ภาคผนวก ก
ตัวอย่างการคำนวณ

การคำนวณหาระยะเวลาคืนทุน

คิดที่เครื่องทำงาน 21 ชั่วโมงต่อวัน 350 วันต่อปี ราคาน้ำมัน 8.70 บาทต่อลิตร

ค่าเฉลี่ยการดึงความร้อนกลับ	4182.3วัตต์
คิดเป็น	316.2 MJ/day(21hr)
ค่าความร้อนของน้ำมันดีเซล(HHV)	45.39 MJ/kg fuel
ค่าความถ่วงจำเพาะของน้ำมันดีเซล	0.85 kg/m3
ค่าความร้อนของน้ำมันดีเซล	= 0.85*45.39 MJ/litre
ค่าความร้อนที่ดึงกลับได้คิดเป็นน้ำมันดีเซล	= 316.2/0.85*45.39 litre
	= 8.2 Litre
คิดที่ราคาน้ำมันดีเซลลิตรละ	8.70 บาท
สามารถประหยัดค่าใช้จ่ายได้	71.3 บาทต่อวัน
ราคาอีโคโนไมเซอร์ที่สร้าง	50,000 บาท
ราคาค่าดำเนินการ	20,000 บาท
สามารถคืนทุนได้	= 70,000/71.3 วัน
	= 981 วัน

การคำนวณค่า IRR

จากสมการ 6.8 กำหนดให้

P	=	70,000 บาท
P1	=	3,000 บาท
F	=	71.3x350
	=	24,955 บาท
N	=	10 ปี

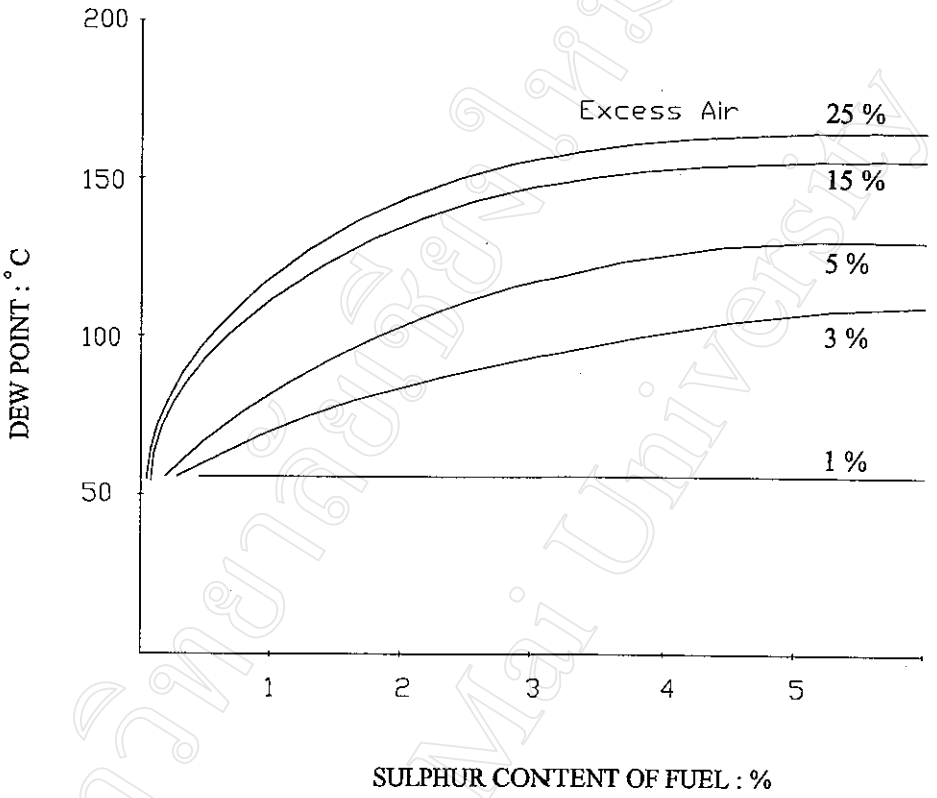
แทนค่าต่างๆลงในสมการ 6.8 จะได้

$$70000+3000\left[\frac{(1+i)^{10}}{i(1+i)^{10}}\right]=24955\left[\frac{(1+i)^{10}-1}{i(1+i)^{10}}\right]$$

