V F-PROPATH: Binary Mixtures by General Equations

Binary mixtures in part V stand for those that have been formulated by applying mixing rule to base equation. Base equations prepared are those of Peng-Robinson, CSD and BWR, at this moment.

1. General Features

1.1 SUBPROGRAM REFERENCE

Every F–PROPATH user has to make the initiation process by writing the following 3 lines before the first REFERENCE to a F–PROPATH SUBPROGRAM(FUNCTION SUBPROGRAM or SUBROUTINE SUBPROGRAM) in the MAIN PROGRAM. If a user happens to want to use other settings in other places of his or her PROGRAM UNIT, he or she is supposed to do a similar at those places.

```
CALL KPAMES(value of KPA, value of MESS)
CALL STNKAS(value of KSTAN, value of KAS)
CALL START1(J, value of KOMBI)
```

The arguments of the these SUBROUTINE SUBPROGRAMs specify the system of units, reference values of enthalpy and entropy, necessity of listing error messages to erroneous SUBPROGRAM REFERENCEs on the standard output device. All arguments in these SUBROUTINE SUBGROGRAMs are INTEGERs. KPA specifies the units of pressure and temperature, and KAS unit of the amount of substance. KSTAN selects the reference values of enthalpy and entropy. The relation between KPA and the units of pressure and temperature and that between KAS and the unit of amount of substance are shown in 1.3. F–PROPATH does not return any messages when MESS= 0, while it does when MESS$\neq$ 0. KSTAN differs from one equation to another, and is described in the chapter of each equation.

The argument KOMBI in SUBROUTINE START1 selects the kind of mixture from the predetermined list of mixtures, which differs from one general equation to another. Users are asked to consult with sections for each equation. If KOMBI bears a value not listed on the list, level 2 error will occur. See the next section.

1.2 Operations to Manage Erroneous SUBPROGRAM REFERENCE

A predetermined sequence of operations will occur to process an erroneous SUBPROGRAM REFERENCE when an improper SUBPROGRAM REFERENCE has been done. Erroneous SUBPROGRAM REFERENCEs are grouped into 2 levels, with the ascending severity of user's mistake. A user has committed a more serious mistake when a level 2 ERROR occurs than when a level 1 ERROR does.

1.2.1 Level 1 ERROR (Convergence Failure)

The method of iterations built in to some of the M-PROPATH SUBPROGRAMs to solve implicit relations will not work somehow from time to time. F–PROPATH stops further iterations after executing the preset number of iterations. Though the user is not responsible for level 1 ERROR, the F–PROPATH detects this type of ERROR time to time, unfortunately.

A level 1 ERROR is processed as below.

FUNCTION SUBPROGRAM

value of REAL FUNCTION returned to the CALLing program : $-1.0E+10$

value of INTEGER FUNCTION returned to the CALLing Program : -1

output to the standard output device:

**** NO CONVERGENCE AT (NAME OF FUNCTION CALLED) ****

SUBROUTINE SUBPROGRAM

value of error detection cord: -1

output to the standard output device:

**** NO CONVERGENCE AT (NAME OF SUBROUTINE CALLED) ****

1.2.2 Level 2 ERROR (Invalid ARGUMENT(s))

A level 2 ERROR will occur when the ARGUMENT(s) a user transferred to M-PROPATH SUBPROGRAM from his or her MAIN PROGRAM fail to drop in the proper range.

A level 2 ERROR is processed as below.

FUNCTION SUBPROGRAM

value of REAL FUNCTION returned to the CALLing Program: $-1.0E+20$

value of INTEGER FUNCTION returned to the CALLing Program : -2

output to the standard output device:

**** OUT OF RANGE AT (NAME OF FUNCTION CALLED) ****

SUBROUTINE SUBPROGRAM

value of error detection cord: -2

output to the standard output device:

**** OUT OF RANGE AT (NAME OF SUBROUTINE CALLED) ****

1.3 System of Units and Reference Values of Enthalpy and Entropy

All REAL quantities are in the fundamental SI or in the coherent derived SI with three exceptions. Pressure can be in the unit of Pascal Pa or bar, temperature in the unit of Kelvin K or degree Celsius °C. These depend on the value of INTEGER KPA when a user referred the SUBROUTINE SUBPROGAM KPAMES(KPA, MESS) shown in 1.1. The amount of substance can be in the unit of kilomole kmol or kilogram kg. INTEGER KAS in the SUBROUTINE SUBPROGAM STNKAS(KSTAN, KAS) in 1.1 switches this. These go as shown in the table below. The INTEGER KSTAN in the SUBROUTINE SUBPROGAM STNKAS(KSTAN, KAS) controls the reference values of enthalpy and entropy and is explained for each specific equation, since they differ from one equation to another.

