


<b>PROJECT :</b>			<b>DATE :</b>	4/22/2011
<b>PROJ. NO.:</b>			<b>BY :</b>	S.Rahimi
<b>CLIENT :</b>			<b>REV :</b>	A
<b>UNIT :</b>			<b>DOC NO.:</b>	0

### Piping Volume Calculation

Line Number	From	To	Pipe length m	Pipe ID mm	Hold up volume m <sup>3</sup>
32"-HW 88011-31031X	V-8801	P-8801A/B/C Suction header	57.00	787.6	27.77
18"-HW-88012-31031X	P-8801A/B/C Suction header	P-8801A/B/C	9.50	428	1.37
18"-HW-88014-31031X	P-8801A/B/C Suction header	P-8801A/B/C	6.40	428	0.92
18"-HW-88017-31031X	P-8801A/B/C Suction header	P-8801A/B/C	5.00	428	0.72
18"-HW 88013-31031X	P-8801A/B/C	P-8801A/B/C Discharge	12.30	428	1.77
18"-HW 88015-31031X	P-8801A/B/C	P-8801A/B/C Discharge	12.30	428	1.77
18"-HW 88018-31031X	P-8801A/B/C	P-8801A/B/C Discharge	10.00	428	1.44
6"HW 88020 31031X	P-8801A/B/C Discharge header	S-8802 to V-8802	25.00	154	0.47
6"HW 88020 31031X	P-8801A/B/C Discharge header	S-8802 to V-8803	45.00	154	0.84
30"-HW 88016-31031X	P-8801A/B/C Discharge header	E-8802 area (piperack)	22.00	736	9.36
10"-HW 88022-31031X	Piperack to E-8802 to piperack	E-8802 area (piperack)	15.00	254	0.76
10"-HW 88023-31031X	P-8801A/B/C		15.00	254	0.76
30"-HW 880-	P-8801A/B/C Discharge header	24" Reducer on piperack	90.00	736	38.29
24"-HW 880-	Reducer on Piperack to Heater		50.00	575	12.98
16"-HW 88024-31031X	Heator Bypass		25.00	381	2.85
18"-HW 88016-31031X	F-8850 A		30.00	428	4.32
18"-HW 880-	F-8850 B		120.00	428	17.26
24"-HW 88-	Supply Header from F-8850 A/B	Heater area	100.00	575	25.97
16"- HW 88021-31031X	Supply Header to E-8801	Main 24" Return Header	80.00	381	9.12
24"-HW 88021-31031X	BSulfinol Reboiler Supply Header		180.00	575	46.74
18"-HW-88077-31031X	E-5104 area (Supply)		170.00	428	24.46
18"-HW-88025-31031X	18" Header	B/L of Phase 2AB	180.00	428	25.90
18"-HW-88025-31031X	B/L of Phase 2AB	Phase 2C	150.00	428	21.58
12"-HW 88025-31031X	Stabilizer Reboiler Supply Header	Phase 2C	142.00	303	10.24
10"-HW 88075-31031X	E-4104 Area Supply		130.00	254	6.59
10"-HW 88021-31031X	10" Header	B/L of Phase 2AB	10.00	254	0.51
10"-HW 88021-31031X	B/L of Phase 2AB	Phase 2C	150.00	254	7.60
6"-HW 88075-31031X	E-4104 supply		20.00	154	0.37
6"-HW 41001-31031X	E-4104 return to 10" header		0.30	154	0.01
6"-HW 880XX-31031X	E-4204 Supply		10.00	154	0.19
6"-HW 880XX-31031X	E-4204 Return to 10" header		10.00	154	0.19
12"- HW 51077-31031X	E-5104 A Supply		25.00	303	1.80
12"- HW 51001-31031X	E-5104 B Supply		24.00	303	1.73
12"- HW 51002-31031X	E-5104 A Return		9.50	303	0.69
12"- HW 51003-31031X	E-5104 B Return		10.00	303	0.72
12"- HW 510XX-31031X	E-5204 A Supply		25.00	303	1.80
12"- HW 510XX-31031X	E-5204 B Supply		25.00	303	1.80
12"- HW 510XX-31031X	E-5204 A Return		10.00	303	0.72
12"- HW 510XX-31031X	E-5204 B Return		10.00	303	0.72
18"-HW 88039-31031X	Phase 2AB B/L till 24"expander		155.00	428	22.30
18"-HW 88039-31031X	Phase 2C E-5204 A/B	Phase 2AB B/L	185.00	428	26.62
18"- HW 51003-31031X	Return Header E-5104A/B Area	Phase 2AB B/L	80.00	428	11.51
24"-HW-88039-31031X	Main Return Header to V-8801		160.00	575	41.55
10"-HW-410XX-31031X	E-5204 A/B	E-4204 supply	30.00	254	1.52
10"-HW-41001-31031X	E-5104 A/B	E-4104 supply	30.00	254	1.52
<b>Piping Volume (m3)</b>					<b>418.09</b>