แก้สมการหาค่า I จะได้

IRR มีค่าเท่ากับ 34.43 เปอร์เซ็นต์

การหาอุณหภูมิน้ำค้าง



กราฟแสดงการหาอุณหภูมิจุดน้ำค้าง

ภาคผนวก ข
โปรแกรมคำนวณช่วยออกแบบเครื่องแลกเปลี่ยนความร้อนแบบท่อความร้อน

```
PROGRAM HEAT_PIPE_ECONOMIZER;
Uses winCRT;
CONST  C = 0.235;
       g = 9.81;
       Pa = 1.013e5;
VAR    Q,dQ,Qrev,Re,Ref,Tci,Tcimin,Tcimax,stTci,Tco,Tei,Teimin,Teimax,StTei,
       Teo,Tsi,Tso,Tv,TdIFf,Ta,X,Y,dX,hfg,heo,hco,La,Lai,Lamin,Lamini,Lamaxi,
       stlai,Lamax,stLa,Lb,Lc,Lci,Lcmin,Lcmini,Lcmaxi,stlci,LcMax,stLc,Le,Lei,
       LeMin,Lemini,Lemaxi,stlei,LeMax,stLe,Sb,Seo,Sco,OD,ODi,ID,IDi,t,ODf,
       ODfi,tf,tfi,p,Pv,Pp,Ts,dTs,Tp1,Tp2,Nu,Ztotal,Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9,
       Z10,Z3f,dTh,Tp,F,fi,Vcmax,Vc,Vhmax,Vh,m_air,Cpair,Cp,C1,C2,k,m,Pr,
       teff,Frac1,hf,ho,psi2,psi3,VisL,denV,denL,mat,Thcon,Z3p,Lamda,V,Frac2,L,
       Leff,Vis_air,Prair,kair,kliq,Beta,BEtai,Alfa,Sigma,St,sti,Sl,sli,a1,a2,a3,a4,b1,
       b2,b3,b4,u1,u2,u3,u4,i1,i2,i3,i4,j1,j2,j3,j4,o1,o2,o3,o4,p1,p2,p3,p4,q1,q2,q3,
       q4,q5,s1,s2,s3,s4,Tr,Tc,DenC,Pc,dQ1,Qboil,MaxHF,Qsonic,Qcount,Bo,Kp,
       f1,f2,f3,Thcon1,matf,Tc1,Toa,Cmin,Cmin1,Cmin2,Den_air,Den_air1,Cp_air,
       Cp_air1,Area,Teor,Te,Tcon,Qtran,Qexp,Quse,Qmax,Effn,Nohp,Nohpr,
       LMTD,Ids,Tb,Lf,Lf1,R2C,LC1,AP,XA,Eff1,Eff2,EffF,nf,nfi,Vfl,Vflmin,Vfl
       max,stVfl,Vwa,Vwamin,Vwamax,stVwa,Vol,Dm,Prr,dEf,dEb,Cpflue,EbyC,
       EbyCi,EbyCmax,Cost,Effni,Qrevm,Qtranm,dQmax,T2,T1,dQ2,dQ3,dQ4,
       Lem,Lcm,Stm,Slm,ODfm,Teom,Tcom,Effm,C11,C12,C13,C14,m1,m2,m3,
       m4,Tz,Nohpm,kc,ODc,IDc,Tk,nfmin,nfmini,nfmaxi,stnfi,nfmax,stnf,Effeni,
       Effen,Teoi,hof,hofmin,hofmini,hofmaxi,sthofi,hofmax,sthof,Vfli,Vwai,Teii,
       Tcii,RHOh,Cph,Uh,Kh,Ulfh,Prrh,et,RHOhh,Cphh,Uhh,vhh,Khh,Ulfhh,Prrhh,
       Kee,Nue,Nuc,Vmaxe,Vmaxc,Dme,Dmc,EffFe,EffFc,Kt,Kf,Ke,Den1,Vol1,Cp
       1,Den2,Vol2,Cp2,Teo1,Ree,Rec,v4:real;
       Typ,typi,kind,kindi,Nri,Nr,Np,Npi,Arr,Arri,i,nf1,cccc,Wkfluid,Wkfluidc,Wkf
       luidh,R,nrmin,nrmini,nrmaxi,stnri,nrmax,stnr,nrr,npmin,npmini,npmaxi,stnpi,
       npmax,stnp,Odmin,odmini,odmaxi,odmax,n,odid:INTEGER;
       Ch,Ch1:Char;
```

```
outfile:text;
FUNCTION Power(x,n : Real) : Real;
  BEGIN
        Power := Exp(ln(x)*n);
  END;
PROCEDURE FineZ2Z8 (ODf,OD,ID,Le,Lc,nf,tf,et,Kt,Kf,Ke: Real;VAR Z2,Z8:real);
    VAR Zt,Ztf,Z1f,Lt,Zte :real;
   PROCEDURE ZTube(OD,ID,Kt,Lt:real;VAR Zt:real);
     BEGIN
       Zt:=ln(OD/ID)/(2*pi*Kt*Lt);
     END;
   PROCEDURE ZTubeE(OD,ID,et,Kt,Ke,Lt:real;VAR Zte:real);
     BEGIN
       Zte:=(ln(OD/ID)/(2*pi*Kt*Lt))+(ln((OD+et)/OD)/(2*pi*Ke*Lt));
     END;
   PROCEDURE ZTubeFin(ODf,OD,ID,Kt,Kf,Lt,tf,nf:real;VAR Z1f,Ztf:real);
       VAR Zf:real;
     BEGIN
       ZTube(OD,ID,Kt,Lt-(Lt*tf*nf*100/2.54),Zt);
       Zf := ln(ODf/OD)/(2*pi*Kf*tf*Lt*nf*100/2.54)+ln(OD/ID)/
            (2*pi*Kt *tf*Lt*nf*100/2.54);
       Ztf  :=Zt+Zf ;
     END;
   PROCEDURE ZTubeFinE(ODf,et,Ke,tf,Lt,nf:real;VAR Ztfe:real);
       VAR Z1fe,Zfe:real;
     BEGIN
       ZTubeE(OD,ID,et,Kt,Ke,Lt-(Lt*(tf+2*et)*nf*100/2.54),Zte);
       ZTubeFin(ODf,ID,ID,Kt,Kf,(Lt*tf*nf*100/2.54),tf,nf,Z1f,Ztf);
       Zfe :=ln((ODf+et)/ODf)/(2*pi*Ke*(Lt*(tf+2*et)*nf*100/2.54))+
             ln((ODf+et)/OD)/(2*pi*Ke*(Lt*2*et*nf*100/2.54));
```

```
    Ztfe:=Zt+Zfe+Ztf ;
  END;
BEGIN
  IF typ = 1 THEN
    BEGIN
      Ztube(OD,ID,Kt,Le,Z2);
      Ztube(OD,ID,Kt,Lc,Z8);
    END;
  IF typ =2  THEN
    BEGIN
      Ztube(OD,ID,Kt,Le,Z2);
      Ztubefin(ODf,OD,ID,Kt,Kf,Lc,tf,nf,Z1f,Z8);
    END;
  IF typ =3  THEN
    BEGIN
      Ztubefin(ODf,OD,ID,Kt,Kf,Le,tf,nf,Z1f,Z2);
      Ztube(OD,ID,Kt,Lc,Z8);
    END;
  IF typ = 4 THEN
    BEGIN
      Ztubefin(ODf,OD,ID,Kt,Kf,Le,tf,nf,Z1f,Z2);
      Ztubefin(ODf,OD,ID,Kt,Kf,Lc,tf,nf,Z1f,Z8);
    END;
  IF typ = 5 THEN
    BEGIN
      ZTubeE(OD,ID,et,Kt,Ke,Le,Z2);
      ZTubeE(OD,ID,et,Kt,Ke,Lc,Z8);
    END;
  IF typ = 6 THEN
    BEGIN
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        ZTubeE(OD,ID,et,Kt,Ke,Le,Z2);
        ZTubeFinE(ODf,et,Ke,tf,Lc,nf,Z8);
      END;
    IF typ = 7 THEN
      BEGIN
        ZTubeFinE(ODf,et,Ke,tf,Le,nf,Z2);
        ZTubeE(OD,ID,et,Kt,Ke,Lc,Z8);
      END;
    IF typ = 8 THEN
      BEGIN
        ZTubeFinE(ODf,et,Ke,tf,Le,nf,Z2);
        ZTubeFinE(ODf,et,Ke,tf,Lc,nf,Z8);
      END;
  END;
PROCEDURE AirProperty(T:REAL;VAR RHO,Cp,U,v,K,Ulf,Prr:REAL);
    TYPE
    AR=ARRAY[1..32] OF ARRAY[1..8]OF REAL;
    VAR A:AR;n:integer;nn,nnn:real;
BEGIN
  BEGIN
  A[1,1]:=100;   A[1,2]:=3.5562; A[1,3]:=1.032;   A[1,4]:=71.1;
  A[1,5]:=2.00;  A[1,6]:=9.34;   A[1,7]:=2.54;    A[1,8]:=0.786;
  A[2,1]:=150;   A[2,2]:=2.3364; A[2,3]:=1.012;   A[2,4]:=103.4;
  A[2,5]:=4.426; A[2,6]:=13.8;   A[2,7]:=5.84;    A[2,8]:=0.758;
  A[3,1]:=200;   A[3,2]:=1.7458; A[3,3]:=1.007;   A[3,4]:=132.5;
  A[3,5]:=7.590; A[3,6]:=18.1;   A[3,7]:=10.3;    A[3,8]:=0.737;
  A[4,1]:=250;   A[4,2]:=1.3947; A[4,3]:=1.006;   A[4,4]:=159.6;
  A[4,5]:=11.44; A[4,6]:=22.3;   A[4,7]:=15.9;    A[4,8]:=0.720;
  A[5,1]:=300;   A[5,2]:=1.1614; A[5,3]:=1.007;   A[5,4]:=184.6;
  A[5,5]:=15.89; A[5,6]:=26.3;   A[5,7]:=22.5;    A[5,8]:=0.707;
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A[6,1]:=350; A[6,2]:=0.9950; A[6,3]:=1.009; A[6,4]:=208.2;
A[6,5]:=20.92; A[6,6]:=30; A[6,7]:=29.9; A[6,8]:=0.7;
A[7,1]:=400; A[7,2]:=0.8711; A[7,3]:=1.014; A[7,4]:=230.1;
A[7,5]:=26.41; A[7,6]:=33.8; A[7,7]:=38.3; A[7,8]:=0.69;
A[8,1]:=450; A[8,2]:=0.774; A[8,3]:=1.021; A[8,4]:=250.7;
A[8,5]:=32.39; A[8,6]:=37.3; A[8,7]:=47.2; A[8,8]:=0.686;
A[9,1]:=500; A[9,2]:=0.6964; A[9,3]:=1.03; A[9,4]:=270.1;
A[9,5]:=38.79; A[9,6]:=40.7; A[9,7]:=56.7; A[9,8]:=0.684;
A[10,1]:=550; A[10,2]:=0.6329; A[10,3]:=1.04; A[10,4]:=288.4;
A[10,5]:=45.57; A[10,6]:=43.9; A[10,7]:=66.7; A[10,8]:=0.683;
A[11,1]:=600; A[11,2]:=0.5804; A[11,3]:=1.051; A[11,4]:=305.8;
A[11,5]:=52.69; A[11,6]:=46.9; A[11,7]:=76.9; A[11,8]:=0.685;
A[12,1]:=650; A[12,2]:=0.5356; A[12,3]:=1.063; A[12,4]:=322.5;
A[12,5]:=60.21; A[12,6]:=49.7; A[12,7]:=87.3; A[12,8]:=0.690;
A[13,1]:=700; A[13,2]:=0.4975; A[13,3]:=1.075; A[13,4]:=338.8;
A[13,5]:=68.1; A[13,6]:=52.4; A[13,7]:=98; A[13,8]:=0.695;
A[14,1]:=750; A[14,2]:=0.4643; A[14,3]:=1.087; A[14,4]:=354.6;
A[14,5]:=76.37; A[14,6]:=54.9; A[14,7]:=109; A[14,8]:=0.702;
A[15,1]:=800; A[15,2]:=0.4354; A[15,3]:=1.099; A[15,4]:=369.8;
A[15,5]:=84.93; A[15,6]:=57.3; A[15,7]:=120; A[15,8]:=0.709;
A[16,1]:=850; A[16,2]:=0.4097; A[16,3]:=1.11; A[16,4]:=384.3;
A[16,5]:=93.8; A[16,6]:=59.6; A[16,7]:=131; A[16,8]:=0.716;
A[17,1]:=900; A[17,2]:=0.3868; A[17,3]:=1.121; A[17,4]:=398.1;
A[17,5]:=102.9; A[17,6]:=62; A[17,7]:=143; A[17,8]:=0.720;
A[18,1]:=950; A[18,2]:=0.3666; A[18,3]:=1.131; A[18,4]:=411.3;
A[18,5]:=112.2; A[18,6]:=64.3; A[18,7]:=155; A[18,8]:=0.723;
A[19,1]:=1000; A[19,2]:=0.3482; A[19,3]:=1.141; A[19,4]:=424.4;
A[19,5]:=121.9; A[19,6]:=66.7; A[19,7]:=168; A[19,8]:=0.726;
A[20,1]:=1100; A[20,2]:=0.3166; A[20,3]:=1.159; A[20,4]:=449;
A[20,5]:=141.8; A[20,6]:=71.5; A[20,7]:=195; A[20,8]:=0.728;

```
A[21,1]:=1200; A[21,2]:=0.2902; A[21,3]:=1.175; A[21,4]:=473;
A[21,5]:=162.9; A[21,6]:=76.3; A[21,7]:=224; A[21,8]:=0.728;
A[22,1]:=1300; A[22,2]:=0.2679; A[22,3]:=1.189; A[22,4]:=496;
A[22,5]:=185.1; A[22,6]:=82; A[22,7]:=238; A[22,8]:=0.719;
A[23,1]:=1400; A[23,2]:=0.2488; A[23,3]:=1.207; A[23,4]:=530;
A[23,5]:=213; A[23,6]:=91; A[23,7]:=303; A[23,8]:=0.703;
A[24,1]:=1500; A[24,2]:=0.2322; A[24,3]:=1.230; A[24,4]:=557;
A[24,5]:=240; A[24,6]:=100; A[24,7]:=350; A[24,8]:=0.685;
A[25,1]:=1600; A[25,2]:=0.2177; A[25,3]:=1.248; A[25,4]:=584;
A[25,5]:=106; A[25,6]:=390; A[25,7]:=390; A[25,8]:=0.688;
A[26,1]:=1700; A[26,2]:=0.2049; A[26,3]:=1.267; A[26,4]:=611;
A[26,5]:=298; A[26,6]:=113; A[26,7]:=435; A[26,8]:=0.685;
A[27,1]:=1800; A[27,2]:=0.1935; A[27,3]:=1.286; A[27,4]:=637;
A[27,5]:=329; A[27,6]:=120; A[27,7]:=482; A[27,8]:=0.683;
A[28,1]:=1900; A[28,2]:=0.1833; A[28,3]:=1.307; A[28,4]:=663;
A[28,5]:=362; A[28,6]:=128; A[28,7]:=534; A[28,8]:=0.677;
A[29,1]:=2000; A[29,2]:=0.1741; A[29,3]:=1.337; A[29,4]:=689;
A[29,5]:=396; A[29,6]:=137; A[29,7]:=589; A[29,8]:=0.672;
A[30,1]:=2100; A[30,2]:=0.1658; A[30,3]:=1.372; A[30,4]:=715;
A[30,5]:=431; A[30,6]:=147; A[30,7]:=646; A[30,8]:=0.667;
A[31,1]:=2200; A[31,2]:=0.1582; A[31,3]:=1.417; A[31,4]:=740;
A[31,5]:=468; A[31,6]:=160; A[31,7]:=714; A[31,8]:=0.655;
END;
T:=T+273.15;
nn:= T / 50 ;
nnn:=((T-1000)/100)+20;
 BEGIN
IF T <= 1000 THEN  n:= trunc(nn)
        ELSE
          BEGIN
```