Table V-1.3-1 Units of Pressure and Temperature Specified by `KPA`

KPA	unit of pressure	unit of temperature
0	Pa	K
1	bar	°C
2	bar	K
3	Pa	°C
others	Pa	K

Table V-1.3-2 Amount of Substance Specified by `KAS`

KAS	amount of substance
0	kmol
1	kg
others	kmol

1.4 Reserved NAMEs

F–PROPATH uses a lot of NAMEs, listed below, for its own purpose. These are the NAMEs of SUBPROGRAMs and NAMED COMMON BLOCK to which a user can access directly and NAMEs of SUBPROGRAM headed by "FMF" which a user cannot access. A user is supposed to use the NAMEs of SUBPROGRAM and COMMON BLOCK only when he/she does so in the original meaning. The letters in the first column are the first LETTERs in the NAMEs listed in the same line.

Name of COMMON BLOCK, FUNCTION and SUBROUTINE

A AKG, AKMOL
C CRPM
F FCM, FMF**** , COMMON /FMFC/
I IDENTM, IPHASE
K KPAMES
M MKTABL
N COMMON /NAME/
P PBT, PDT, PSTM
Q QMIX
S START1, START2, STNKAS, SUBCRT, SUBM, SUBMIX, SUBPAR, SUBPB, SUBPD, SUBPST, SUBPUR, SUBTB, SUBTD, SUBTSP, SUBXY
T T68, T90, TBP, TDP, TSPM
U COMMON /UNIT/

1.5 Terminology, Symbols and Compositions

The component with lower critical temperature is to be called as the first component. A composition is supposed to stand for the mole fraction or the mass fraction of the first component. The symbolic distinction of the compositions between the two phases and that between two saturation temperatures are done as shown below.

total composition Z	:	composition of mixture as a whole
composition at liquid phase X	:	liquid composition at vapor-liquid equilibrium
composition at vapor phase Y	:	vapor composition at vapor-liquid equilibrium
temperature at dew point	:	The lowest temperature of vapor for given pressure and Z
temperature at bubble point	:	The highest temperature of liquid for given pressure and Z
pressure at dew point	:	The highest pressure of vapor for given temperature and Z
pressure at bubble point	:	The lowest pressure of liquid for given temperature and Z

1.6 The NAMEs of FUNCTION and SUBROUTINE SUBPROGRAMs

NAMEs of FUNCTIONs and SUBROUTINEs are shown below and the full descripion of these SUBPROGRAMs is given in 1.7. Some of these SUBPROGRAMs have not been prepared in each equation shown in 2. and after. These are listed there for each equation.

1.6.1 FUNCTION

REAL valued FUNCTION (conversion of temperature scale)

T68	=	conversion from ITS–1990 to IPTS–1968
T90	=	conversion from IPTS-1968 to ITS-1990

REAL valued FUNCTION (pure component)

CRPM	=	critical constants of pure component
FCM	=	fundamental constants of pure components
PSTM	=	vapor pressure of pure components
TSPM	=	saturation temperature of pure components

REAL valued FUNCTION (mixture)

AKG	=	mole fraction to mass fraction conversion
AKMOL	=	mass fraction to mole fraction conversion
PBT	=	bubble point pressure of mixture (temperature and X input)
PDT	=	dew point pressure of mixture (temperature and Y input)
QMIX	=	dryness fraction of mixture
TBP	=	bubble point temperature of mixture (pressure and X input)
TDP	=	dew point temperature of mixture (pressure and Y input)