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### Equipment Volume Calculation

Heat Exchanger Volume Calculation		Equipment Tag no.				
Geometry	Units	E-8801	E-8802	E-9101	E-9102	
Heating Media in	----	Shell	Shell	Tube	Tube	
Tube no	----	330.00	468.00	140.00	250.00	
Tube ID	mm	19.05	19.05	25.00	25.00	
Tube OD	mm	23.00	23.00	30.00	30.00	
Tube Length	m	3.10	3.10	6.00	7.00	
Shell ID	m	0.70	0.70	2.00	2.00	
<b>Total Volume</b>	<b>m3</b>	<b>0.77</b>	<b>0.59</b>	<b>0.41</b>	<b>0.86</b>	<b>0.00</b>

Aircooler Volume Calculation		Equipment Tag no.				
Geometry	Units	AE-8801				
Tube no	----	984.00				
Tube ID	mm	21.18				
Tube Length	m	9.00				
<b>Tube Volume</b>	<b>m3</b>	<b>3.12</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Header Length	m	3.00				
Header Width	mm	150.00				
Header height	m	0.35				
Number of headers	----	12.00				
<b>Header Volume</b>	<b>m3</b>	<b>1.86</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>Total Volume</b>	<b>m3</b>	<b>4.98</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>

Fired Heater Volume Calculation		Radiant	Convection 1	Convection 2	Convection 3	
Tube ID	mm	154.08	154.08	154.08	154.08	
Tubes No	----	96	36	24	60	
Overall Tube Length	m	17	9	9	9	
<b>Total Volume</b>	<b>m3</b>	<b>30.43</b>	<b>6.04</b>	<b>4.03</b>	<b>10.07</b>	<b>0.00</b>

Equipment Volume		
HX Volume	m3	2.63
Aircooler Volume	m2	4.98
Heater Volume	m3	50.57
Pump Volume	m3	1.00
Expansion Vessel Volume	m3	49.83
<b>Total Volume</b>	<b>m3</b>	<b>109.01</b>

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### Expansion Vessel Sizing

Input Data		
Piping Volume	m3	418.1
Piping Volume Overdesign	%	10.0
Equipment Hold up Volume	m3	109.0
Minimum Operating temp	°C	23
Max. Operating temp	°C	150
Density at Min Operating Temp	kg/m3	997.497
Density at Max Operating Temp.	kg/m3	917.008
Vessel L/D	---	2.75
Vessel Orientation	---	H

Vessel Sizing		
Total System Hold up volume	m3	568.9
Mass @ Min. Operating temp	kg	567490
Volume @ maximum op. temp	m3	713.8
Expansion Volume	m3	52.7

Final Results		
Vessel Diameter	m	4.00
Vessel Length	m	11.0
Vessel Cross sectional Area	m2	12.6
Vessel Volume	m3	138.2
NLL - BTM	m	1.6
Vessel Liquid volume	m3	49.8

Level Setting		
Parameter	Height m	Volume m <sup>3</sup>
LSHH - LAH	0.2	7.87
LAH - LAL	1.5	64.40
LAL - LSL	1	34.10
LSL - BTM	0.3	5.23

Sizing Status			
Parameter	Sizing Criteria	Value	Status
Vapor Space	25 % Vessel dia.	25%	OK
LSHH - LAH	0.1 m minimum	0.2	OK
LAH - LAL	120 % expansion vol	122%	OK
LAL - LSL	25% vessel volume	28%	OK

Notes