```
            n:= trunc(nnn);
            END
    END;
        i:= n;
        BEGIN
      RHO:=(((A[i,2]-A[i-1,2])*(T-A[i-1,1]))/(A[i,1]-A[i-1,1]))+A[i-1,2];
      Cp :=((((A[i,3]-A[i-1,3])*(T-A[i-1,1]))/(A[i,1]-A[i-1,1]))+A[i-1,3])*1e3;
      U  :=((((A[i,4]-A[i-1,4])*(T-A[i-1,1]))/(A[i,1]-A[i-1,1]))+A[i-1,4])*1e-7;
      v  :=((((A[i,5]-A[i-1,5])*(T-A[i-1,1]))/(A[i,1]-A[i-1,1]))+A[i-1,5])*1e-6;
      K  :=((((A[i,6]-A[i-1,6])*(T-A[i-1,1]))/(A[i,1]-A[i-1,1]))+A[i-1,6])*1e-3;
      Ulf:=((((A[i,7]-A[i-1,7])*(T-A[i-1,1]))/(A[i,1]-A[i-1,1]))+A[i-1,7])*1e-6;
      Prr:=(((A[i,8]-A[i-1,8])*(T-A[i-1,1]))/(A[i,1]-A[i-1,1]))+A[i-1,8];
        END;
END;
PROCEDURE Waterproperty(Tv:real;VAR Pv,DenL,DenV,L,Cp,VisL,
            Sigma,lamda,Psi2,Psi3,Prr:real);
 BEGIN
  BEGIN
   a1 := -7.78747;  a2 :=  1.50255;  a3 := -2.81152;  a4 := -1.22268;
   b1 :=  2.24670;  b2 := -2.09405;  b3 :=  2.73700;  b4 := -1.74750;
   u1 := -1.38200;  u2 := -6.06253;  u3 :=  5.91090;  u4 := -6.68477;
   i1 :=  1.7035e5; i2 :=  1.12332e7; i3 := -1.47041e7; i4 :=  6.35750e6;
   j1 := -1.4995e4; j2 :=  8.8e-2;   j3 := -6.82e-1;  j4 := -7.05e-1;
   o1 := -1.01083e1; o2 :=  1.39621;  o3 :=  4.8431e-1; o4 :=  7.1019e-1;
   p1 := -1.0373e1;  p2 := -8.6737e-1; p3 := -2.9699e-1; p4 :=  9.051e-2;
   q1 := -1.63975;  q2 :=  1.11421e1; q3 := -2.00805e1; q4 :=  1.67447e1;
   s1 :=  2.358e-1;  s2 := -6.25e-1;  s3 :=  1.256;    q5 := -5.78763;
   Pc :=  22.093e6;  Tc :=  647.25;   DenC := 315.5;   s4 :=  0;
  END;
 Tr      :=(Tv+273.15)/(Tc);
```

```
Pv      := Exp(ln(Pc)+((1/Tr)*(a1*(1-Tr)+a2*Power((1-Tr),(3/2))
           +a3*Power((1-Tr),3)+a4*Power((1-Tr),6))));
DenL    := DenC*Exp(b1*Power((1-Tr),(1/3))
           +b2*Power((1-Tr),(2/3))+b3*(1-Tr)+b4*Power((1-Tr),(4/3)));
DenV    := DenC*Exp(u1*Power((1/Tr)-1,(1/3))+u2*Power((1/Tr)-1,(2/3))
           +u3*((1/Tr)-1)+u4*Power((1/Tr)-1,(4/3)));
L       := i1*Power((1-Tr),(1/3))+i2*Power((1-Tr),(2/3))
           +i3*(1-Tr)+i4*Power((1-Tr),(4/3));
Cp      := j1*(1+j2*Power((1-Tr),(-2/3))+j3*Power((1-Tr),(-1/3))
           +j4*Power((1-Tr),(1/3)));
VisL    := Exp(o1+o2*Power((1/Tr)-1,(1/3))+o3*Power((1/Tr)-1,(4/3))
           +o4*Power((1/Tr)-1,(7/3)));
Sigma   := s1*Power((1-Tr),s3)*(1+s2*(1-Tr));
Lamda   := q1+(q2*Tr)+(q3*Power(Tr,2))+(q4*Power(Tr,3))+(q5*Power(Tr,4));
Psi2    := Power((L*Power(Lamda,3)*Power(DenL,2)/VisL),(1/4));
Prr     :=Cp*VisL/Lamda;
END;
PROCEDURE Working_Fluids(Tv:real;VAR Pv,DenL,DenV,L,Cp,VisL,
          Sigma,lamda,Psi2,Psi3,Prr:real);
BEGIN
 CASE KIND OF
 1:BEGIN
  a1 := -7.53950;  a2 :=  1.41391;  a3 := -2.82444;  a4 := -2.35154;
  b1 :=  1.54197;  b2 :=  6.2638e-1; b3 := -2.10512;  b4 :=  1.33993;
  u1 := -3.32412;  u2 := -1.56371;  u3 :=  3.08367;  u4 := -6.26958;
  i1 :=  6.47071e5; i2 :=  8.2478e4;  i3 :=  1.4827e4;  i4 := -6.851e3;
  j1 := -1.7005e4; j2 :=  1.36e-1;  j3 := -7.33e-1;  j4 := -5.22e-1;
  o1 := -9.83603;  o2 :=  1.27550;  o3 :=  9.4798e-1; o4 :=  4.46e-3;
  p1 := -1.06462e1; p2 := -1.14058;  p3 := -1.72007e-1;p4 :=  4.8399e-2;
  q1 :=  7.0244e-2; q2 :=  2.2;     q3 := -5.6;      q4 :=  6.6;
```

```
 s1 := 6.4483e-2; s2 := 0;       s3 := 1.1635;    s4 := 0;
 Pc := 4.705e6;  Tc := 508.10;   DenC := 278;
END;
2:BEGIN
 a1 := -7.22986;  a2 := 1.28909;  a3 := -2.45958;  a4 := -1.37809;
 b1 := 1.95729;  b2 := -1.62786;  b3 := 1.98719;  b4 := -9.9541e-1;
 u1 := -1.27692;  u2 := -5.59572;  u3 := 5.24646;  u4 := -6.06360;
 i1 := 9.46938e5; i2 := 2.35139e6; i3 := -1.68977e6; i4 := 2.07175e5;
 j1 := 1.92251e4; j2 := 1.155e-1; j3 := -4.73e-1;  j4 := -4.61e-1;
 o1 := -1.04378e1; o2 := 1.87484;  o3 := 8.2174e-1; o4 := 2.8326e-1;
 p1 := -1.07908e1; p2 := -8.1566e-1; p3 := -4.5000e-1; p4 := 1.59615e-1;
 q1 := 1.31337e-1;q2 := 3.450;    q3 := -5.12;     q4 := 9.68;
 s1 := 9.593e-2;  s2 := 0;       s3 := 1.1624;    s4 := 0;
 Pc := 11.333e6;  Tc := 405.4;    DenC := 235;
END;
3:BEGIN
 a1 := -8.12693;  a2 := 1.70017;  a3 := -4.81471;  a4 := -2.61427;
 b1 := 2.76853;  b2 := -5.08798;  b3 := 6.81475;  b4 := -3.18776;
 u1 := -5.65438;  u2 := 1.09708e1; u3 := -1.5548e1; u4 := 1.45414;
 i1 := 3.83989e5; i2 := 2.21890e5; i3 := -3.34590e5; i4 := 1.87394e5;
 j1 := 1.5321e4;  j2 := 6.7e-2;   j3 := 3.92e-1;  j4 := -6.20e-1;
 o1 := -1.04705e1; o2 := 2.60094;  o3 := 4.8223e-1; o4 := 3.1866e-1;
 p1 := -1.09084e1; p2 := -6.09692e-1;p3 := -4.59603e-1;p4 := 1.36688e-1;
 q1 := 7.6083e-2; q2 := 3.50e-1;  q3 := -5.05e-1;  q4 := 1.480;
 s1 := 7.4875e-2; s2 := 0;       s3 := 1.293;     s4 := 0;
 Pc := 3.225e6;  Tc := 770;      DenC := 318;
END;
4:BEGIN
 a1 := -7.56005;  a2 := 1.44629;  a3 := -3.15907;  a4 := -2.76893;
 b1 := 1.90853;  b2 := -9.4306e-1; b3 := 3.6555e-1; b4 := 4.168e-2;
```

