PROJECT :			**DATE :**	3/4/2011
PROJ. NO.:			**BY :**	S.R
CLIENT :			**REV :**	A
UNIT :			**DOC NO.:**	0

Tube Rupture Relief Rate Calculation (Two Phase - based on API 520 section D.2.1 A1)

Input Data		
HP Side Vapor Mass fraction	----	0.1000
HP Side Vapor Mass Density	lb/ft3	1.33
HP Side Liquid Mass Density	lb/ft3	49.54
HP Side Latent Heat of Vaporization (hvl)	btu/lb	728.3
HP Side Liquid Specific Heat	btu/lbR	1.17
HP Side Operating Pressure	psig	600.00
LP Side PSV Set Pressure	psig	200.00
HP Side Operating Temperature	R	948.80
Exchanger Tube Length	in	192.00
Exchanger Tube Inside Diameter	in	0.7320

A1:		
Rvl = 1/ Rl- 1/Rv	lb/ft3	0.7306
Ro = Xv Rv + (1-Xv) Rl	lb/ft3	44.7183
HP Side Operating Pressure (Po)	psia	614.70
LP Side Design Pressure (Pb)	psia	214.70
ω (from equation D.1)		8.25
set to zero		0.0011
ηc = Pc/P		0.834
Critical Pressure (Pc)	psia	512.42
Flow Regime	----	Critical
used Pb	psia	512.42
Tube Discharge Area	in2	0.421
Mass Flux Rate Through Tubesheet (G1)	lb/hr in2	81795.5
Mass Flow Rate Through Tubesheet	**lb/hr**	**34405**

Itration on η1		0.983
η2		0.480
delta (set to zero by changing η1)		-0.4980
firiction factor f = 1/ (44.137+ 11.691 ln di)		0.02470
Mass Flow Rate Through Tube (G2)	lb/hr in2	47066.7
Mass Flow Rate Through Tube	**lb/hr**	**19797**
Total Flow Rate Throubh Breakage	**lb/hr**	**54202**

General Notes

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UNIT :			**DOC NO.:**	0

Tube Rupture Relief Rate Calculation (Two Phase - based on API 520 section D.2.1 A2)

Input Data		
HP Side Vapor Mass fraction	---	0.2000
HP Side Vapor Mass Density	lb/ft3	1.33
HP Side Liquid Mass Density	lb/ft3	20.10
HP Side Vapor Mass fraction @ 90% Pop HPS	%	0.9000
HP Side Vapor Mass Density @ 90% Pop HPS	lb/ft3	1.20
HP Side Liquid Mass Density @ 90% Pop HPS	lb/ft3	16.75
HP Side Operating Pressure	psig	66.00
LP Side PSV Set Pressure	psig	15.00
Exchanger Tube Length	in	192.00
Exchanger Tube Inside Diameter	in	0.7320

A2 :		
R9 = Xv9 Rv + (1-Xv9) Rl	lb/ft3	2.7550
Ro = Xv Rv + (1-Xv) Rl	lb/ft3	16.3464
HP Side Operating Pressure (Po)	psia	80.70
LP Side Design Pressure (Pb)	psia	29.70
ω (from equation D.3)		44.400
set to zero		0.0012
ηc = Pc/P		0.931
Critical Pressure (Pc)	psia	75.16
Flow Regime	----	Critical
used Pb	psia	75.16
Tube Discharge Area	in2	0.421
Mass Flux Rate Through Tubesheet (G1)	lb/hr in2	8629.7
Mass Flow Rate Through Tubesheet	**lb/hr**	**3630**

Itration on η1		0.957
η2		0.919
delta (set to zero by changing η1)		6.4331
firiction factor f = 1/ (44.137+ 11.691 ln di)		0.02470
Mass Flow Rate Through Tube (G2)	lb/hr in2	8513.3
Mass Flow Rate Through Tube	**lb/hr**	**3581**
Total Flow Rate Throubh Breakage	**lb/hr**	**7211**

General Notes

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UNIT :			**DOC NO.:**	0

Tube Rupture Relief Rate Calculation (Two Phase - based on API 520 section D.2.1 A3)

Input Data		
HP Side Vapor Mass fraction	---	0.1000
HP Side Vapor Mass Density	lb/ft3	6.58
HP Side Liquid Mass Density	lb/ft3	61.15
HP Side Vapor Specific Heat Ratio	----	1.00
HP Side Operating Pressure	psig	558.25
LP Side PSV Set Pressure	psig	101.50
Exchanger Tube Length	in	192.00
Exchanger Tube Inside Diameter	in	1.0000