INTEGER valued FUNCTION

IPHASE	=	distinction between phases of mixture

CHARACTER valued FUNCTION

IDENTM	=	name of pure components and version number

1.6.2 SUBROUTINE

initialization

KPAMES/STNKAS	=	See 1.1
START1/START2	=	consult with chapters for each equation

pure component

MKTABL	=	listing critical constants and fundamental constants of pure component
SUBPST	=	saturation properies of pure components (temperature input)
SUBPUR	=	single phase properties of pure component
SUBTSP	=	saturation properties of pure components (pressure input)

mixture

SUBCRT	=	critical constants of mixture
SUBPAR	=	partial properties of mixture
SUBPB	=	bubble point pressure and other properties of mixture (temperature and X input)
SUBPD	=	dew point pressure and other properties of mixture (temperature and Y input)
SUBTB	=	bubble point temperature and other properties of mixture (pressure and X input)
SUBTD	=	dew point temperature and other properties of mixture (pressure and Y input)
SUBM	=	adiabatic and isobaric mixing of two streams
SUBMIX	=	properties of mixture
SUBXY	=	properties of mixture at VLE
SUBMXH	=	isobaric mixing of two mixtures with different composition, enthalpy input
SUBMXT	=	isobaric mixing of two mixtures with different composition, temperature input

1.7 Descriptions of FUNCTIONs and SUBROUTINEs

Shown in alphabetical order of NAMEs.

AKG

REAL FUNCTION **AKG(Z)** : mole fraction to mass fraction conversion

REAL Z : mole fraction [kmol/kmol]
REAL AKG : mass fraction [kg/kg]

AKMOL

REAL FUNCTION **AKMOL(Z)** : mass fraction to mole fraction conversion

REAL Z : mass fraction [kg/kg]
REAL AKMOL : mole fraction [kmol/kmol]

CRPM

REAL FUNCTION **CRPM(I,A)** : critical constant

INTEGER I : component
1 : first component
2 : second component
CHARACTER*1 A : kind of critical constant returned
'T' : critical temperature [K], [°C]
'P' : critical pressure [Pa], [bar]
'V' : critical volume [m^3/kmol], [m^3/kg]
'H' : critical enthalpy [J/kmol], [J/kg]
'S' : critical entropy [J/(kmol·K)], [J/(kg·K)]

FCM

REAL FUNCTION **FCM(I,A)** : fundamental constants of pure components

INTEGER I : component
1 : first component
2 : secund component
CHARACTER*1 A : kind of fundamental constant returned
'M' : molar mass [kg/kmol]
'R' : gas constant [J/(kg·K)]
'T' : critical temperature [K] , [°C]
'P' : critical pressure [Pa] , [bar]
'V' : critical volume [m^3/kmol] , [m^3/kg]
'E' : acentric factor [-]

IDENTM

CHARACTER*40 FUNCTION **IDENTM(I,A)** : name of pure component and version number

INTEGER I : component
1 : first component
2 : second component
CHARACTER*1 A : kind of characters returned
'C' : molecular formula
'S' : name of substance
'V' : version number

IPHASE

INTEGER FUNCTION **IPHASE(T,P,Z)** : distinction between phases of mixture

REAL T : temperature [K] , [°C]
REAL P : pressure [Pa] , [bar]
REAL Z : composition [kmol/kmol] , [kg/kg]

value of IPHASE

1 : single phase
2 : two phase
−1 : Convergence failure
−2 : invalid ARGUMENT(s)

KPAMES

SUBROUTINE **KPAMES(KPA,MESS)**
See 1.11

MKTABL

SUBROUTINE **MKTABL(J,M)**
: listing fundamental constants and isobaric specific heat at the ideal gas state

input
INTEGER M : value of KOMBI index to mixtures

output
See example 4. Units of fundamental constants are prefixed as shown below and depend on neither KPA or KAS.

molar mass : [kg/kmol]
critical temperature : [K]
critical pressure : [Pa]
critical volume : [m^3/kmol]
acentric factor : [-]

If you use just MKTABL in your main program, you do not need to CALL SUBROUTINE KPAMES,STNKAS and START1 before calling MKTABL.

