



Separators Simulation

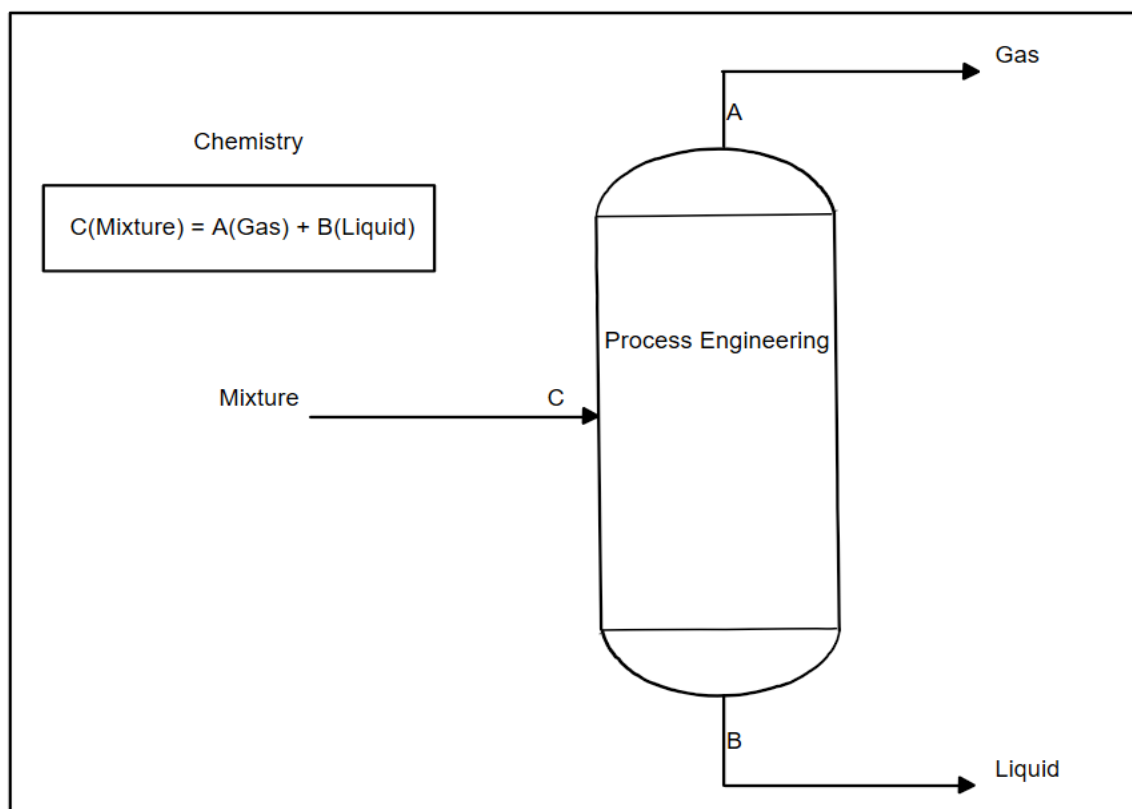




Example: Determine components' fraction in both liquid and gaseous phases for a mixture containing 15% propane, 35% iso-butane, 50% n-pentane. The percentages are molar fraction. The operating pressure is 150 kPa and the operating temperature is 25C.

Solution: In order to solve the problem, we are supposed to perform the tedious long flash calculation. Aspen Hysys can solve the problem in a minute. That is the reason we use software like Aspen Plus or Hysys.

We assume that we have a mixture with aforementioned operating conditions which is introduced to a separator. The function of the separator is to separate the gaseous phase/stream from liquid phase/stream. Aspen Hysys can easily simulate the separator and provide us with both stream thermodynamic and physical properties result. Isn't it what we want?





1. Define the components

Source Databank: HYSYS

Select: **Pure Components** Filter: **All Families**

Search for: Search by: **Full Name/Synonym**

Component	Type	Group
Propane	Pure Component	
i-Butane	Pure Component	
n-Pentane	Pure Component	

< Add

Replace

Remove

Simulation Name	Full Name / Synonym	Formula
Methane	C1	CH4
Ethane	C2	C2H6
n-Butane	n-C4	C4H10
i-Pentane	i-C5	C5H12
n-Hexane	C6	C6H14
n-Heptane	C7	C7H16
n-Octane	C8	C8H18
n-Nonane	C9	C9H20
n-Decane	C10	C10H22
n-C11	C11	C11H24
n-C12	C12	C12H26
n-C13	C13	C13H28

Status: **OK**

2. For fluid package selection, this time we will use Methods Assistance under Home.

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Aspen HYSYS Property Package Selection Assistant

Welcome to the Property Package Selection Assistant.