```
 u1 := 6.75227;  u2 := -2.92431e1; u3 := 2.91023e1; u4 := -1.46316e1;
 i1 := 5.04192e5; i2 := -1.05814e6; i3 := 2.09985e6; i4 := -1.16691e6;
 j1 := -1.8970e4; j2 := 1.038e-1; j3 := -6.82e-1; j4 := -4.71e-1;
 o1 := -9.61368;  o2 := 1.70927;  o3 := 5.9186e-1; o4 := 1.3840e-1;
 p1 := -1.07304e1; p2 := -8.04782e-1;p3 := -2.95985e-1;p4 := 8.6748e-2;
 q1 := 4.8087e-2; q2 := 1.728;   q3 := -3.816;   q4 := 4.778;
 s1 := 1.02537e-1;s2 := -3.13e-1;  s3 := 1.475;   s4 := 0;
 Pc := 4.350e6; Tc := 690;  DenC := 407;
END;
5:BEGIN
 a1 := -8.48160;  a2 := 5.8803e-1; a3 := -2.68463;  a4 := -7.940e-2;
 b1 := 1.67947;  b2 := 9.1985e-1; b3 := -3.14769;  b4 := 1.94256;
 u1 := -2.94474;  u2 := -2.1800e-1; u3 := -2.56475;  u4 := -3.82626;
 i1 := 1.59735e6; i2 := -1.82128e6; i3 := 5.28893e6; i4 := -3.87480e6;
 j1 := -4.7883e4; j2 := 1.35e-2;  j3 := -6.93e-1;  j4 := -4.91e-1;
 o1 := -1.14659e1; o2 := 4.07687;  o3 := 2.1788e-1; o4 := 3.2409e-1;
 p1 := -1.06045e1; p2 := -8.74383e-1;p3 := -2.80468e-1;p4 := 6.1553e-2;
 q1 := 1.0676e-1; q2 := 3.00;    q3 := -6.50;    q4 := 5.40;
 s1 := 7.6184e-2; s2 := -6.003e-1; s3 := 1.08;    s4 := 0;
 Pc := 8.078e6; Tc := 512.64;  DenC := 272;
END;
6:BEGIN
 a1 := -7.28135;  a2 := 1.37090;  a3 := -2.79369;  a4 := -2.97865;
 b1 := 1.62760;  b2 := 1.680e-2; b3 := -1.00363;  b4 := 7.2222e-1;
 u1 := -1.60099;  u2 := -4.90117;  u3 := 5.55375;  u4 := -6.79782;
 i1 := 1.16646e6; i2 := -3.20299e6; i3 := 4.96029e6; i4 := -2.45921e6;
 j1 := -2.1813e3; j2 := 2.34e-1;  j3 := -1.5920;   j4 := -1.840e-1;
 o1 := -9.80333;  o2 := 1.21142;  o3 := 1.17678;  o4 := -5.709e-2;
 p1 := -1.06238e1; p2 := -1.18387;  p3 := -1.23772e-1;p4 := 2.8483e-2;
 q1 := 5.0070e-2; q2 := 3.517;   q3 := -9.235;   q4 := 9.254;
```

```
    s1 := 6.8887e-1; s2 := 0;      s3 := 1.289;    s4 := 0;
    Pc := 4.106e6;  Tc := 591.80;  DenC := 291.4;
   END;
  END;
  Tr     :=(Tv+273.15)/(Tc);
  Pv     := Exp(ln(Pc)+((1/Tr)*(a1*(1-Tr)+a2*Power((1-Tr),(3/2))
            +a3*Power((1-Tr),3)+a4*Power((1-Tr),6))));
  DenL   := DenC*Exp(b1*Power((1-Tr),(1/3))
            +b2*Power((1-Tr),(2/3))+b3*(1-Tr)+b4*Power((1-Tr),(4/3)));
  DenV   := DenC*Exp(u1*Power((1/Tr)-1,(1/3))+u2*Power((1/Tr)-1,(2/3))
            +u3*((1/Tr)-1)+u4*Power((1/Tr)-1,(4/3)));
  L      := i1*Power((1-Tr),(1/3))+i2*Power((1-Tr),(2/3))
            +i3*(1-Tr)+i4*Power((1-Tr),(4/3));
  Cp     := j1*(1+j2*Power((1-Tr),(-2/3))+j3*Power((1-Tr),(-1/3))
            +j4*Power((1-Tr),(1/3)));
  VisL   := Exp(o1+o2*Power((1/Tr)-1,(1/3))+o3*Power((1/Tr)-1,(4/3))
            +o4*Power((1/Tr)-1,(7/3)));
  Sigma  := s1*Power((1-Tr),s3)*(1+s2*(1-Tr));
  Lamda  := q1*(1+q2*Power((1-Tr),(1/3))
            +q3*Power((1-Tr),(2/3))+q4*(1-Tr));
  Psi2   := Power((L*Power(Lamda,3)*Power(DenL,2)/VisL),(1/4));
  Prr    :=Cp*VisL/Lamda;
END;
PROCEDURE SelecWorkingFluids(Tv:real;VAR Pv,DenL,DenV,L,Cp,VisL,
          Sigma,lamda,Psi2,Psi3,Prr:real);
PROCEDURE Fluids;
    BEGIN
     BEGIN
     Write(' WORKING FLUIDS ');
     Writeln;
```

```
      Write('    1 = Acetone   temp. range -95.0  <= T (C) <= 180 ');Writeln;
      Write('    2 = Ammonia   temp. range -77.7  <= T (C) <=  90 ');Writeln;
      Write('    3 = Diphenyl  temp. range  12.0  <= T (C) <= 400 ');Writeln;
      Write('    4 = O-Dichlorobenzene temp. range -17.0 <= T (C) <= 340
           ');Writeln;
      Write('    5 = Methanol  temp. range -97.56 <= T (C) <= 180 ');Writeln;
      Write('    6 = Toluene   temp. range -94.97 <= T (C) <= 260 ');Writeln;
      Write('    7 = Water     temp. range  0.01 <= T (C) <= 360 ');Writeln;
      Write('  Select working Fluids No.');
      Readln(kind);
      END;
    END;
BEGIN
    BEGIN
     IF kind = 1 THEN
          WORKING_FLUIDS(Tv,Pv,DenL,DenV,L,Cp,VisL,
                              Sigma,lamda,Psi2,Psi3,Prr)
     ELSE
     IF kind = 2 THEN
          WORKING_FLUIDS(Tv,Pv,DenL,DenV,L,Cp,VisL,
                              Sigma,lamda,Psi2,Psi3,Prr)
     ELSE
     IF kind = 3 THEN
          WORKING_FLUIDS(Tv,Pv,DenL,DenV,L,Cp,VisL,
                              Sigma,lamda,Psi2,Psi3,Prr)
    ELSE
    IF kind =4 THEN
          WORKING_FLUIDS(Tv,Pv,DenL,DenV,L,Cp,VisL,
                              Sigma,lamda,Psi2,Psi3,Prr)
     ELSE
```

```
        IF kind = 5 THEN
                WORKING_FLUIDS(Tv,Pv,DenL,DenV,L,Cp,VisL,
                                        Sigma,lamda,Psi2,Psi3,Prr)
        ELSE
        IF kind = 6 THEN
                WORKING_FLUIDS(Tv,Pv,DenL,DenV,L,Cp,VisL,
                                Sigma,lamda,Psi2,Psi3,Prr)
        ELSE
        IF kind = 7 THEN
                Waterproperty(Tv,Pv,DenL,DenV,L,Cp,VisL,
                                Sigma,lamda,Psi2,Psi3,Prr)
        ELSE
                BEGIN
                        Writeln;
                        Writeln;
                        Writeln('****** enter new working fluids******');
                        Fluids;
                        SelecWorkingFluids(Tv,Pv,DenL,DenV,L,Cp,VisL,
                                Sigma,lamda,Psi2,Psi3,Prr);
                END;
      END;
 END;
PROCEDURE Flowrate(Vole,Volc, St,Le,Lc,Np,OD,ODf,nf,tf,et: Real;
      VAR VmaxE,VmaxC,Dme,Dmc:real);
      VAR Dm,Af,Ab,PAL,Atube,Afin,Amin,Area :real;
 PROCEDURE Flow(Vol, St,Lb,Np,OD,ODf,nf,tf: Real;
      VAR Vmax,Dm:real);
   BEGIN
     Area   := St*(Lb+0.02)*(Np+2);
     Atube  := OD*Np*Lb;
```

```
    Afin   := tf*(ODf-OD)*Np*(Lb-0.04)*nf*100/2.54;
    Amin   := Area-Atube-Afin;
    Vmax   := Vol/(Amin*3600);
    Af     := pi*(Power(ODf,2)-Power(OD,2))*2*Lb*nf*100/(2.54*4);
    Ab     := pi*OD*Lb*(1-(tf*nf*100/2.54));
    PAl    := ((ODf-OD)*2*Lb*nf*100/2.54)+(Lb-Lb*nf*tf*100/2.54)*2;
    Dm     :=2*(Af+Ab)/(pi*PAl);
  END;
BEGIN
    IF typ = 1 THEN
      BEGIN
        Flow(VolE, St,Le,Np,OD,OD,nf,tf, VmaxE,Dme);
        Flow(VolC, St,Lc,Np,OD,OD,nf,tf,VmaxC,Dmc);
      END;
    IF typ =2  THEN
      BEGIN
        Flow(VolE, St,Le,Np,OD,OD,nf,tf,VmaxE,Dme);
        Flow(VolC, St,Lc,Np,OD,ODf,nf,tf, VmaxC,Dmc);
      END;
    IF typ =3  THEN
      BEGIN
        Flow(VolE, St,Le,Np,OD,ODf,nf,tf,VmaxE,Dme);
        Flow(VolC, St,Lc,Np,OD,OD,nf,tf, VmaxC,Dmc);
      END;
    IF typ = 4 THEN
      BEGIN
        Flow(VolE, St,Le,Np,OD,ODf,nf,tf,VmaxE,Dme);
        Flow(VolC, St,Lc,Np,OD,ODf,nf,tf, VmaxC,Dmc);
      END;
    IF typ = 5 THEN
```

