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Content Based
Chemical Engineering

ENGINEERING DESIGN CALCULATION - DENNIS KIRK ENGINEERING

Calculation of Gas Properties - GPSA Engineering Data Book - SI Units - 11th Edition 1998 Version 1.513

CALCULATION TITLE

		SEAGas Pipeline Design - Minerva	Uniformly Normalised	
		mole %	mole %	
CH4	Methane	93.605	93.6050	%
C2H6	Ethane	2.24	2.2400	%
C3H8	Propane	0.81	0.8100	%
C4H10	I-Butane	0.107	0.1070	%
C4H10	n-Butane	0.171	0.1710	%
C5H12	i-Pentane	0.057	0.0570	%
C5H12	n-Pentane	0.052	0.0520	%
C6H14	n-Hexane	0.098	0.0980	%
C7H16	n-Heptane		0.0000	%
C8H18	n-Octane		0.0000	%
C9H20	n-Nonane		0.0000	%
C10H22	n-Decane		0.0000	%
C6H6	Benzene		0.0000	%
CO	Carbon Monoxide		0.0000	%
CO2	Carbon Dioxide	1.885	1.8850	%
H2S	Hydrogen Sulfide		0.0000	%
N2+02	Air		0.0000	%
H2	Hydrogen		0.0000	%
O2	Oxygen		0.0000	%
N2	Nitrogen	0.972	0.9720	%
H2O	Water	0.003	0.0030	%
		100.0000	100.0000	%

R=	8.314510	kJ/mol.°K					
MW air=	28.9625	kg/kmol					
Zb air=	0.99958						
Pb=	0	kPa(g)			0	psi(g)	
Ps=	101.325	kPa(abs)					
Pb=	101.325	kPa(abs)					
Tb=	15	°C			59	°F	
Ts=	273.15	°K					
Tb=	288.15	°K					

MW	17.4749		kg/kmol		17.4797	from AGA8 GCM2 Method
SG ideal	0.6034		Specific Gravity		0.6035	from AGA8 GCM2 Method
SG real	0.6046				0.6046	from AGA8 GCM2 Method
Zb [15°C, 0 kPa(g)]	0.9975		Compressibility at base conditions		0.9978	from AGA8 GCM2 Method
HHV ideal	38.2125	MJ/Sm³	Higher Heating Value			
HHV real	38.2975	MJ/Sm³	Wobbe Index	49.253544	38.2797	from AGA8 GCM2 Method
LHV ideal	34.4554	MJ/Sm³	Lower Heating Value			
LHV real	34.5320	MJ/Sm³				
P	6900	kPa(g)	Operating Pressure	1000.776	psi(g)	
T	69.8	°C	Operating Temperature	157.64	°F	
P	7001.325	kPa(abs)				
T	342.95	°K				
Pc	4597.01	kPa(abs)	Pseudo Critical Pressure		includes Wichert & Aziz Correction for Sour Gas	
Tc	195.60	°K	Pseudo Critical Temperature		includes Wichert & Aziz Correction for Sour Gas	
Vc	0.0058	m³/kg	Pseudo Critical Specific Volume			
Zc	0.2868		Pseudo Critical Compressibility			
Pr (Pro)	1.5230	0.0220	Pseudo Reduced Pressure			
Tr	1.7533		Pseudo Reduced Temperature			
Z (MW<40, P<70MPa)	0.9248		Compressibility (Pr 0 to 15, Tr 1 to 3)		0.9295	from AGA8 GCM2 Method
d	46.3972	kg/m³	Density		46.0937	from AGA8 GCM2 Method
Cpo (T -25 to 150°C)	38.8280	kJ/kmole.°C	Heat Capacity (Pconstant)	2221.9282	J/kg.°C	
Cvo	30.5135	kJ/kmole.°C	Heat Capacity (T constant)	1746.131	J/kg.°C	
ko=Cpo/Cvo	1.2725		Thermal Conductivity	0.0473265	W/m.°C (MW>16, 20<T<200°C, Pr<8, 1<Tr<3)	
Cp	44.0491	kJ/kmole.°C	refer Redlich-Kwong	2520.7087	J/kg.°C	
Cv	32.6013	kJ/kmole.°C	Equations of State	1865.6061	J/kg.°C	
k=Cp/Cv	1.3511		Velocity of Sound	438.67355	m/sec	
w	0.0200		Acentric Factor			
u (T -130 to 500°C)	0.0149	cP (mPa.s)	Viscosity from Fig 23-23 (P 0 to 21 Mpa)			
ua @101.325 kPa(a)	0.01206114	cP (mPa.s)	**or** Viscosity from 23-22 **(if Tr > 1.0)**			
u/ua	1.12063134		**and** pressure correction from 23-24			
u	0.0135	cP (mPa.s)			0.0137468	from John M Campbell & Co
or if high levels of non hydrocarbons are present (eg 20%)						
E	0.04532		Eq 23-20 (corrected)			
E.ua	0.00056		Eq 23-21 (corrected) and Eq 23-22			
ua @101.325 kPa(a)	0.01241	cP (mPa.s)	for high levels of non hydrocarbons			
u	0.0139	cP (mPa.s)	with pressure correction from 23-24			
H (T -30 to 480°C)	10890.7928	kJ/kmol	Enthalpy (Pr 0.1 to 10, Tr 1 to 4)		**Note:H=0 for T=0°K and P=0 kPa(abs)**	
	623.224831	kJ/kg	Note: Values for Hexane, Heptane, Octane, Nonane, Decane are approximate only!			
JT	2.8878889	oC/MPa	JT Effect of Gas Expansion		2.8924	from AGA8 GCM2 Method
S (T -80 to 240oC)	181.128199	kJ/kmole.K	Entropy (Pr 01 to 10, Tr 0.8 to 4)		**Note:S=0 for T=0°K and P=0 kPa(abs)**	
	10.365	kJ/kg.K	Note: Values for Hexane, Heptane, Octane, Nonane, Decane are not available!			