N
Circumferential Moment	MC	1677.0	N-m
Longitudinal Moment	ML	1563.0	N-m
Torsional Moment	MT	0.0	N-m

Dimensionless Parameters used : Gamma = 31.39

Dimensionless Loads for Cylindrical Shells at Attachment Junction:

Curves read for 1979 B1/B2	Beta	Figure	Value	Location
N(PHI) / (P/Rm)	0.089	4C	5.671	(A,B)
N(PHI) / (P/Rm)	0.089	3C	5.145	(C,D)
M(PHI) / (P)	0.048	2C1	0.163	(A,B)
M(PHI) / (P)	0.048	1C	0.203	(C,D)
N(PHI) / (MC/ (Rm**2 * Beta))	0.035	3A !	0.225	(A,B,C,D)
M(PHI) / (MC/ (Rm * Beta))	0.045	1A	0.104	(A,B,C,D)
N(PHI) / (ML/ (Rm**2 * Beta))	0.088	3B !	2.636	(A,B,C,D)
M(PHI) / (ML/ (Rm * Beta))	0.078	1B1	0.053	(A,B,C,D)
N(x) / (P/Rm)	0.070	3C	5.524	(A,B)
N(x) / (P/Rm)	0.070	4C	5.805	(C,D)
M(x) / (P)	0.073	1C1	0.168	(A,B)
M(x) / (P)	0.073	2C	0.128	(C,D)
N(x) / (MC/ (Rm**2 * Beta))	0.035	4A !	0.278	(A,B,C,D)
M(x) / (MC/ (Rm * Beta))	0.061	2A	0.061	(A,B,C,D)
N(x) / (ML/ (Rm**2 * Beta))	0.088	4B !	0.743	(A,B,C,D)
M(x) / (ML/ (Rm * Beta))	0.108	2B1	0.074	(A,B,C,D)

Note - The ! mark next to the figure name denotes curve value exceeded.

Stress Concentration Factors: Kn = 1.00, Kb = 1.00

Stresses in the Vessel at the Attachment Junction (N./mm²)

Type of Stress	Load	Stress Intensity Values at							
		Au	Al	Bu	Bl	Cu	Cl	Du	Dl
Circ. Memb. P		4.5	4.5	4.5	4.5	4.1	4.1	4.1	4.1
Circ. Bend. P		24.4	-24.4	24.4	-24.4	30.5	-30.5	30.5	-30.5
Circ. Memb. MC		0.0	0.0	0.0	0.0	-0.5	-0.5	0.5	0.5
Circ. Memb. MC		0.0	0.0	0.0	0.0	-126.5	126.5	126.5	-126.5
Circ. Memb. ML		-5.2	-5.2	5.2	5.2	0.0	0.0	0.0	0.0
Circ. Bend. ML		-34.7	34.7	34.7	-34.7	0.0	0.0	0.0	0.0
Tot. Circ. Str.		-11.0	9.5	68.8	-49.3	-92.4	99.6	161.5	-152.4

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><th>نسخه</th><th>سریال</th><th>نوع مدرک</th><th>رشته</th><th>تسهیلات</th><th>صادر کننده</th><th>بسته کاری</th><th>پروژه</th></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 242 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Long. Memb. P	4.4	4.4	4.4	4.4	4.6	4.6	4.6	4.6
Long. Bend. P	25.1	-25.1	25.1	-25.1	19.1	-19.1	19.1	-19.1
Long. Memb. MC	0.0	0.0	0.0	0.0	-1.1	-1.1	1.1	1.1
Long. Bend. MC	0.0	0.0	0.0	0.0	-54.6	54.6	54.6	-54.6
Long. Memb. ML	-2.7	-2.7	2.7	2.7	0.0	0.0	0.0	0.0
Long. Bend. ML	-35.5	35.5	35.5	-35.5	0.0	0.0	0.0	0.0
Tot. Long. Str.	-8.6	12.1	67.7	-53.6	-32.0	39.0	79.4	-68.0
Shear VC	27.1	27.1	-27.1	-27.1	0.0	0.0	0.0	0.0
Shear VL	0.0	0.0	0.0	0.0	-1.9	-1.9	1.9	1.9
Shear MT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tot. Shear	27.1	27.1	-27.1	-27.1	-1.9	-1.9	1.9	1.9
Str. Int.	54.3	54.3	95.4	78.7	92.5	99.7	161.6	152.4