```
      BEGIN
        Flow(VolE, St,Le,Np,OD+et,OD+et,nf,tf+et, VmaxE,Dme);
        Flow(VolC, St,Lc,Np,OD+et,OD+et,nf,tf+et,VmaxC,Dmc);
      END;
    IF typ =6  THEN
      BEGIN
        Flow(VolE, St,Le,Np,OD+et,OD+et,nf,tf+et,VmaxE,Dme);
        Flow(VolC, St,Lc,Np,OD+et,ODf+et,nf,tf+et,VmaxC,Dmc);
      END;
    IF typ =7  THEN
      BEGIN
        Flow(VolE, St,Le,Np,OD+et,ODf+et,nf,tf+et,VmaxE,Dme);
        Flow(VolC, St,Lc,Np,OD+et,OD+et,nf,tf+et,VmaxC,Dmc);
      END;
    IF typ = 8 THEN
      BEGIN
        Flow(VolE, St,Le,Np,OD+et,ODf+et,nf,tf+et,VmaxE,Dme);
        Flow(VolC, St,Lc,Np,OD+et,ODf+et,nf,tf+et,VmaxC,Dmc);
      END;
  END;
PROCEDURE hout(Dme,Dmc,Dene,Denc,Vmaxe,Vmaxc,Vise,Visc,
               St,Sl,OD,Kee,Kc : Real; VAR Nue,Nuc,heo,hco:real);
  BEGIN
      Ree   := (Dene*Vmaxe*Dme)/Vise;
      Rec   := (Denc*Vmaxc*Dmc)/Visc;
      Frac1 := St/OD;
      Frac2 := Sl/OD;
  IF Arr = 1 THEN
   BEGIN
    IF Nr = 1 THEN C2 := 0.64;
```

```
IF Nr = 2 THEN C2 := 0.80;
IF Nr = 3 THEN C2 := 0.87;
IF Nr = 4 THEN C2 := 0.90;
IF Nr = 5 THEN C2 := 0.92;
IF Nr = 6 THEN C2 := 0.94;
IF Nr = 7 THEN C2 := 0.96;
IF Nr = 8 THEN C2 := 0.98;
IF Nr = 9 THEN C2 := 0.99;
IF Nr >= 10 THEN C2 := 1 ;
END;
IF Frac1 = 1.25 THEN
 BEGIN
  IF Frac2 = 1.25 THEN C1 := 0.348; m := 0.592;
  IF Frac2 = 1.5  THEN C1 := 0.367; m := 0.586;
  IF Frac2 = 2    THEN C1 := 0.418; m := 0.570;
  IF Frac2 = 3    THEN C1 := 0.290; m := 0.601;
 END;
IF Frac1 = 1.5 THEN
 BEGIN
  IF Frac2 = 1.25 THEN C1 := 0.275; m := 0.608;
  IF Frac2 = 1.5  THEN C1 := 0.250; m := 0.620;
  IF Frac2 = 2    THEN C1 := 0.299; m := 0.602;
  IF Frac2 = 3    THEN C1 := 0.357; m := 0.584;
 END;
IF Frac1 = 2 THEN
 BEGIN
  IF Frac2 = 1.25 THEN C1 := 0.100; m := 0.704;
  IF Frac2 = 1.5  THEN C1 := 0.101; m := 0.702;
  IF Frac2 = 2    THEN C1 := 0.229; m := 0.632;
  IF Frac2 = 3    THEN C1 := 0.374; m := 0.581;
```

```
  END;
IF Frac1 = 3 THEN
  BEGIN
     IF Frac2 = 1.25 THEN C1 := 0.0633; m := 0.752;
     IF Frac2 = 1.5  THEN C1 := 0.0678; m := 0.744;
     IF Frac2 = 2    THEN C1 := 0.198; m := 0.648;
     IF Frac2 = 3    THEN C1 := 0.286; m := 0.608;
  END;
IF Arr = 2 THEN
 BEGIN
    IF Nr = 1 THEN C2 := 0.68;
    IF Nr = 2 THEN C2 := 0.75;
    IF Nr = 3 THEN C2 := 0.83;
    IF Nr = 4 THEN C2 := 0.89;
    IF Nr = 5 THEN C2 := 0.92;
    IF Nr = 6 THEN C2 := 0.95;
    IF Nr = 7 THEN C2 := 0.97;
    IF Nr = 8 THEN C2 := 0.98;
    IF Nr = 9 THEN C2 := 0.99;
    IF Nr >= 10 THEN C2 := 1 ;
 END;
   IF Frac2 < 1.25 THEN
     C11 := 0.518+(0.067*(1.25-Frac2)/0.25);
     m1  := 0.556-(0.012*(1.25-Frac2)/0.25);
   IF Frac2 < 1.50 THEN
     C11 := 0.518-(0.067*(Frac2-1.25)/0.25);
     m1  := 0.556+(0.012*(Frac2-1.25)/0.25);
   IF Frac2 < 2.00 THEN
     C11 := 0.451-(0.047*(Frac2-1.5)/0.5);
     m1  := 0.568+(0.004*(Frac2-1.5)/0.5);
```

```
IF Frac2 < 3.00 THEN
  C11 := 0.404-(0.094*(Frac2-2));
  m1  := 0.572+(0.02*(Frac2-2));
IF Frac2 > 3.00 THEN
  C11 := 0.310-(0.094*(Frac2-3));
  m1  := 0.592+(0.02*(Frac2-3));
IF Frac2 < 1    THEN
  C12 := 0.497-(0.008*(1-Frac2)/0.25);
  m2  := 0.558+(0.004*(1-Frac2)/0.25);
IF Frac2 < 1.25 THEN
  C12 := 0.497+(0.008*(Frac2-1)/0.25);
  m2  := 0.558-(0.004*(Frac2-1)/0.25);
IF Frac2 < 1.50 THEN
  C12 := 0.505-(0.045*(Frac2-1.25)/0.25);
  m2  := 0.554+(0.008*(Frac2-1.25)/0.25);
IF Frac2 < 2.00 THEN
  C12 := 0.460-(0.044*(Frac2-1.5)/0.5);
  m2  := 0.562+(0.006*(Frac2-1.5)/0.5);
IF Frac2 < 3.00 THEN
  C12 := 0.416-(0.060*(Frac2-2));
  m2  := 0.568+(0.012*(Frac2-2));
IF Frac2 > 3.00 THEN
  C12 := 0.356-(0.060*(Frac2-3));
  m2  := 0.580+(0.012*(Frac2-3));
IF Frac2 < 0.9  THEN
  C13 := 0.446-(0.034*(0.9-Frac2)/0.225);
  m3  := 0.571+(0.006*(0.9-Frac2)/0.225);
IF Frac2 < 1.125 THEN
  C13 := 0.446+(0.034*(Frac2-0.9)/0.225);
  m3  := 0.571-(0.006*(Frac2-0.9)/0.225);
```

```
IF Frac2 < 1.25  THEN
  C13 := 0.478+(0.041*(Frac2-1.125)/0.125);
  m3  := 0.565-(0.009*(Frac2-1.125)/0.125);
IF Frac2 < 1.50  THEN
  C13 := 0.519-(0.067*(Frac2-1.25)/0.25);
  m3  := 0.556+(0.012*(Frac2-1.25)/0.25);
IF Frac2 < 2.00  THEN
  C13 := 0.452+(0.030*(Frac2-1.5)/0.5);
  m3  := 0.568-(0.012*(Frac2-1.5)/0.5);
IF Frac2 < 3.00  THEN
  C13 := 0.482-(0.042*(Frac2-2));
  m3  := 0.556+(0.006*(Frac2-2));
IF Frac2 > 3.00 THEN
  C13 := 0.440-(0.042*(Frac2-3));
  m3  := 0.562+(0.006*(Frac2-3));
IF Frac2 < 0.6   THEN
  C14 := 0.213-(0.188*(0.6-Frac2)/0.3);
  m4  := 0.636+(0.055*(0.6-Frac2)/0.3);
IF Frac2 < 0.9   THEN
  C14 := 0.213+(0.188*(Frac2-0.6)/0.3);
  m4  := 0.636-(0.055*(Frac2-0.6)/0.3);
IF Frac2 < 1.125 THEN
  C14 := 0.401+(0.117*(Frac2-0.9)/0.225);
  m4  := 0.581-(0.021*(Frac2-0.9)/0.225);
IF Frac2 < 1.25  THEN
  C14 := 0.518+(0.004*(Frac2-1.125)/0.125);
  m4  := 0.560+(0.002*(Frac2-1.125)/0.125);
IF Frac2 < 1.50  THEN
  C14 := 0.522-(0.034*(Frac2-1.25)/0.25);
  m4  := 0.562+(0.006*(Frac2-1.25)/0.25);
```