PBT

REAL FUNCTION **PBT(T,X)** : bubble point pressure

REAL T : temperatuer [K], [°C]
REAL X : composition [kmol/kmol], [kg/kg]
REAL PBT : bubble point pressure [Pa], [bar]

PDT

REAL FUNCTION **PDT(T,Y)** : dew point pressure

REAL T : temperatuer [K], [°C]
REAL Y : composition [kmol/kmol], [kg/kg]
REAL PDT : dew point pressure [Pa], [bar]

PSTM

REAL FUNCTION **PSTM(I,T)** : saturation pressure of pure component

INTEGER I : component
1 : first component
2 : second component
REAL T : temperature [K] , [°C]
REAL PSTM : saturation pressure [Pa], [bar]

QMIX

REAL FUNCTION **QMIX(T,P,Z)** : dryness fraction

REAL T : temperature [K], [°C]
REAL P : pressure [Pa], [bar]
REAL Z : total composition [kmol/kmol], [kg/kg]
REAL QMIX : dryness fraction [kmol/kmol], [kg/kg]

START1

SUBROUTINE **START1(J,value of KOMBI)**
See chapters of each equation

START2

SUBROUTINE **START2(J,· · · ·)**
See chapters of each equation

STNKAS

SUBROUTINE **STNKAS(KSTAN,KAS)**
See 1.1

SUBCRT

SUBROUTINE **SUBCRT(I,J,T,P,Z,V,H,S)** : critical constants of mixture
INTEGER I : type of problem (input, I=1,2)

I= 1 :
input
REAL Z : total composition [kmol/kmol], [kg/kg]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL T : critical temperature [K], [°C]
P : critical pressure [Pa], [bar]
V : critical volume [m^3/kmol], [m^3/kg]
H : critical enthalpy [J/kmol], [J/kg]
S : critical entropy [J/(kmol·K)], [J/(kg·K)]

I= 2 :
input
REAL T : critical temperature [K], [°C]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL Z : total composition [kmol/kmol], [kg/kg]
P : critical pressure [Pa], [bar]
V : critical volume [m^3/kmol], [m^3/kg]
H : critical enthalpy [J/kmol], [J/kg]
S : critical entropy [J/(kmol·K)], [J/(kg·K)]

SUBMXH

SUBROUTINE **SUBMXH(J,T,P,ZA,ZB,Z,V,HA,HB,H,S,W)** : isobaric mixing of two mixtures with different compositions, enthalpy input

input
REAL P : pressure [Pa] , [bar]
REAL ZA : total composition of A [kmol/kmol] , [kg/kg]
REAL ZB : total composition of B [kmol/kmol] , [kg/kg]
REAL HA : enthalpy of A [J/kmol] , [J/kg]
REAL HB : enthalpy of B [J/kmol] , [J/kg]

REAL W : Fraction of A in Mixing [kmol/kmol] , [kg/kg]

output

INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL T : temperature after mixing [K] , [°C]
REAL Z : total composition after mixing [kmol/kmol] , [kg/kg]
REAL V : volume after mixing [m^3/kmol] , [m^3/kg]
REAL H : enthalpy after mixing [J/kmol] , [J/kg]
REAL S : entropy after mixing [J/(kmol·K)] , [J/(kg·K)]

SUBMXT

SUBROUTINE **SUBMXT(J,T,P,ZA,ZB,Z,V,TA,TB,H,S,W)** : isobaric mixing of two mixtures with different compositions, temperature input

input

REAL P : pressure [Pa] , [bar]
REAL ZA : total composition of A [kmol/kmol] , [kg/kg]
REAL ZB : total composition of B [kmol/kmol] , [kg/kg]
REAL TA : temperature of A [K] , [°C]
REAL TB : temperature of B [K] , [°C]
REAL W : Fraction of A in Mixing [kmol/kmol] , [kg/kg]

output

INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL T : temperature after mixing [K] , [°C]
REAL Z : total composition after mixing [kmol/kmol] , [kg/kg]
REAL V : volume after mixing [m^3/kmol] , [m^3/kg]
REAL H : enthalpy after mixing [J/kmol] , [J/kg]
REAL S : entropy after mixing [J/(kmol·K)] , [J/(kg·K)]