The purpose of the assistant is to help you select the most appropriate property packages for use with Aspen HYSYS. The assistant will ask you a number of questions. Based on your responses, it will suggest one or more property packages to use.

Start by selecting one of the following process types or applications:

- Oil and Gas Processing
- Refining
- Chemical
- Clean Fuels
- Electrolyte
- Environmental
- Mineral and Metallurgical
- Petrochemical
- Power



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 - GCEOS
 - Kabadi Danner
 - Lee-Kesler Plocker
 - Peng-Robinson
 - Peng-Robinson**

Oil and Gas Processing

In general, we recommend that you use a cubic equation of state-based property package, such as:

- Peng-Robinson
- CPA
- SRK
- BWRS
- MBWR

Select the process that you are modeling for further assistance:

- Gas Treating
- Cryogenic Gas Processing
- Reservoirs
- Hydrates

See Also

- [Property Package Descriptions](#)

Set Up Binary Coeffs StabTest Phase Order Tabular Notes

Package Type: HYSYS Component List Selection **Component List - 1 [HYSYS Databanks]** View

Property Package Selection

- Glycol Package
- Grayson-Streed
- IAPWS-IF97
- Kabadi-Danner
- Lee-Kesler-Plocker
- MBWR
- NBS Steam
- NRTL
- Peng-Robinson**
- PR-Twu
- PRSV
- Sour PR
- Sour SRK
- Sour Water
- SRK
- SRK-Twu
- Sulsim (Sulfur Recovery)
- Twu-Sim-Tassone

Options

Enthalpy	Property Package EOS
Density	Costald
Modify Tc, Pc for H2, He	Modify Tc, Pc for H2, He
Viscosity Method	HYSYS Viscosity
Peng-Robinson Options	HYSYS
EOS Solution Methods	Cubic EOS Analytical Method
Phase Identification	Default
Surface Tension Method	HYSYS Method
Thermal Conductivity	API 12A3.2-1 Method

Parameters

Property Pkg **OK** Edit Properties



4. Enter Simulation Environment and define a mixture with mentioned operating conditions. Notice since the flowrate is not mentioned, the flowrate is set to 1 kmole/hr.

Worksheet	Stream Name	Separator
Conditions	Vapour / Phase Fraction	<empty>
Properties	Temperature [C]	25.00
Composition	Pressure [kPa]	150.0
Oil & Gas Feed	Molar Flow [kgmole/h]	1.000
Petroleum Assay	Mass Flow [kg/h]	<empty>
K Value	Std Ideal Liq Vol Flow [m3/h]	<empty>
User Variables	Molar Enthalpy [kJ/kgmole]	<empty>
Notes	Molar Entropy [kJ/kgmole-C]	<empty>
Cost Parameters	Heat Flow [kJ/h]	<empty>
Normalized Yields	Liq Vol Flow @Std Cond [m3/h]	<empty>
Emissions	Fluid Package	Basis-1
	Utility Type	

Unknown Compositions

Delete Define from Stream... View Assay

5. Now enter the composition. Click Composition/Edit and provide the composition.

	Mole Fractions	Vapour Phase
Propane	0.1500	0.2076
i-Butane	0.3500	0.4299
n-Pentane	0.5000	0.3626

Total 1.00000

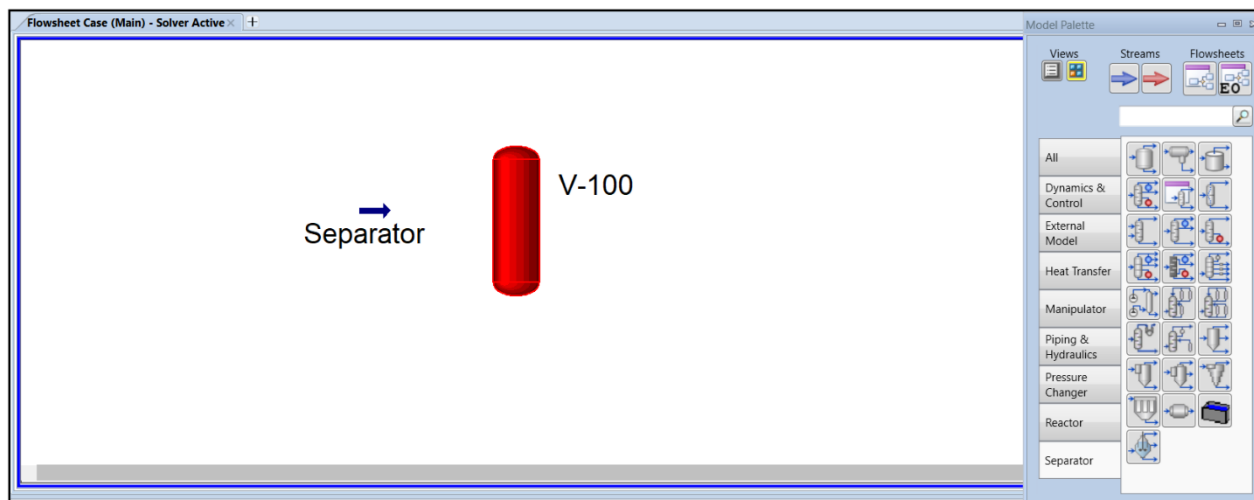
Edit... View Properties... Basis...