Dimensionless Parameters used : Gamma = 93.17

Dimensionless Loads for Cylindrical Shells at Pad edge:

Curves read for 1979 B1/B2	Beta	Figure	Value	Location
N(PHI) / (P/Rm)	0.302	4C	7.511	(A,B)
N(PHI) / (P/Rm)	0.302	3C	2.615	(C,D)
M(PHI) / (P)	0.220	2C1	0.015	(A,B)
M(PHI) / (P)	0.220	1C !	0.067	(C,D)
N(PHI) / (MC/(Rm**2 * Beta))	0.216	3A	2.972	(A,B,C,D)
M(PHI) / (MC/(Rm * Beta))	0.226	1A	0.056	(A,B,C,D)
N(PHI) / (ML/(Rm**2 * Beta))	0.260	3B	5.347	(A,B,C,D)
M(PHI) / (ML/(Rm * Beta))	0.240	1B1	0.011	(A,B,C,D)
N(x) / (P/Rm)	0.264	3C	3.277	(A,B)
N(x) / (P/Rm)	0.264	4C	8.487	(C,D)
M(x) / (P)	0.270	1C1	0.027	(A,B)
M(x) / (P)	0.270	2C !	0.036	(C,D)
N(x) / (MC/(Rm**2 * Beta))	0.216	4A	8.390	(A,B,C,D)
M(x) / (MC/(Rm * Beta))	0.270	2A	0.022	(A,B,C,D)
N(x) / (ML/(Rm**2 * Beta))	0.260	4B	2.779	(A,B,C,D)
M(x) / (ML/(Rm * Beta))	0.277	2B1	0.015	(A,B,C,D)

Note - The ! mark next to the figure name denotes curve value exceeded.

Stress Concentration Factors: Kn = 1.00, Kb = 1.00

Stresses in the Vessel at the Edge of Reinforcing Pad (N./mm²)

Type of Stress	Stress Intensity Values at							
	Au	Al	Bu	Bl	Cu	Cl	Du	Dl
Circ. Memb. P	18.1	18.1	18.1	18.1	6.3	6.3	6.3	6.3
Circ. Bend. P	20.2	-20.2	20.2	-20.2	90.1	-90.1	90.1	-90.1
Circ. Memb. MC	0.0	0.0	0.0	0.0	-6.9	-6.9	6.9	6.9

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK	شماره صفحه : 243 از 251
نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه											
V01	0003	CN	ME	120	MF	GCS	BK											

Circ. Memb. MC	0.0	0.0	0.0	0.0	-124.8	124.8	124.8	-124.8
Circ. Memb. ML	-14.4	-14.4	14.4	14.4	0.0	0.0	0.0	0.0
Circ. Bend. ML	-21.8	21.8	21.8	-21.8	0.0	0.0	0.0	0.0
Tot. Circ. Str.	2.1	5.3	74.6	-9.6	-35.4	34.1	228.2	-201.7
Long. Memb. P	7.9	7.9	7.9	7.9	20.5	20.5	20.5	20.5
Long. Bend. P	36.1	-36.1	36.1	-36.1	48.7	-48.7	48.7	-48.7
Long. Memb. MC	0.0	0.0	0.0	0.0	-27.0	-27.0	27.0	27.0
Long. Bend. MC	0.0	0.0	0.0	0.0	-40.1	40.1	40.1	-40.1
Long. Memb. ML	-9.7	-9.7	9.7	9.7	0.0	0.0	0.0	0.0
Long. Bend. ML	-24.9	24.9	24.9	-24.9	0.0	0.0	0.0	0.0
Tot. Long. Str.	9.5	-13.0	78.6	-43.5	2.1	-15.2	136.2	-41.2
Shear VC	6.5	6.5	-6.5	-6.5	0.0	0.0	0.0	0.0
Shear VL	0.0	0.0	0.0	0.0	-4.0	-4.0	4.0	4.0
Shear MT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tot. Shear	6.5	6.5	-6.5	-6.5	-4.0	-4.0	4.0	4.0
Str. Int.	15.0	22.5	83.4	44.7	38.3	49.9	228.4	201.8

WRC 107/537 Stress Summations:

Vessel Stress Summation at Attachment Junction (N./mm²)