SUBMIX

SUBROUTINE **SUBMIX(I,J,T,P,Z,V,H,S)** : properties of mixture

INTEGER I : type of problem (input)
1 : inputs (T,P,Z) → outputs (V,H,S)
2 : inputs (P,Z,H) → outputs (T,V,S)
3 : inputs (P,Z,S) → outputs (T,V,H)
4 : inputs (P,Z,V) → outputs (T,H,S)
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL T : temperature [K] , [°C]
REAL P : pressure [Pa] , [bar]
REAL Z : total composition [kmol/kmol] , [kg/kg]
REAL V : volume [m^3/kmol] , [m^3/kg]
REAL H : enthalpy [J/kmol] , [J/kg]
REAL S : entropy [J/(kmol·K)] , [J/(kg·K)]

SUBPAR

SUBROUTINE **SUBPAR(A,J,T,P,XL,XV)**: partial properties

input

CHARACTER*1 A : kind of partial properties, one of 'V','H'and'S'
REAL T : temperature [K], [°C]
REAL P : pressure [Pa], [bar]

output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)

REAL ARRAY XL(2), XV(2) : one of volume, enthalpy and entropy

A='V'
XL(1) partial volume of first component in liquid [m^3/kmol], [m^3/kg]
XL(2) partial volume of second component in liquid [m^3/kmol], [m^3/kg]
XV(1) partial volume of first component in vapor [m^3/kmol], [m^3/kg]
XV(2) partial volume of second component in vapor [m^3/kmol], [m^3/kg]

A='H'
XL(1) partial enthalpy of first component in liquid [J/kmol], [J/kg]
XL(2) partial enthalpy of second component in liquid [J/kmol], [J/kg]
XV(1) partial enthalpy of first component in vapor [J/kmol], [J/kg]
XV(2) partial enthalpy of second component in vapor [J/kmol], [J/kg]

A='S'
XL(1) partial entropy of first component in liquid [J/(kmol·K)], [J/(kg·K)]
XL(2) partial entropy of second component in liquid [J/(kmol·K)], [J/(kg·K)]
XV(1) partial entropy of first component in vapor [J/(kmol·K)], [J/(kg·K)]
XV(2) partial entropy of second component in vapor [J/(kmol·K)], [J/(kg·K)]

SUBPB

SUBROUTINE **SUBPB(J,T,P,X,V,H,S)**
: bubble point pressure and other properties of mixture (temperature and X input)

input
REAL T : temperature [K] , [°C]
REAL X : composition [kmol/kmol] , [kg/kg]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL P : bubble point pressure [Pa] , [bar]
REAL V : bubble point volume [m^3/kmol] , [m^3/kg]
REAL H : bubble point enthalpy [J/kmol] , [J/kg]
REAL S : bubble point entropy [J/(kmol·K)] , [J/(kg·K)]

SUBPD

SUBROUTINE **SUBPD(J,T,P,Y,V,H,S)**
: dew point pressure and other properties of mixture (temperature and Y input)

input
REAL T : temperature [K] , [°C]
REAL Y : composition [kmol/kmol] , [kg/kg]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL P : dew point pressure [Pa] , [bar]
REAL V : dew point volume [m^3/kmol] , [m^3/kg]
REAL H : dew point enthalpy [J/kmol] , [J/kg]
REAL S : dew point entropy [J/(kmol·K)] , [J/(kg·K)]

SUBPST

SUBROUTINE **SUBPST(I,J,T,PS,VL,VV,HL,HV,SL,SV)**
: saturation properties of pure component (temperature intput)

input
INTEGER I : component
1 : first component
2 : second component
REAL T : temperature [K] , [°C]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL PS : saturation pressure [Pa] , [bar]
REAL VL : liquid volume [m^3/kmol] , [m^3/kg]
REAL VV : vapor volume [m^3/kmol] , [m^3/kg]
REAL HL : liquid enthalpy [J/kmol] , [J/kg]
REAL HV : vapor enthalpy [J/kmol] , [J/kg]
REAL SL : liquid entropy [J/(kmol·K)] , [J/(kg·K)]
REAL SV : vapor entropy [J/(kmol·K)] , [J/(kg·K)]