OK

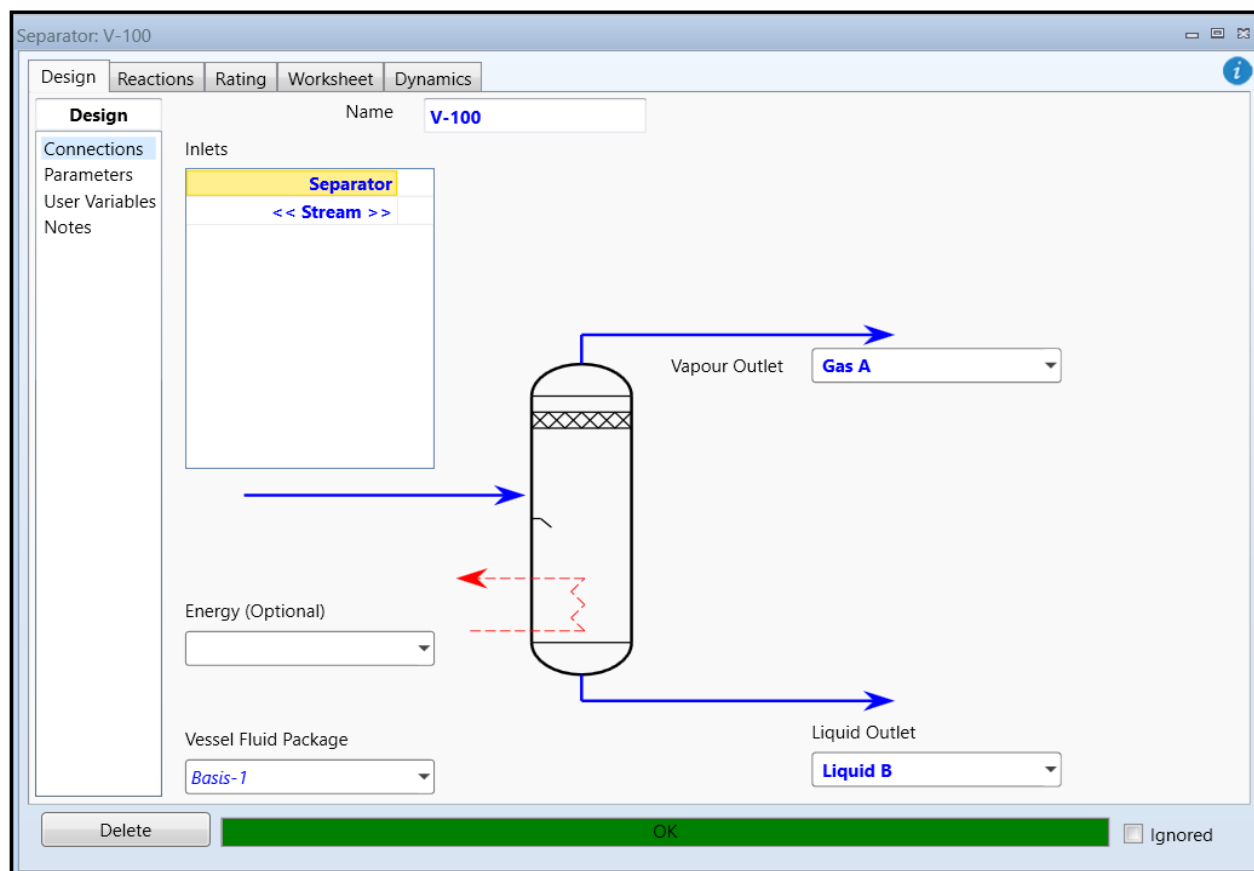
Delete Define from Stream... View Assay



6. From the Model Palette, select separators and click on first icon which is two-phase separator.



7. Double-click on the separator and define streams like below:





8. The moment you define the streams, the problem is solved and you see the green indication on the separator window.

9. Click on the Worksheet and then Composition tab.

Separator: V-100

Design Reactions Rating Worksheet Dynamics

Worksheet

	Separator	Liquid B	Gas A
Vapour	0.6624	0.0000	1.0000
Temperature [C]	25.00	25.00	25.00
Pressure [kPa]	150.0	150.0	150.0
Molar Flow [kgmole/h]	1.000	0.3376	0.6624
Mass Flow [kg/h]	63.03	23.09	39.94
Std Ideal Liq Vol Flow [m3/h]	0.1065	3.760e-002	6.894e-002
Molar Enthalpy [kJ/kgmole]	-1.446e+005	-1.676e+005	-1.328e+005
Molar Entropy [kJ/kgmole-C]	137.9	82.67	166.1
Heat Flow [kJ/h]	-1.446e+005	-5.657e+004	-8.799e+004

Delete OK Ignored

Separator: V-100

Design Reactions Rating Worksheet Dynamics

Worksheet

	Separator	Liquid B	Gas A
