



Turbine Simulation





Example: In a gas let-down station, a turbine is installed to reduce the HP-NG pressure to 3 bar, aiming to produce electricity. Here is the HP-NG info at the turbine suction:

Stream Name	HP-NG
Temperature	25C
Pressure	40barg
Mass Flow	10000 kg/hr.
Component	Composition-Mole%
Methane	95.2
Ethane	2.5
Propane	0.2
Iso-Butane	0.03
Normal-Butane	0.03
Iso-Pentane	0.01
Normal-Pentane	0.01
Hexanes	0.01
Nitrogen	1.3
Carbon Dioxide	0.7
Oxygen	0.02



How to simulate:

1. Select the aforementioned components in component list

Source Databank: HYSYS

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

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

Component	Type	Group
Methane	Pure Component	
Ethane	Pure Component	
Propane	Pure Component	
i-Butane	Pure Component	
n-Butane	Pure Component	
i-Pentane	Pure Component	
n-Pentane	Pure Component	
n-Hexane	Pure Component	
Nitrogen	Pure Component	
CO2	Pure Component	
Oxygen	Pure Component	

< Add Replace Remove

Simulation Name	Full Name / Synonym	Formula
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
n-C14	C14	C14H30
n-C15	C15	C15H32
n-C16	C16	C16H34
n-C17	C17	C17H36
n-C18	C18	C18H38

Status: OK

2. Select PRSV as Fluid Package. To help you better understand how to use Method Assistance, for this example we use such tool as follows:

Aspen HYSYS V12 Help

Search Help

Contents Index

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Chemical Processes

At low pressures of less than 10 bars, an activity coefficient-based property package is appropriate, such as:

- NRTL-based packages (NRTL, Extended NRTL, General NRTL)
- UNIQUAC (for modeling LLE systems)
- van Laar or Wilson (for non-LLE systems)

For preliminary designs at Low Pressures, UNIFAC can be used.

At high pressures (>10 bars), use an equation of state method, such as:

- Peng-Robinson and variations (PR-Twu, PRSV)
- SRK and variations (SRK-Twu, Kabadi-Danner, Zudkevitch-Joffee)
- Lee-Kesler-Plocker
- CPA
- EOS for natural gas systems (BWRS, MBWR)
- Generalized Cubic EOS (GCEOS)

See Also

- [Property Package Descriptions](#)
- [Carboxylic acids](#)



Since the stream pressure is more than 10 bar, a Peng-Robinson variant like PRSV is selected.

Set Up | Binary Coeffs | StabTest | Phase Order | Tabular | Notes

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

Property Package Selection

- Kabadi-Danner
- Lee-Kesler-Plöcker
- MBWR
- NBS Steam
- NRTL
- Peng-Robinson
- PR-Twu
- PRSV**
- Sour PR
- Sour SRK
- Sour Water
- SRK
- SRK-Twu
- Sulsim (Sulfur Recovery)
- Twu-Sim-Tassone
- UNIQUAC
- Wilson
- Zudkevitch-Joffe

Options

Enthalpy	Peng-Robinson Equation
Density Method	Costald
Surface Tension Method	HYSYS Method

PRSV Component Parameters

	Kappa
Methane	-0.0193
Ethane	0.0134
Propane	0.0316
i-Butane	0.0378
n-Butane	0.0395
i-Pentane	0.0445
n-Pentane	0.0223
n-Hexane	0.0700
Nitrogen	0.0089
CO2	0.1430
Oxygen	0.0209

Property Pkg: OK Edit Properties

3. Enter Simulation Environment and define HP-NG stream like below:

Material Stream: HP-NG

Worksheet | Attachments | Dynamics

Worksheet

- Conditions
- Properties
- Composition
- Oil & Gas Feed
- Petroleum Assay
- K Value
- User Variables
- Notes
- Cost Parameters
- Normalized Yields
- ▶ Emissions

Stream Name	HP-NG
Vapour / Phase Fraction	<empty>
Temperature [C]	25.00
Pressure [kPa]	4101
Molar Flow [kgmole/h]	<empty>
Mass Flow [kg/h]	1.000e+004
Std Ideal Liq Vol Flow [m3/h]	<empty>
Molar Enthalpy [kJ/kgmole]	<empty>
Molar Entropy [kJ/kgmole-C]	<empty>
Heat Flow [kJ/h]	<empty>
Liq Vol Flow @Std Cond [m3/h]	<empty>
Fluid Package	Basis-1
Utility Type	