Type of Stress Load		Stress Intensity Values at							
		Au	Al	Bu	Bl	Cu	Cl	Du	Dl
Circ. Pm (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circ. Pl (SUS)		-0.7	-0.7	9.8	9.8	3.6	3.6	4.6	4.6
Circ. Q (SUS)		-10.2	10.2	59.1	-59.1	-96.0	96.0	156.9	-156.9
Long. Pm (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long. Pl (SUS)		1.7	1.7	7.1	7.1	3.5	3.5	5.7	5.7
Long. Q (SUS)		-10.4	10.4	60.6	-60.6	-35.5	35.5	73.7	-73.7
Shear Pm (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Pl (SUS)		27.1	27.1	-27.1	-27.1	-1.9	-1.9	1.9	1.9
Shear Q (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pm (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pm+Pl (SUS)		54.3	54.3	54.3	54.3	5.4	5.4	7.1	7.1
Pm+Pl+Q (Total)		54.3	54.3	95.4	78.7	92.5	99.7	161.6	152.4

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 244 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Vessel Stress Summation Comparison (N./mm²):

Type of Stress Int.	Max. S.I.	S.I. Allowable	Result
Pm (SUS)	0.00	137.90	Passed
Pm+Pl (SUS)	54.33	206.85	Passed
Pm+Pl+Q (TOTAL)	161.55	413.70	Passed

Because only sustained loads were specified, the Pm+Pl+Q allowable was 3 * Smh.

WRC 107/537 Stress Summations:

Vessel Stress Summation at Reinforcing Pad Edge (N./mm²)

Type of Stress	Load	Stress Intensity Values at							
		Au	Al	Bu	Bl	Cu	Cl	Du	Dl
Circ. Pm (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Circ. Pl (SUS)		3.7	3.7	32.5	32.5	-0.6	-0.6	13.2	13.2
Circ. Q (SUS)		-1.6	1.6	42.1	-42.1	-34.7	34.7	214.9	-214.9
Long. Pm (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long. Pl (SUS)		-1.8	-1.8	17.6	17.6	-6.6	-6.6	47.5	47.5
Long. Q (SUS)		11.3	-11.3	61.0	-61.0	8.6	-8.6	88.7	-88.7
Shear Pm (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shear Pl (SUS)		6.5	6.5	-6.5	-6.5	-4.0	-4.0	4.0	4.0
Shear Q (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pm (SUS)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pm+Pl (SUS)		14.1	14.1	35.0	35.0	9.9	9.9	47.9	47.9
Pm+Pl+Q (Total)		15.0	22.5	83.4	44.7	38.3	49.9	228.4	201.8

Vessel Stress Summation Comparison (N./mm²):

Type of Stress Int.	Max. S.I.	S.I. Allowable	Result
Pm (SUS)	0.00	137.90	Passed
Pm+Pl (SUS)	47.95	206.85	Passed
Pm+Pl+Q (TOTAL)	228.36	413.70	Passed

Because only sustained loads were specified, the Pm+Pl+Q allowable was 3 * Smh.

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)	شماره صفحه : 245 از 251																
	<table><tr><td>نسخه</td><td>سریال</td><td>نوع مدرک</td><td>رشته</td><td>تسهیلات</td><td>صادر کننده</td><td>بسته کاری</td><td>پروژه</td></tr><tr><td>V01</td><td>0003</td><td>CN</td><td>ME</td><td>120</td><td>MF</td><td>GCS</td><td>BK</td></tr></table>		نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه	V01	0003	CN	ME	120	MF	GCS	BK
	نسخه		سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه									
V01	0003	CN	ME	120	MF	GCS	BK											

Lifting Calculation

LIFTING LUG CALCULATION

FOR

V-120



نگهداشت و افزایش تولید میدان نفتی بینک
سطح الارض و ابنیه تحت الارض

خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک
(قرارداد BK-HD-GCS-CO-0010_08)



شماره پیمان:

053 - 073 - 9184

MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)

نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه
V01	0003	CN	ME	120	MF	GCS	BK