Propane	0.1500	0.0370	0.2076
i-Butane	0.3500	0.1932	0.4299
n-Pentane	0.5000	0.7697	0.3626

Delete OK Ignored



There is nothing to explain; each component fraction in each phase is provided.

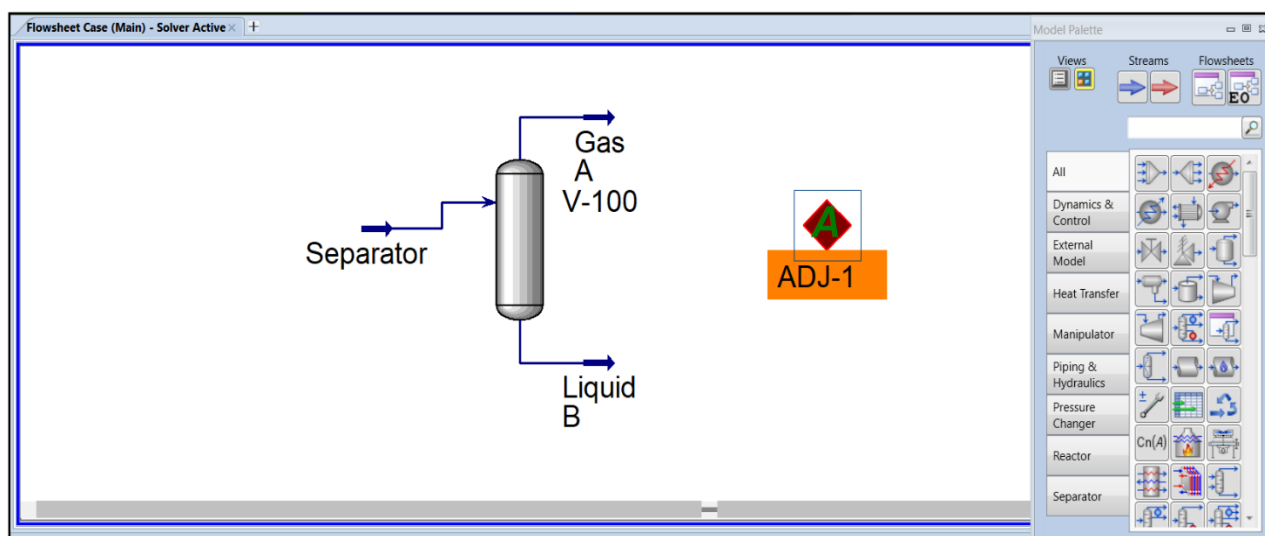


Example 2: For the mixture in last example, determine the inlet mixture temperature in a way that at 150kPa the propane mole fraction is 0.07.

Solution:

Just for your notice, as shown in previous pages, the propane mole fraction in liquid stream was 0.037.

For this problem, we can reach a solution via trial and error but when we have such an amazing software, we can reach our target in a much faster way. In order to exploit the software and solve our problem, we can use Adjust tool under Model Palette.



2. Open Adjust tool window



3. The adjusted variable is a variable which shall be changed to meet the specification. Here the temperature shall be changed until the propane fraction becomes 0.07. Select Variable, select Separator stream as the object, and select temperature as the variable.