Unknown Compositions

Delete Define from Stream... View Assay



Input Composition for Stream: Material Stream: HP-NG

	Mole Fraction
Methane	0.9519
Ethane	0.0250
Propane	0.0020
i-Butane	0.0003
n-Butane	0.0003
i-Pentane	0.0001
n-Pentane	0.0001
n-Hexane	0.0001
Nitrogen	0.0130
CO2	0.0070
Oxygen	0.0002

Composition Basis

☒ Mole Fractions
☐ Mass Fractions
☐ Liq Volume Fractions
☐ Mole Flows
☐ Mass Flows
☐ Liq Volume Flows

Composition Controls

Erase
Equalize Composition

Cancel

Normalize Total 1.0000 OK

Material Stream: HP-NG

Worksheet Attachments Dynamics

Worksheet

- Conditions
- Properties
- Composition
- Oil & Gas Feed
- Petroleum Assay
- K Value
- User Variables
- Notes
- Cost Parameters
- Normalized Yields
- Emissions

Stream Name	HP-NG	Vapour Phase
Vapour / Phase Fraction	1.0000	1.0000
Temperature [C]	25.00	25.00
Pressure [kPa]	4101	4101
Molar Flow [kgmole/h]	593.6	593.6
Mass Flow [kg/h]	1.000e+004	1.000e+004
Std Ideal Liq Vol Flow [m3/h]	32.18	32.18
Molar Enthalpy [kJ/kgmole]	-7.729e+004	-7.729e+004
Molar Entropy [kJ/kgmole-C]	152.7	152.7
Heat Flow [kJ/h]	-4.587e+007	-4.587e+007
Liq Vol Flow @Std Cond [m3/h]	<empty>	<empty>
Fluid Package	Basis-1	
Utility Type		

OK

Delete Define from Stream... View Assay



4. Select turbine from Model Palette/Pressure Change and put it in the flowsheet. Then, select HP-NG as the inlet stream and define LP-NG as the outlet stream. Finally specify a name like Electricity for the energy.

Expander: K-100

Design Rating Worksheet Performance Dynamics

Design

Connections
Parameters
Links
User Variables
Notes

Name: **K-100**

Inlet: **HP-NG**

Fluid Package: **Basis-1**

Energy: **Electricity**

Outlet: **LP-NG**

Delete

Unknown Duty

Ignored

Expander: K-100

Design Rating Worksheet Performance Dynamics

Design

Connections
Parameters
Links
User Variables
Notes

Efficiency

Isentropic Efficiency	75.000
Polytropic Efficiency	68.610

Duty: 543.4 kW

Pressure Specs

Delta P: **3801**

Pressure Ratio: 7.323e-002

Curve Input Option

☒ Single Curve ☐ Multiple IGV Curves

☐ Non-Dimensional ☐ Quasi-Dimensionless

☐ Atlas Copco/Mafi Trench

Delete

OK

Ignored



5. Based on the result, the power produced is 543.4 kW.

6. By checking the Worksheet table or Performance table, more info could be gained.

Expander: K-100

Design	Rating	Worksheet	Performance	Dynamics
Worksheet				
Conditions	Name	HP-NG	LP-NG	Electricity
Properties	Vapour	1.0000	0.9996	<empty>
Composition	Temperature [C]	25.00	-88.94	<empty>
PF Specs	Pressure [kPa]	4101	300.3	<empty>
	Molar Flow [kgmole/h]	593.6	593.6	<empty>
	Mass Flow [kg/h]	1.000e+004	1.000e+004	<empty>
	Std Ideal Liq Vol Flow [m3/h]	32.18	32.18	<empty>
	Molar Enthalpy [kJ/kgmole]	-7.729e+004	-8.058e+004	<empty>
	Molar Entropy [kJ/kgmole-C]	152.7	159.2	<empty>
	Heat Flow [kJ/h]	-4.587e+007	-4.783e+007	1.956e+006

Delete OK Ignored

Expander: K-100

Design	Rating	Worksheet	Performance	Dynamics
Performance				
Results	Results			
	Adiabatic Head [m]	2.660e+004		
	Polytropic Head [m]	2.907e+004		
	Adiabatic Fluid Head [kJ/kg]	260.8		
	Potential Fluid Head [kJ/kg]	285.1		
	Isentropic Efficiency	75.000		
	Polytropic Efficiency	68.610		
	Power Produced [kW]	543.4		
	Friction Loss [kW]	0.0000		
	Rotational inertia [kW]	0.0000		
	Fluid Power [kW]	543.4		
	Polytropic Head Factor	0.9945		
	Polytropic Exponent	1.1911		
	Isentropic Exponent	1.3072		

Delete OK Ignored