شماره صفحه : 246 از 251

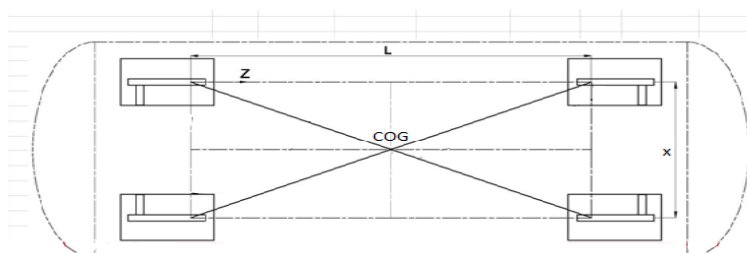
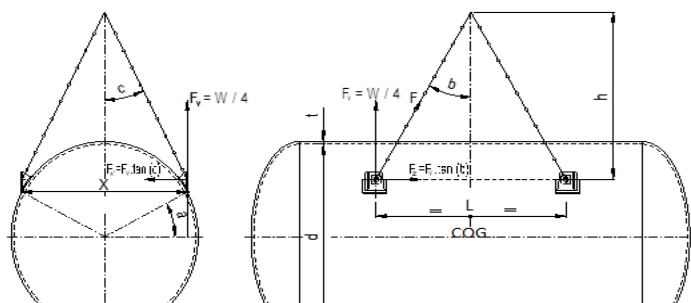
INPUT DATA:

Lifting Distance (L)-mm	2,500
W = Weight-Kg	3,420
Inside Diameter (d)-mm	1,100
Thickness (t)-mm	12
Lifting Orientation (a)-Degree	45
Lifting Angle (b)-Degree	45
Number of Lug	4
I = Impact Factor	2
Corrosion ALLOWANCE	6

RESULT:

Lifting Distance (X)-mm:	795
Outside Radius-mm:	562
Lifting Angle (c)-Degree :	18
Lifting Height (h)-mm:	1,250
Normal Force (F _y)-Kg:	1,710
Tangential Force (F _x)-Kg:	544
Axial Force (F _z)-Kg:	1,710
Angle-Degree(180-2a) :	90

* Corroded thickness for shell is considered in lifting calculation

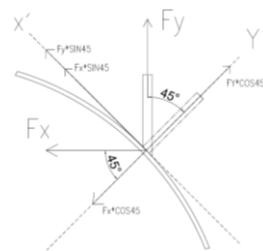


Top View

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 247 از 251	
	نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری		پروژه
	V01	0003	CN	ME	120	MF	GCS		BK

Design Data:

Material of Lug:	SA-283 C	
Errrection weight :	We = 3,420	Kg
Number of Lug:	N = 4	
Impact Factor:	C = 2	
Yield Stress of Lug:	S _y = 191	N / mm ² @85°C
Max. Tensil Stress :	S _t = 379	N / mm ²
Allowable Tensil Stress:(2/7 * S _t)	S _a = 108.3	N / mm ²
Allowable Contact Stress:(2*S _y)	P ₀ = 382	N / mm ²
Max. Bending Stress :(0.66* S _y)	S _b = 126.1	N / mm ²
Joint Efficiency of Fillet Weld:	J.E = 0.6	(Base on Moss)
Moduls of Elasticity:	E = 19,905	Kg/mm ² @85°C
F =	24,306	N
F _x =	5,332	N
F _y =	16,768	N
F _z =	16,768	N
F _y ' = (F _y -F _x)COS 45	8,086	N
F _x ' = (F _y +F _x)SIN 45	15,627	N



(F_x'=V_C) AND (F_y'=P) AND (F_z=V_L) ARE THREE FORCES WHICH HAVE BEEN USED FOR STRESS CALCULATIONS ON SHELL WITH CODE CALC. SOFTWARE & MOMENTS EQUAL TO ($\underline{MC}=F_{x'} * L$) & ($\underline{ML}=F_{z'} * L$)

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)																	
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120) <table><tr><td>پروژه</td><td>بسته کاری</td><td>صادر کننده</td><td>تسهیلات</td><td>رشته</td><td>نوع مدرک</td><td>سریال</td><td>نسخه</td></tr><tr><td>BK</td><td>GCS</td><td>MF</td><td>120</td><td>ME</td><td>CN</td><td>0003</td><td>V01</td></tr></table>	پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	BK	GCS	MF	120	ME	CN	0003	V01	شماره صفحه : 248 از 251
پروژه	بسته کاری	صادر کننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه											
BK	GCS	MF	120	ME	CN	0003	V01											