Select Adjusted Variable For ADJ-1

Context: Case (Main)

Object Type: All

Object: Separator

Variables: Temperature

Physical Type: All

Description: Temperature

Buttons: Disconnect, Select

4. Select Variable, select Separator stream as the object, and select temperature as the variable.

Select Target Variable For ADJ-1

Context: Case (Main)

Object Type: All

Object: Separator

Variables: Master Comp Mole Frac (Propane)

Physical Type: All

Description: Master Comp Mole Frac (Propane)

Buttons: Disconnect, Select



5. Under Specified Target Value, write 0.07.

It is not solved but if look at the message box we can understand why it has not solved.

6. In this step we go to Parameter tab and specify the maximum temperature, minimum temperature, and step size. We set minimum temperature to bubbling point while maximum temperature to dew point. The step size changed to 5C.



ADJ-1

Connections Parameters Monitor User Variables

Parameters

Parameters
Options

☐ Simultaneous Solution

Method	Secant
Tolerance	1.0000e-003
Step Size	5.0000 C
Minimum (Optional)	3.0000 C
Maximum (Optional)	31.000 C
Maximum Iterations	10

Sim Adj Manager...

☐ Optimizer Controlled

OK

Delete Reset Ignored

7. As the last step, check the Monitor tab to see the history of what Aspen Hysys has done.

ADJ-1

Connections Parameters Monitor User Variables

Monitor

Tables
Plots

Iteration History

Total Iterations 5

Iter	Adjusted Value [C]	Target Value	Residual
1	17.901	0.058	-0.0116
2	17.629	0.059	-0.0105
3	12.591	0.082	0.0121
4	16.754	0.063	-0.0071
5	15.214	0.069	-0.0006