```
    IF Frac2 < 2.00  THEN
      C14 := 0.488-(0.039*(Frac2-1.5)/0.5);
      m4  := 0.568+(0.002*(Frac2-1.5)/0.5);
    IF Frac2 < 3.00  THEN
      C14 := 0.449-(0.021*(Frac2-2));
      m4  := 0.570+(0.004*(Frac2-2));
    IF Frac2 > 3 THEN
      C14 := 0.428-(0.021*(Frac2-3));
      m4  := 0.574+(0.004*(Frac2-3));
   IF Frac1 < 1.25 THEN
     C1 := C11-((C12-C11)*(1.25-Frac1)/0.25);
     m  := m1-((m2-m1)*(1.25-Frac1)/0.25);
   IF Frac1 < 1.50 THEN
     C1 := C11+((C12-C11)*(Frac1-1.25)/0.25);
     m  := m1+((m2-m1)*(Frac1-1.25)/0.25);
   IF Frac1 < 2.00 THEN
     C1 := C12+((C13-C12)*(Frac1-1.5)/0.5);
     m  := m2+((m3-m2)*(Frac1-1.5)/0.5);
   IF Frac1 < 3.00 THEN
     C1 := C14+((C14-C12)*(Frac1-2));
     m  := m4+((m4-m3)*(Frac1-2));
   IF Frac1 > 3.00 THEN
     C1 := C14+((C14-C12)*(Frac1-3));
     m  := m4+((m4-m3)*(Frac1-3));
    Nue  := C1*C2*Power(Ree,m);
    Nuc  := 1.13*C1*C2*Power(Rec,m)*Power(Prr,1/3);
    heo  := (kee*Nue)/Dme;
    hco  := (kc*Nuc)/Dmc;
END;
PROCEDURE Fin_eff(odf,tf,od,h,Thcon:Real;VAR EffF:real);
```

```
 BEGIN
   LC1   := ((ODf-OD)/2)+(tf/2);
   R2C   := ((ODf/2)+(tf/2))/(OD/2);
   AP    := LC1*tf;
   XA    := Power(LC1,1.5)*Power((h/(Thcon*AP)),0.5);
IF R2C < 1 THEN
     BEGIN
       EffF := 100.114-5.668*XA-(57.526*Power(XA,2))+(33.792*Power(XA,3))
            -(5.75*Power(XA,4));
     END;
IF R2C < 2 THEN
     BEGIN
        Eff1 := 100.114-5.668*XA-(57.526*Power(XA,2))+(33.792*Power(XA,3))
             -(5.75*Power(XA,4));
        Eff2 := 100.495-20.239*XA-(51.5*Power(XA,2))+(33.394*Power(XA,3))
             -(5.876*Power(XA,4));
        EffF := Eff1+((Eff2-Eff1)*(R2C-1));
      END;
IF R2C < 3 THEN
      BEGIN
         Eff1 := 100.495-20.239*XA-(51.5*Power(XA,2))+(33.394*Power
              (XA,3)) -(5.876*Power(XA,4));
         Eff2 := 100.476-31.997*XA-(44.527*Power(XA,2))+(32.942*Power
              (XA,3))-(6.18*Power(XA,4));
         EffF := Eff1+((Eff2-Eff1)*(R2C-2));
       END;
IF R2C < 5 THEN
        BEGIN
           Eff1 := 100.476-31.997*XA-(44.527*Power(XA,2))+(32.942*Power
                (XA,3))-(6.18*Power(XA,4));
```

```
                Eff2 := 100.526-52.057*XA-(21.385*Power(XA,2))+(22.955*Power
                        (XA,3))-(4.72*Power(XA,4));
                EffF := Eff1+((Eff2-Eff1)*(R2C-3)/2);
            END;
 IF R2C >= 5 THEN
            BEGIN
                EffF := 100.526-52.057*XA-(21.385*Power(XA,2))+
                        (22.955*Power(XA,3)) -(4.72*Power(XA,4));
            END;
        EffF:= EffF/100 ;
END;
PROCEDURE FineSeoSco (ODf,OD,ID,Le,Lc,nf,tf,et,EffFe,EffFc: Real;
                        VAR Seo,Sco:real);
                VAR Sfe,Lt,stt :real;
  PROCEDURE STube(OD,Lt:real;VAR Stt:real);
    BEGIN
      Stt:=pi*OD*Lt;
    END;
  PROCEDURE STubeE(OD,et,Lt:real;VAR Ste:real);
    BEGIN
      Ste:= pi*(OD+et)*Lt;
    END;
  PROCEDURE STubeFin(ODf,OD,Lt,tf,nf,EffF:real;VAR Stf:real);
      VAR Sf:real;
    BEGIN
      STube(OD,Lt-(tf*nf*Lt*100/2.54),Stt);
      Sf:=(Pi*ODf*tf*nf*Lt*100/2.54)+
        (2*pi*(Power((ODf/2),2)-Power((OD/2),2))*nf*Lt*100/2.54);
      Stf:=Stt+(Sf*EffF);
    END;
```

```
PROCEDURE STubeFinE(ODf,OD,et,Lt,nf,EffF:real;VAR Stfe:real);
    VAR Sfe,Ste:real;
  BEGIN
    STube(OD+et,Lt-(tf*2*et*nf*Lt*100/2.54),Ste);
    Sfe:=(Pi*(ODf+et)*(tf+(2*et))*nf*Lt*100/2.54)+
      (2*pi*(Power(((ODf+et)/2),2)-Power((OD/2),2))*nf*Lt*100/2.54);
    Stfe:=Ste+(Sfe*EffF);
  END;
BEGIN
  IF typ = 1 THEN
    BEGIN
      Stube(OD,Le,Seo);
      Stube(OD,Lc,Sco);
    END;
  IF typ =2  THEN
    BEGIN
      Stube(OD,Le,Seo);
      Fin_eff(odf,tf,od,hco,63,EffFc);
      STubeFin(ODf,OD,Lc-0.04,tf,nf,EffFc,Sco);
    END;
  IF typ =3  THEN
    BEGIN
      Fin_eff(odf,tf,od,heo,63,EffFe);
      STubeFin(ODf,OD,Le-0.04,tf,nf,EffFe,Seo);
      Stube(OD,Lc,Sco);
    END;
  IF typ = 4 THEN
    BEGIN
      Fin_eff(odf,tf,od,heo,63,EffFe);
      STubeFin(ODf,OD,Le-0.04,tf,nf,EffFe,Seo);
```

```
        Fin_eff(odf,tf,od,hco,63,EffFc);
        STubeFin(ODf,OD,Lc-0.04,tf,nf,EffFc,Sco);
      END;
    IF typ = 5 THEN
      BEGIN
        STubeE(OD,et,Le,Seo);
        STubeE(OD,et,Lc,Sco);
      END;
    IF typ = 6 THEN
      BEGIN
        STubeE(OD,et,Le,Seo);
        Fin_eff(odf+et,tf+(2*et),od,hco,63,EffFc);
        STubeFinE(ODf,OD,et,Lc-0.04,nf,EffFc,Sco);
      END;
    IF typ = 7 THEN
      BEGIN
        Fin_eff(odf+et,tf+(2*et),od,heo,63,EffFe);
        STubeFinE(ODf,OD,et,Le-0.04,nf,EffFe,Seo);
        STubeE(OD,et,Lc,Sco);
      END;
    IF typ = 8 THEN
      BEGIN
        Fin_eff(odf+et,tf+(2*et),od,heo,63,EffFe);
        STubeFinE(ODf,OD,et,Le-0.04,nf,EffFe,Seo);
        Fin_eff(odf+et,tf+(2*et),od,hco,63,EffFc);
        STubeFinE(ODf,OD,et,Lc-0.04,nf,EffFc,Sco);
      END;
  END;

PROCEDURE FindZ1Z9(heo,hco,Seo,Sco:real;VAR Z1,Z9:real);
```

```
    BEGIN
      Z1:=1/(heo*Seo);
      Z9:=1/(hco*Seo);
    END;
PROCEDURE FindCmin(Den1,Vol1,Cp1,Den2,Vol2,Cp2,Tei,Tci: Real;
                   VAR Cmin1,Cmin2,Cmin,Qmax:real);
BEGIN
    Cmin1  := Den1*(Vol1/3600)*Cp1;
    Cmin2  := Den2*(Vol2/3600)*Cp2;
    IF Cmin1 < Cmin2 THEN Cmin := Cmin1;
    IF Cmin1 > Cmin2 THEN Cmin := Cmin2;
    Qmax   := (Cmin*(Tei-Tci));
END;
PROCEDURE Find_QdIFf(RHOh,Vfl,Cph,DenL,Vwa,Cp,Teo,Tei,Tci,Le:real;
                     VAR Quse,Qtran,dQmax:real);
BEGIN
 Tso      := Tei;
 Tsi      := Tci;
 LMTD     := ((Tei-Tco)-(Teo-Tci))/ln((Tei-Tco)/(Teo-Tci));
 Ztotal   := Z1+Z2+Z8+Z9;
 Tv       := Tsi+((Z8+Z9)/Ztotal)*LMTD;
 SelecWorkingFluids(Tv,Pv,DenL,DenV,L,Cp,VisL,Sigma,lamda,Psi2,Psi3,Prr);
 Pp       := Pv+(DenL*g*F*Le*sin(Beta*pi/180));
 SelecWorkingFluids(Tv,Pv,DenL,DenV,L,Cp,VisL,Sigma,lamda,Psi2,Psi3,Prr);
 Psi3     := 0.325*Power(DenL,0.65)*Power(Lamda,0.3)*Power(Cp,0.7)*
             Power((Pp/Pa),0.23)/(Power(Denv,0.25)*Power(L,0.4)
             *Power(VisL,0.1));
    Ta:=Tr;
  Repeat
   Ta  := Ta+(dX/Tc);
```