CONVERTING SECTION OF ATTACHMENT TO RECTANGLE:

DUE TO PRESSURE VESSEL DESIGN MANUAL BY DENNIS R.MOSS FOR LOCAL STRESS CALCULATION IN CYLINDRICAL SHELLS(Chapter.7) ,IRREGULAR ATTACHMENTS CAN BE CONVERTED IN TO A RECTANGLE. SO THIS PROCEDURE HAS BEEN USED :

TC:

b:

e:

C1:

C2:

C11:

C22

D+p

16

100

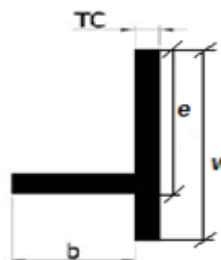
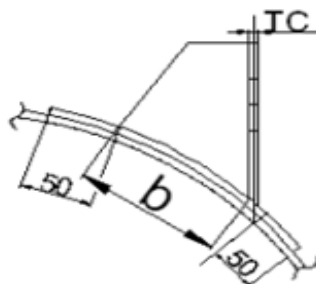
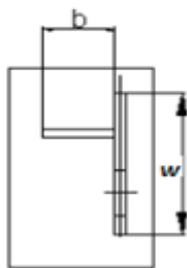
150

20

60

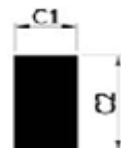
40

120



$$C1=0.2*b$$

$$C2=0.4*e$$



C1 IS IN CIRCUMFERENTIAL DIRECTION AND C2 IS IN LONGITUDINAL DIRECTION



نگهداشت و افزایش تولید میدان نفتی بینک
سطح الارض و ابنیه تحت الارض

خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک
(قرارداد BK-HD-GCS-CO-0010_08)



شماره پیمان:

053 - 073 - 9184

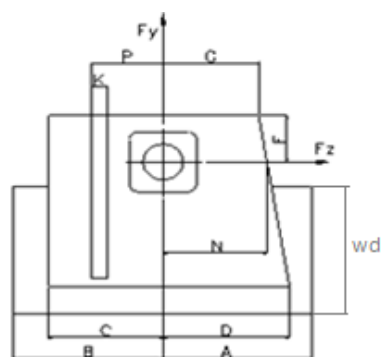
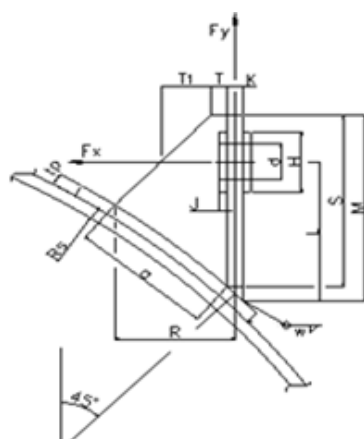
MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)

نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه
V01	0003	CN	ME	120	MF	GCS	BK

شماره صفحه : 249 از 251

CLIP DESIGN:

A =	150	mm	K =	12	mm
B =	200	mm	L =	100	mm
C =	150	mm	M =	150	mm
D =	100	mm	N =	80	mm
T =	16	mm	d =	70	mm
F =	70	mm	R =	80	mm
G =	60	mm	Rs =	562	mm
H =	0	mm	S =	140	mm
J =	0	mm	P =	50	mm
a =	100	mm	w =	11	mm (Weld Leg for Lug)
T1 =	50	mm	d ₁ =	50	mm (Pin Dia.)
t _p =	12	mm	wd =	100	mm





نگهداشت و افزایش تولید میدان نفتی بینک
سطح الارض و ابنیه تحت الارض

خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک
(قرارداد BK-HD-GCS-CO-0010_08)



شماره پیمان:

053 - 073 - 9184

MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)

نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادر کننده	بسته کاری	پروژه
V01	0003	CN	ME	120	MF	GCS	BK