SUBPUR
SUBROUTINE **SUBPUR(I,J,T,P,V,H,S)** : single phase properties of pure components

input
INTEGER I : component
1 : first component
2 : second component
REAL T : temperature [K] , [°C]
REAL P : pressure [Pa] , [bar]

output
output are those of satureted liquid, when temperature-pressure is on saturation line

INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL V : volume [m^3/kmol] , [m^3/kg]
REAL H : enthalpy [J/kmol] , [J/kg]
REAL S : entropy [J/(kmol·K)] , [J/(kg·K)]

SUBTB
SUBROUTINE **SUBTB(J,T,P,X,V,H,S)**
: bubble point temperature and other properties of mixture (pressure and X input)

input
REAL P : pressure [Pa] , [bar]
REAL X : composition [kmol/kmol] , [kg/kg]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL T : bubble point temperature [K] , [°C]
REAL V : bubble point volume [m^3/kmol] , [m^3/kg]
REAL H : bubble point enthalpy [J/kmol] , [J/kg]
REAL S : bubble point entropy [J/(kmol·K)] , [J/(kg·K)]

SUBTD
SUBROUTINE **SUBTD(J,T,P,Y,V,H,S)**
: dew point temperature and other properties of mixture (pressure and Y input)

input

REAL P : pressure [Pa] , [bar]
REAL Y : composition [kmol/kmol] , [kg/kg]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL T : dew point temperature[K] , [°C]
REAL V : dew point volume [m^3/kmol] , [m^3/kg]
REAL H : dew point enthalpy[J/kmol] , [J/kg]
REAL S : dew point entropy [J/(kmol·K)] , [J/(kg·K)]

SUBTSP

SUBROUTINE **SUBTSP(I,J,TS,P,VL,VV,HL,HV,SL,SV)**
: saturation properties of pure component (pressure input)

input
INTEGER I : component
1 : first component
2 : second component
REAL P : pressure [Pa] , [bar]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL TS : temperature [K] , [°C]
REAL VL : liquid volume [m^3/kmol] , [m^3/kg]
REAL VV : vapor volume [m^3/kmol] , [m^3/kg]
REAL HL : liquid enthalpy [J/kmol] , [J/kg]
REAL HV : vapor enthalpy [J/kmol] , [J/kg]
REAL SL : liquid entropy [J/(kmol·K)] , [J/(kg·K)]
REAL SV : vapor entropy [J/(kmol·K)] , [J/(kg·K)]

SUBXY

SUBROUTINE **SUBXY(J,T,P,X,Y,VL,VV,HL,HV,SL,SV)** : properties of mixture at VLE

input
REAL T : temperature [K] , [°C]
REAL P : pressure [Pa] , [bar]
output
INTEGER J : error detection code
−1 : convergence failure
−2 : invalid ARGUMENT(s)
REAL X : composition of liquid X [kmol/kmol] , [kg/kg]
REAL Y : composition of vapor Y [kmol/kmol] , [kg/kg]
REAL VL : liquid volume [m^3/kmol] , [m^3/kg]
REAL VV : vapor volume [m^3/kmol] , [m^3/kg]
REAL HL : liquid enthalpy [J/kmol] , [J/kg]
REAL HV : vapor enthalpy [J/kmol] , [J/kg]
REAL SL : liquid entropy [J/(kmol·K)] , [J/(kg·K)]
REAL SV : vapor entropy [J/(kmol·K)] , [J/(kg·K)]

TBP

REAL FUNCTION **TBP(P,X)** : bubble point temperature

REAL P : pressure [Pa], [bar]
REAL X : composition [kmol/kmol], [kg/kg]
REAL TBP : bubble point temperatuer [K], [°C]

TDP

REAL FUNCTION **TDP(P,Y)** : dew point temperature

REAL	P	: pressure [Pa], [bar]
REAL	Y	: composition [kmol/kmol], [kg/kg]
REAL	TDP	: dew point temperatuer [K], [°C]

TSPM

REAL FUNCTION **TSPM(I,P)** : saturation temperature of pure components

INTEGER	I	: component 1 : first component 2 : second component
REAL	P	: pressure of pure component [Pa] , [bar]
REAL	TSPM	: saturation temperature [K], [°C]