```
  X  := ln(Pp)-ln(Pc);
  Y  := (1/Ta)*(a1*(1-Ta)+a2*Power((1-Ta),1.5)+a3*Power((1-Ta),3)
      +a4*Power((1-Ta),6));
  dX := X-Y;
 Until dX < 0.001;
Tv     := Tsi+((Z7+Z8+Z9)/Ztotal)*LMTD;
Tp1    := (Ta*Tc)-273.15;
dTs    := Tp1*g*((DenL/DenV)-1)/L;
Tp2    := Tv+(dTs*F*Le);
Tp     := (Tp1+Tp2)/2;
dTh    := (Tp-Tv)*F/2;
TdIFf  := LMTD-dTh;
Q      := LMTD/Ztotal;
i      := 0;
 REPEAT
      i  := i+1;
     Z3f := (C*Power(Q,(1/3)))/(Power(ID,(4/3))*Power(g,(1/3))*Le
          *Power(Psi3,(4/3)));
     Z3p := 1/(Psi3*Power(g,0.2)*Power(Q,0.4)*Power((ID*Le*pi),0.6));
       IF Z3p >= Z3f THEN
         BEGIN
            Z3 := (Z3p*F)+(Z3f*(1-F));
         END;
       IF Z3p < Z3f THEN
         BEGIN
            Z3 := Z3p;
         END;
     Z7 := (0.335*Power(Q,(1/3))) /(ID*Power(g,(1/3))*Power(Lc,(4/3))
          *Power(Psi2,(4/3)));
     Ztotal := Z1+Z2+Z3+Z7+Z8+Z9;
```

```
            Qrev   := TdIFf/Ztotal;
            dQ     := Q-Qrev;
              IF dQ < 0 THEN dQ := (-1*dQ);
                 Q := Qrev;
    UNTIL dQ < 0.00001;
             Quse    := Cmin1*(Tei-Teo);
             Nohp    := Np*Nr;
             Qtran   := Nohp*Qrev;
             dQmax  := Quse-Qtran;
END;
PROCEDURE call;
   BEGIN
      FineZ2Z8 (ODf,OD,ID,Le,Lc,nf,tf,et,63,63,45,Z2,Z8);
      AirProperty    (Tei,RHOh,Cph,Uh,vh,Khh,Ulfh,Prrh);
      Waterproperty (Tci,Pv,DenL,DenV,L,Cp,VisL,Sigma,lamda,Psi2,Psi3,Prr);
      FindCmin   (RHOh,Vfl,Cph,DenL,Vwa,Cp,Tei,Tci,Cmin1,Cmin2,Cmin,Qmax);
      Flowrate    (Vfl,Vwa,St,Le,Lc,Np,OD,ODf,nf,tf,et,VmaxE,VmaxC,Dme,Dmc);
         Teo:=(Tei+Tci)/2;
 repeat
            Tco    := (Cmin1*(Tei-Teo)/Cmin2)+Tci;{writeln('Teo=',Teo);readln;}
            Te:=(Tei+Teo)/2;
             Tc:=(Tci+Tco)/2;
       AirProperty   (Te,RHOh,Cph,Uh,vh,Khh,Ulfh,Prrh);
       Waterproperty (Tc,Pv,DenL,DenV,L,Cp,VisL,Sigma,lamda,Psi2,Psi3,Prr);
        hout          (Dme,Dmc,RHOh,DenL,Vmaxe,Vmaxc,Uh,VisL,
                       St,Sl,OD,Khh,lamda,Nue,Nuc,heo,hco);
        Fin_eff       (odf,tf,od,heo,63,EffFe);
        FineSeoSco (ODf,OD,ID,Le,Lc,nf,tf,et,EffFe,EffFc,Seo,Sco);
         FindZ1Z9  (heo,hco,Seo,Sco,Z1,Z9);
         Find_QdIFf(RHOh,Vfl,Cph,DenL,Vwa,Cp,Teo,Tei,Tci,Le,Quse,
```

```
                Qtran,dQmax);
            Teor:=Tei-(Qtran/Cmin1);
            Teo1:=Teo;
            Teo:=(Teo1+Teor)/2;
  until Abs(Teo1-Teor) < 1e-5;
            Cost := ((Le+Lc)*Nohp*1000)+(((Sl*(Nr+1))*(11*St)*2000*3)
                +((Sl*(Nr+1))*(Le+Lc)*2*2000));
            EbyC := Qtran/Cost;
  END;
PROCEDURE input;
  BEGIN
  Writeln;
  Write('Outside Diameter of tube in metre  is    =');Readln(ODi);
  Write('Inside Diameter of tube in metre   is    =');Readln(IDi);
  Write('Outside Diameter of fin in metre   is    =');Readln(ODfi);
  Write('Number of fin per inch    is             =');Readln(nfi);
  Write('fin  thikness    is                     =');Readln(tfi);
  Write('Tube spacing in metre(St)        is      =');Readln(Sti);
  Write('Tube spacing in metre(Sl)        is      =');Readln(Sli);
  Write('Pipe arrangement 1 = align 2 = stagger   ');Readln(Arri);
  Write('Number of tube row       is              =');Readln(Nri);
  Write('Number of tube per row   is              =');Readln(Npi);
  Write('Length of Condenser Bath in metre  is    =');Readln(Lci);
  Write('Length of Adiabatic Bath in metre  is    =');Readln(Lai);
  Write('Length of Evaporator Bath in metre is    =');Readln(Lei);
  Write('Filling Ratio of Working fluids (F)   is =');Readln(Fi);
  Write('Value of Beta                        is =');Readln(Betai);
  Write('Type of Bath');Writeln;
  Write('    1 = BOTH BARE        ');Writeln;
  Write('    2 = FIN AT CONDENSER ');Writeln;
```

```
Write('    3 = FIN AT EVAPORATOR ');Writeln;
Write('    4 = BOTH FIN          ');Writeln;
Write(' Select type of bath No.');Readln(Typi);Writeln;
Write(' SELECT WORKING FLUIDS ');
Writeln;
Write('    1 = Acetone   temp. range -95.0  <= T (C) <= 180 ');Writeln;
Write('    2 = Ammonia   temp. range -77.7  <= T (C) <=  90 ');Writeln;
Write('    3 = Diphenyl  temp. range  12.0  <= T (C) <= 400 ');Writeln;
Write('    4 = O-Dichlorobenzene temp. range -17.0 <= T (C) <= 340 ');Writeln;
Write('    5 = Methanol  temp. range -97.56 <= T (C) <= 180 ');Writeln;
Write('    6 = Toluene   temp. range -94.97 <= T (C) <= 260 ');Writeln;
Write('    7 = Water     temp. range  0.01 <= T (C) <= 360 ');Writeln;
Write('  Select working Fluids No.'); Readln(kindi);
 END;
PROCEDURE input1;
 BEGIN
Write('MinFlue Gas inlet temperature   : Degree C is ');Readln(Teimin);
Write('MaxFlue Gas inlet temperature   : Degree C is ');Readln(Teimax);
Write('StepFlue Gas inlet temperature  : Degree C is ');Readln(stTei);writeln;
 Write('Water inlet temperature      : Degree C is ');Readln(Tci);
Write('Volume flow rate of flue gas : Cu.m/hr is ');Readln(Vfl);
Write('Volume flow rate of water    : Cu.m/hr is ');Readln(Vwa);
Tei:=Teimin;
clrscr;
Writeln(outfile,'Tei':7,'Quse':10,'EE':11,'Tco':11,'Teo':11);Writeln;
 Writeln('Tei':7,'Quse':10,'EE':10,'Tco':10,'Teo':10);Writeln;
 END;
 PROCEDURE input2;
 BEGIN
Write('Flue Gas inlet temperature   : Degree C is ');Readln(Tei); writeln;
```

```
  Write('MinWater inlet temperature    : Degree C is ');Readln(Tcimin);
  Write('MaxWater inlet temperature    : Degree C is ');Readln(Tcimax);
  Write('StepWater inlet temperature   : Degree C is ');Readln(stTci);writeln;
  Write('Volume flow rate of flue gas : Cu.m/hr is ');Readln(Vfl);
  Write('Volume flow rate of water    : Cu.m/hr is ');Readln(Vwa);
  Tci:=Tcimin;
  clrscr;
  Writeln(outfile,'Tci':7,'Quse':10,'EE':11,'Tco':11,'Teo':11);Writeln;
  Writeln('Tci':7,'Quse':10,'EE':10,'Tco':10,'Teo':10);Writeln;
   END;
PROCEDURE input3;
  BEGIN
  Write('Flue Gas inlet temperature   : Degree C is ');Readln(Tei);
  Write('Water inlet temperature      : Degree C is ');Readln(Tci);writeln;
  Write('Minflow rate of flue gas     : Cu.m/hr is ');Readln(Vflmin);
  Write('Maxflow rate of flue gas     : Cu.m/hr is ' );Readln(Vflmax);
  Write('Stepflow rate of flue gas    : Cu.m/hr is ');Readln(stVfl); writeln;
  Write('Volume flow rate of water    : Cu.m/hr is ');Readln(Vwa);
  Vfl:=Vflmin;
  clrscr;
  Writeln(outfile,'Vfl':7,'Quse':10,'EE':11,'Tco':11,'Teo':11);Writeln;
  Writeln('Vfl':7,'Quse':10,'EE':10,'Tco':10,'Teo':10);Writeln;
   END;
  PROCEDURE input4;
  BEGIN
  Write('Flue Gas inlet temperature   : Degree C is ');Readln(Tei);
  Write('Water inlet temperature      : Degree C is ');Readln(Tci);
  Write('Volume flow rate of flue gas : Cu.m/hr is ');Readln(Vfl);writeln;
  Write('Minflow rate of water        : Cu.m/hr is ');Readln(Vwamin);
  Write('Maxflow rate of water        : Cu.m/hr is ' );Readln(Vwamax);
```