A3 :		
Ro = Xv Rv + (1-Xv) Rl	lb/ft3	55.6951
HP Side Operating Pressure (Po)	psia	572.95
LP Side Design Pressure (Pb)	psia	116.20
ω (from equation D.4)		0.85
set to zero		0.0011
ηc = Pc/P		0.584
Critical Pressure (Pc)	psia	334.84
Flow Regime	----	Critical
used Pb	psia	334.84
Tube Discharge Area	in2	0.785
Mass Flux Rate Through Tubesheet (G1)	lb/hr in2	192950.9
Mass Flow Rate Through Tubesheet	**lb/hr**	**151466**

Itration on η1		0.851
η2		0.452
delta (set to zero by changing η1)		3.2214
firiction factor f = 1/ (44.137+ 11.691 ln di)		0.02266
Mass Flow Rate Through Tube (G2)	lb/hr in2	149362.9
Mass Flow Rate Through Tube	**lb/hr**	**117250**
Total Flow Rate Throubh Breakage	**lb/hr**	**268716**

General Notes

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UNIT :			**DOC NO.:**	0

Tube Rupture Relief Rate Calculation (Two Phase - based on API 520 section D.2.2 A1)

Input Data		
HP Side Operating Temperature	R	520.00
HP Side Liquid Saturatin Pressure (Ps)	psia	107.6
HP Side Liquid Mass Density @ Ps	lb/ft3	31.64
HP Side Vapor Mass Density @ Ps	lb/ft3	1.00
HP Side Liquid Mass Density	lb/ft3	31.92
HP Side Latent Heat of Vaporization (hvl) @ Ps	btu/lb	152.3
HP Side Liquid Specific Heat	btu/lbR	0.64
HP Side Operating Pressure	psig	286.00
LP Side PSV Set Pressure	psig	10.00
Exchanger Tube Length	in	192.00
Exchanger Tube Inside Diameter	in	0.7320

A1:		
Rvl = 1/ Rl- 1/Rv	lb/ft3	0.9684
HP Side Operating Pressure (Po)	psia	300.70
LP Side Design Pressure (Pb)	psia	24.70
ωs (from equation D.8)	----	8.50
ηst	----	0.944
Subcooling Region	----	High Subcooling
ηs = Ps/Po	----	0.36
ηc from Figure D3 (for low subcooling only)	----	0.300
Critical Pressure (Pc)	psia	90.21
Flow Regime	----	Critical
used η as per type of flow regime	----	0.30
used P as per type of flow regime	psia	107.600
Mass Flux Rate Through Tubesheet (G1)	lb/hr in2	189012
Tube Discharge Area	in2	0.421
Mass Flow Rate Through Tubesheet	**lb/hr**	**79502**

Itration on η1		0.983
η2		0.491
delta (set to zero by changing η1)		-0.0422
firiction factor f = 1/ (44.137+ 11.691 ln di)		0.02470
Mass Flow Rate Through Tube (G2)	lb/hr in2	28060
Mass Flow Rate Through Tube	**lb/hr**	**11803**
Total Flow Rate Throubh Breakage	**lb/hr**	**91305**

General Notes

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UNIT :			**DOC NO.:**	0

Tube Rupture Relief Rate Calculation (Two Phase - based on API 520 section D.2.2 A2)

Input Data		
HP Side Operating Temperature	R	600.00
HP Side Liquid Saturatin Pressure (Ps)	psia	171.80
HP Side Vapor Mass fraction @ 90% Ps	---	0.1050
HP Side Liquid Mass Density @ 90% Ps	lb/ft3	33.18
HP Side Vapor Mass Density @ 90% Ps	lb/ft3	1.65
HP Side Liquid Mass Density	lb/ft3	32.74
HP Side Operating Pressure	psig	286.00
LP Side PSV Set Pressure	psig	10.00
Exchanger Tube Length	in	192.00
Exchanger Tube Inside Diameter	in	0.7320

A1:		
R9 = Xv9 Rv9+ (1 - Xv9) Rl9	lb/ft3	29.8719
HP Side Operating Pressure (Po)	psia	300.70
LP Side Design Pressure (Pb)	psia	24.70
ωs (from equation D.9)		0.86
ηst		0.633
Subcooling Region		High Subcooling
ηs = Ps/Po		0.57
ηc from Figure D3 (for low subcooling only)		0.300
Critical Pressure (Pc)	psia	90.21
Flow Regime	----	Critical
used η as per type of flow regime		0.30
used P as per type of flow regime	psia	171.800
Mass Flux Rate Through Tubesheet (G1)	lb/hr in2	156398
Tube Discharge Area	in2	0.421
Mass Flow Rate Through Tubesheet	**lb/hr**	**65785**

Itration on η1		0.947
η2		0.292
delta (set to zero by changing η1)		0.0412
firiction factor f = 1/ (44.137+ 11.691 ln di)		0.02470
Mass Flow Rate Through Tube (G2)	lb/hr in2	53002
Mass Flow Rate Through Tube	**lb/hr**	**22294**
Total Flow Rate Throubh Breakage	**lb/hr**	**88078**

General Notes