OK

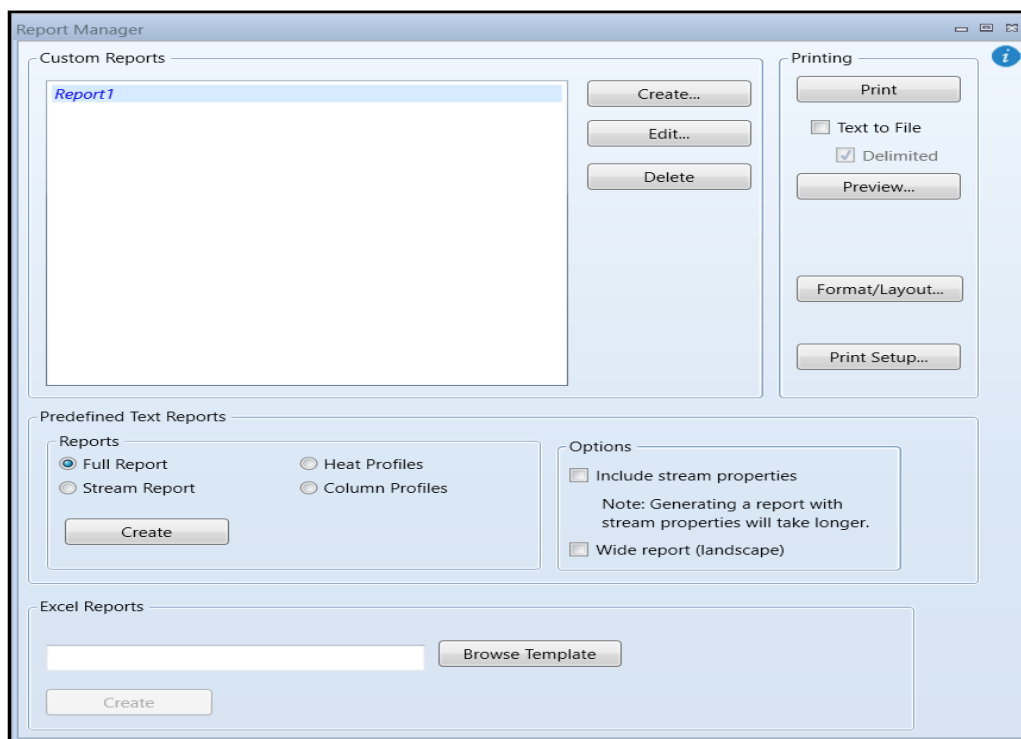
Delete Reset Ignored



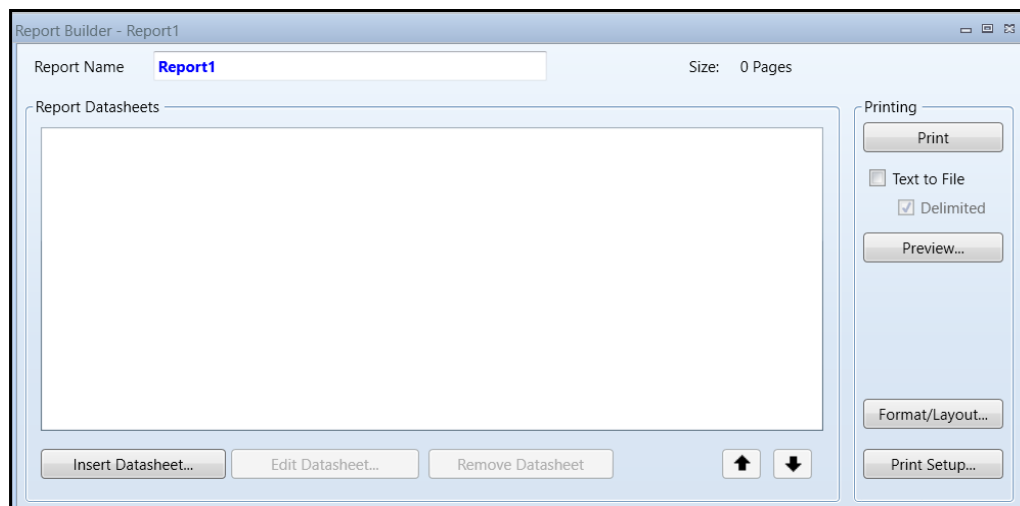
8. Based on the result, if the temperature of inlet mixture were about 15 C, then the propane fraction in liquid stream would be 0.07.

Before ending the session, let's learn how to print a report like a vessel datasheet.

9. Press CTRL+R to see the Report Manager window:



10. Click Create and then Insert Datasheet. Select V-100 and click Add.





Select Datablocks for Datasheet

Source for Datablocks

☒ Pick a Specific Object by Name ☐ Pick All Objects of a Given Type

Flowsheets

Case (Main)

Object

<Workbook - Main>
ADJ-1
FeederBlock_Separator
Gas A
Liquid B
Main Properties
ProductBlock_Gas A
ProductBlock_Liquid B
Separator
V-100

Filter

☒ All
☐ Streams
☐ UnitOps
☐ Logicals
☐ Utilities
☐ Reactions
☐ Assays
☐ Other
☐ Custom

Setup Custom

Available Datablocks

☒ Design
☒ Reactions
☒ Rating
☒ Worksheet
☒ Dynamics
☒ Notes
☒ Carry Over

Add
Cancel
Select All
Invert Selection

Checked Datablocks will be included in the Datasheet. Datablocks with trailing ellipses have additional options that will appear here when selected.

11. Click Preview before printing.

32	Sizing				
33					
34	Cylinder	Vertical	Separator has a Boot: No		
35	Volume: ---	Diameter: ---	Height: ---		
36	Nozzles				
37					
38	Base Elevation Relative to Ground Level	0.0000 m *	Diameter	---	Height
39		Separator	Gas A	Liquid B	
40	Diameter (m)	5.000e-002 *	5.000e-002 *	5.000e-002	
41	Elevation (Base) (m)	0.0000 *	0.0000 *	0.0000	
42	Elevation (Ground) (m)	0.0000 *	0.0000 *	0.0000	
43	Elevation (% of Height) (%)	---	---	---	
44	Level Taps: Level Tap Specification				
45					
46	Level Tap	PV High	PV Low	OP High	OP Low
47	Level Taps: Calculated Level Tap Values				
48					
49	Level Tap	Liquid Level	Aqueous Level		
50	Options				
51					
52	PV Work Term Contribution (%)	100.00 *			
53	CONDITIONS				
54					
55	Name	Separator	Liquid B	Gas A	
56	Vapour	0.3371	0.0000	1.0000	
57	Temperature (C)	15.2140 *	15.2140	15.2140	
58	Pressure (kPa)	150.0000 *	150.0000	150.0000	
59	Molar Flow (kgmole/h)	1.0000 *	0.6629	0.3371	
60	Mass Flow (kg/h)	63.0335	43.8954	19.1381	
61	Std Ideal Liq Vol Flow (m3/h)	0.1065	0.0726	0.0340	
62	Molar Enthalpy (kJ/kgmole)	-1.533e+005	-1.657e+005	-1.288e+005	