شماره صفحه : 250 از 251

Stress Calculation:

a) Shear Stress Due to F_y :

$$S_1 = F_y / (K \times (F - d / 2) + 2 \times J \times (H / 2 - d / 2))$$

$$S_1 = 39.92 \quad \text{N/mm}^2 < 0.4 S_y \quad 76.40$$

OK

b) Tension Stress Due to F_y :

$$S_2 = F_y / (K \times (C + D - d) + 2 \times J \times (H - d) + K \times T_1)$$

$$S_2 = 6.08 \quad \text{N/mm}^2 < 0.6 S_y \quad 114.60$$

OK

c) Shear Stress Due to F_z :

$$S_3 = F_z / (K \times (N - d / 2) + 2 \times J \times (H / 2 - d / 2))$$

$$S_3 = 31.05 \quad \text{N/mm}^2 < 0.4 S_y \quad 76.40$$

OK

d) Tension Stress Due to F_z :

$$S_4 = F_z / (K \times (M - d) + 2 \times J \times (H - d))$$

$$S_4 = 17.47 \quad \text{N/mm}^2 < 0.6 S_y \quad 114.60$$

OK

e) Bending Stress Due to F_x :

$$M_z = F_x \times L \quad 533,230.67 \quad \text{N.mm}$$

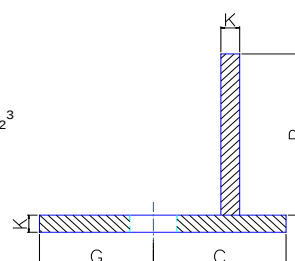
$$C_y = 52.7$$

$$I = K \times R^3 / 12 + K \times R \times d_1^2 + (C + G) \times K^3 / 12 + K \times (C + G) \times d_2^3$$

$$I = 1,304,035.3 \quad \text{mm}^4$$

$$S_5 = M_z \times C_y / I$$

$$S_5 = 21.56 \quad \text{N/mm}^2$$



f) Tension Stress Due to F_y :

$$S_6 = F_y / (K \times (C + D))$$

$$S_6 = 5.59 \quad \text{N/mm}^2$$

Combined Stress:

$$S_7 = S_5 + S_6 \quad 27.15 \quad \text{N/mm}^2$$

$$S_8 = S_5 - S_6 \quad 15.97 \quad \text{N/mm}^2$$

 NISOC	نگهداشت و افزایش تولید میدان نفتی بینک سطح الارض و ابنیه تحت الارض خرید بسته نم زدای گاز ایستگاه تقویت فشار گاز بینک (قرارداد BK-HD-GCS-CO-0010_08)								
شماره پیمان: 053 – 073 – 9184	MECHANICAL CALCULATION BOOK FOR GLYCOL FLASH DRUM (V-120)							شماره صفحه : 251 از 251	
	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال		نسخه
	BK	GCS	MF	120	ME	CN	0003		V01

$$\tau = F_z / ((C + D) \times K)$$

$$\tau = 5.6$$

$$\sigma_1 = S_7 / 2 + ((S_7 / 2)^2 + \tau^2)^{0.5}$$

$$\sigma_1 = 23.3 \quad \text{N/mm}^2 < 0.6 S_y \quad 114.60$$

OK

$$\sigma_2 = S_7 / 2 - ((S_7 / 2)^2 + \tau^2)^{0.5}$$

$$\sigma_2 = 3.8 \quad \text{N/mm}^2 < 0.6 S_y \quad 114.60$$

OK

$$\tau_{Max} = (\sigma_1 - \sigma_2) / 2$$

$$\tau_{Max} = 9.7 \quad \text{N/mm}^2 < 0.5 S_y \quad 95.50$$

OK

$$S_5 / F_a + S_6 / F_b < 1$$

$$0.24$$

OK

Hertz Stress:

$$P_0 = 0.418 \times \sqrt{(F \times E.L. / (-(d_1/2) \times (d/2) \times (K + 2 \times J)) / (d_1/2 - d/2)}$$

$$P_0 = 283.7 < P_0 \quad 382.0$$

OK

Weld Size Calculation:

Shear Load in Weld is Greater of Following

$$\tau_w = (6 \times F_x \times L) / (2 \times R^2)$$

$$\tau_w = 250.0 \quad \text{N/mm}^2$$

$$\tau_w = (6 \times F_z \times L) / (2 \times (C + D)^2)$$

$$\tau_w = 80.48765 \quad \text{N/mm}^2$$

$$\tau_w = (F_y) / (2 \times (C + D))$$

$$\tau_w = 33.5 \quad \text{N/mm}^2$$

$$\text{Max.} = 250.0$$

Minimum Weld Size

$$\tau_w / (0.7 \times J.E. \times S_a) = 5$$

$$\text{Weld Leg} = 11$$

OK