

Program A.II.1. A FORTRAN Program to Perform Saturation Pressure Search

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c  Output of this program: P, T, and x of a control volume
c  Inputs to this program: v, u
c
   print *, 'Enter > specific volume (v) in ft3/lbm and specific',
1  'internal energy (u) in Btu/lbm'
   read(*,*) v,u
   T = 344.00
1  continue
   n=n+1
   call watsat(T,P,vf,vfg,vg,hf,hfg,hg,uf,ufg,ug,dpdt,dvfdt,
1  dvfgdt,dvgdt,dhfdt,dhfgdt,dhgdt,dufdt,dufgdt,dugdt,n)
   Foft=(v-vf)*ufg-(u-uf)*vfg
   Fpft=-ufg*dvfdt+(v-vf)*dufgdt+vfg*dufdt-(u-uf)*dvfgdt
   eps=Foft/Fpft
   T=T-eps
   if(abs(eps).le.1E-5.or.n.gt.250) go to 2

   go to 1
2  continue
   x=(u-uf)/ufg
   write(*,4)
   write(*,3) n,eps,v,u,t,p,x
3  format(
1      ' Number of steps:.....',i14,/,
2      ' Convergence criterion:.....',E14.4,/,
3      ' Specific volume (ft3/lbm):.....',f14.4,/,
4      ' Specific int. energy (Btu/lbm):.....',f14.4,/,
5      ' Temperature (F):.....',f14.2,/,
6      ' Pressure (psia):.....',f14.2,/,
7      ' Quality (-):.....',f14.4,/)
4  format(/////////)
   stop
   end

c-----
   subroutine watsat(t,p,vf,vfg,vg,hf,hfg,hg,uf,ufg,ug,dpdt,dvfdt,
1  dvfgdt,dvgdt,dhfdt,dhfgdt,dhgdt,dufdt,dufgdt,dugdt,n)
c
c  Water properties p, vf, vfg, uf, and ufg are correlated to saturated
c  tempearture between 32 and 656 Deg F (0.0886 < P < 2300 psia).
c  Data in British units.
c
   data c/.1850899/
   if(t.lt.32.0.or.t.gt.656.0) go to 1
   call psatot(t,p,dpdt)
   call vfsatt(t,vf,dvfdt)
   call vfgsat(t,vfg,dvfgdt)
   call ufsatt(t,uf,dufdt)
   call ugsatt(t,ug,dugdt)
   vg=vf+vfg
   dvgdt=dvfdt+dvfgdt
   ufg=ug-uf
   dufgdt=dugdt-dufdt
   hf=uf+c*p*vf
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        hg=ug+c*p*vg
        hfg=hg-hf
        dhfdt=dufdt+c*(dpdt*vf+p*dvfdt)
        dhgdt=dugdt+c*(dpdt*vg+p*dvgdt)
        dhfgdt=dhfdt+dhgdt
    return
1    continue
    write(*,*) n
    write(*,2) t
2    format(' Sat. Temp. Outside of the Range of Properties.',f10.3)
    end
c
    subroutine psatot(tsat,psat,dpdt)
    dimension b(8)

    data a,b(1),b(2),b(3),b(4),b(5),b(6),b(7),b(8)/.6962719,
1      -.3579628e-1,.7568188e-3,-.6924369e-5,.4086826e-7,
2      -.1124099e-9,.2708745e-12,-.3145232e-15,.1427914e-18/
c
    arg=0.0
    argp=0.0
    do 1 i=1,8
        arg=arg+b(i)*(tsat**i)
        argp=argp+i*b(i)*(tsat**(i-1))
1    continue
    psat=a+arg
    dpdt=argp
    return
    end
c
    subroutine vfsatt(tsat,vf,dvfdt)
    dimension b(8)
    data a,b(1),b(2),b(3),b(4),b(5),b(6),b(7),b(8)/62.11036,
1      .1722592e-1,-.2852652e-3,.1485193e-5,-.6087479e-8,
2      .1660097e-10,-.2821841e-13,.2669788e-16,-.1077666e-19/
c
    arg=0.0
    argp=0.0
    do 1 i=1,8
        arg=arg+b(i)*(tsat**i)
        argp=argp+i*b(i)*(tsat**(i-1))
1    continue
    vf=1./(a+arg)
    dvfdt=-vf*vf*argp
    return
    end
c
    subroutine vfgsat(tsat,vfg,dvfgdt)
    dimension b(10)
    data a,b(1),b(2),b(3),b(4),b(5),b(6),b(7),b(8),b(9),b(10)/
1      9.429309,-.4471527e-1,.1089104e-3,-.1994522e-6,
2      -.4738610e-10,.2567196e-11,-.1197328e-13,.3006035e-16,
3      -.4408149e-19,.3543467e-22,-.1208486e-25/
c
    arg=0.0
    argp=0.0
    do 1 i=1,10

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        arg=arg+b(i)*(tsat**i)
        argp=argp+i*b(i)*(tsat**(i-1))
1      continue
        vfg=exp(a+arg)
        dvfgdt=vfg*argp
        return
    end

c
    subroutine ufsatt(tsat,uf,dufdt)
    dimension b(8)
    data a,b(1),b(2),b(3),b(4),b(5),b(6),b(7),b(8)/-31.33822,
1      .9664909,.6886926e-3,-.7099748e-5,.3951334e-7,-.1246218e-9,
2      .2283063e-12,-.2246668e-15,.9254311e-19/

c
    arg=0.0
    argp=0.0
    do 1 i=1,8
        arg=arg+b(i)*(tsat**i)
        argp=argp+i*b(i)*(tsat**(i-1))
1      continue
    uf=a+arg
    dufdt=argp
    return
    end

c
    subroutine ugsatt(tsat,ug,dugdt)
    dimension b(8)
    data a,b(1),b(2),b(3),b(4),b(5),b(6),b(7),b(8)/1016841.,
1      920.3534,-4.762259,.4607905e-1,-.2479441e-3,.7584943e-6,
2      -.1346369e-8,.1283154e-11,-.5100722e-15/

c
    arg=0.0
    argp=0.0
    do 1 i=1,8
        arg=arg+b(i)*(tsat**i)
        argp=argp+i*b(i)*(tsat**(i-1))
1      continue
    ug=sqrt(arg+a)
    dugdt=0.5*argp/ug
    return
    end
c.....

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