```
Write('Stepflow rate of water      : Cu.m/hr is ');Readln(stVwa);
Vwa:=Vwamin;
clrscr;
Writeln(outfile,'Vwa':7,'Quse':10,'EE':11,'Tco':11,'Teo':11);Writeln;
Writeln('Vwa':7,'Quse':10,'EE':10,'Tco':10,'Teo':10);Writeln;
 END;
PROCEDURE runinput;
  BEGIN
 OD   := ODi;  {IF run on BASE used OD }
 ID   := IDi;
 St  := sti;
 Sl  := sli;
 Arr  := arri;
 Nr   := nri;
 Np   := npi;
 Lc  := lci;
 La  := lai;
 Le   := lei;
 F    := fi;
 Beta := Betai;
 nf  := nfi;
 ODf  := odfi;
 tf  := tfi;
 Typ  := typi;
 Kind := kindi;
  END;
 PROCEDURE runbase;
  BEGIN
 OD   := OD;  {IF run on BASE used OD }
 ID   := ID;
```

```
St  := st;
Sl  := sl;
Arr  := arr;
Nr   := nr;
Np   := np;
Lc  := lc;
La  := la;
Le   := le;
F    := f;
Beta := Beta;
nf  := nf;
ODf  := odf;
tf  := tf;
Typ  := typ;
Kind := kind;
 END;
PROCEDURE VTei;
BEGIN
{input; }{use runinput}
base;  {use runbase}
input1;
REPEAT
{runinput;}
runbase;
 call1;
Writeln(Tei:7:2,Cmin1*(Tei-Teo):10:2,Quse/Qmax:10:2,Tco:10:2,Teo:10:2);
Writeln(outfile,Tei:7:2,Cmin1*(Tei-Teo):10:2,Quse/Qmax:10:2,Tco:10:2,
        Teo:10:2);
Tei := Tei+StTei;
Until Tei >= Teimax+stTei;
```

```
END;
PROCEDURE VTci;
BEGIN
 {input; } {use runinput}
  base;  {use runbase}
 input2;
 REPEAT
 {runinput;}
 runbase;   call;
 Writeln(Tci:7:2,Cmin1*(Tei-Teo):10:2,Quse/Qmax:10:2,Tco:10:2,Teo:10:2);
 Writeln(outfile,Tci:7:2,Cmin1*(Tei-Teo):10:2,Quse/Qmax:10:2,Tco:10:2,
      Teo:10:2);
 Tci := Tci+StTci;
 Until Tci >= Tcimax+stTci;
END;
PROCEDURE VVfl;
BEGIN
 {input; } {use runinput}
  base;  {use runbase}
 input3;
 REPEAT
 {runinput;}
 runbase;   call;
 Writeln(Vfl:7:2,Cmin1*(Tei-Teo):10:2,Quse/Qmax:10:2,Tco:10:2,Teo:10:2);
 Writeln(outfile,Vfl:7:2,Cmin1*(Tei-Teo):10:2,Quse/Qmax:10:2,Tco:10:2,
      Teo:10:2);
 Vfl := Vfl+StVfl;
 Until Vfl >= Vflmax+stVfl;
END;
PROCEDURE VVwa;
```

```
BEGIN
{input; } {use runinput}
 base;  {use runbase}
 input4;
 REPEAT
 {runinput;}
 runbase;   call1;
 Writeln(Vwa:7:2,Cmin1*(Tei-Teo):10:2,Quse/Qmax:10:2,Tco:10:2,Teo:10:2);
 Writeln(outfile,Vwa:7:2,Cmin1*(Tei-Teo):10:2,Quse/Qmax:10:2,Tco:10:2,
      Teo:10:2);
 Vwa := Vwa+StVwa;
 Until Vwa >= Vwamax+stVwa;
 END;
PROCEDURE calhp;
 BEGIN
     FineZ2Z8 (ODf,OD,ID,Le,Lc,nf,tf,et,63,63,45,Z2,Z8);
      AirProperty    (Tei,RHOh,Cph,Uh,vh,Khh,Ulfh,Prrh);
     Waterproperty  (Tci,Pv,DenL,DenV,L,Cp,VisL,
                     Sigma,lamda,Psi2,Psi3,Prr);
      FindCmin       (RHOh,Vfl,Cph,DenL,Vwa,Cp,Tei,Tci,Cmin1,Cmin2,
                     Cmin,Qmax);
       Flowrate       (Vfl,Vwa,St,Le,Lc,Np,OD,ODf,nf,tf,et,VmaxE,VmaxC,
                     Dme,Dmc);
                     Teo:=(Tei+Tci)/2;
  repeat
       Tco    := (Cmin1*(Tei-Teo)/Cmin2)+Tci;{writeln('Teo=',Teo);readln;}
       Te     :=(Tei+Teo)/2;
       Tc     :=(Tci+Tco)/2;
       AirProperty       (Te,RHOh,Cph,Uh,vh,Khh,Ulfh,Prrh);
       Waterproperty     (Tc,Pv,DenL,DenV,L,Cp,VisL,Sigma,lamda,Psi2,Psi3,Prr);
```

```
        FindCmin        (RHOh,Vfl,Cph,DenL,Vwa,Cp,Tei,Tci,Cmin1,Cmin2,
                         Cmin,Qmax);
        hout            (Dme,Dmc,RHOh,DenL,Vmaxe,Vmaxc,Uh,VisL,
                         St,Sl,OD,Khh,lamda,Nue,Nuc,heo,hco);
        Fin_eff         (odf,tf,od,heo,63,EffFe);
        FineSeoSco      (ODf,OD,ID,Le,Lc,nf,tf,et,EffFe,EffFc,Seo,Sco);
        FindZ1Z9        (heo,hco,Seo,Sco,Z1,Z9);
        Find_QdIFf      (RHOh,Vfl,Cph,DenL,Vwa,Cp,Teo,Tei,Tci,Le,Quse,
                         Qtran,dQmax);
       Teor:=Tei-(Qtran/Cmin1);
        Teo1:=Teo;
        Teo:=(Teo1+Teor)/2;
  until Abs(Teo1-Teor) < 1e-5;
 END;
PROCEDURE simecot;
 BEGIN
 assign(outfile,'c:\k_egVvfl.txt');
 rewrite(outfile);
 writeln('simmulate  '  :20); writeln;
 writeln('Select type ':20 );
 writeln('1.VARIFy flue Gas inlet temperature   :' :50);
 Writeln('2.VARIFy water inlet temperature     :' :50);
 Writeln('3.VARIFy volume flow rate of flue gas :' :50);
 Writeln('4.VARIFy volume flow rate of water    :' :50);
 readln(v4);
 IF v4=1 THEN
 BEGIN
 VTei ;
 END;
 IF v4=2 THEN
```

```
BEGIN
VTci ;
END;
IF v4=3 THEN
BEGIN
VVfl ;
END;
IF v4=4 THEN
BEGIN
VVwa ;
END;
close(outfile);
END;
 PROCEDURE inputdata;
 BEGIN
writeln('      input data          ');writeln;
writeln('Pipe diameter');
writeln('  1. 3/8 inch ');
writeln('  2. 1/2 inch ');
writeln('  3. 3/4 inch ');
writeln('  4. 1 inch ');writeln;
Write('MinOutside Diameter of tube    : Number(1-4) ');
  readln(odmini);
Write('MaxOutside Diameter of tube    : Number(1-4) ');
  readln(odmaxi);
  Writeln;
Write('minEvaporator Length          : (Metre) ');
  readln(Lemini);
Write('maxEvaporator Length          : (Metre) ');
  readln(Lemaxi);
```

```
Write('StepEvaporator Length        : (Metre) ');
  readln(stLei);
  Writeln;
Write('minCondenser  Length         : (Metre) ');
  readln(Lcmini);
Write('maxCondenser  Length         : (Metre) ');
  readln(Lcmaxi);
Write('stepCondenser  Length        : (Metre) ');
  readln(stLci);
  Writeln;
Write('minAdiabatic  Length         : (Metre) ');
  readln(Lamini);
Write('maxAdiabatic  Length         : (Metre) ');
  readln(Lamaxi);
Write('stepAdiabatic  Length        : (Metre) ');
  readln(stLai);
  Writeln;
Write('minFin per Inch              :      ');
 readln(nfmini);
Write('maxFin per Inch              :      ');
 readln(nfmaxi);
Write('StepFin per Inch             :      ');
 readln(stnfi);
 Writeln;
Write('MinNumber of tube row        :      ');
 Readln(Nrmini);
Write('MaxNumber of tube row        :      ');
 Readln(Nrmaxi);
 Writeln;
Write('MinNumber of tube per row    :      ');
```

```
Readln(Npmini);
Write('MaxNumber of tube per row     :       ');
Readln(NpMaxi);
Writeln;
Write('MinHigh of Fin              : (Metre) ');
Readln(hofmini);
Write('MaxHigh of Fin              : (Metre) ');
Readln(hofMaxi);
Write('StepHigh of Fin             : (Metre) ');
Readln(sthofi);
Writeln;
Write('Volume Flowrate of Flue gas    : (Cu.m./Hr) ');
Readln(Vfli);
Write('Volume Flowrate of Water       : (Cu.m./H)r ');
Readln(Vwai);
Write('Inlet Temperature of Flue gas  : (C)       ');
Readln(Teii);
Write('Inlet Temperature of Water     : (C)       ');
Readln(Tcii);
Write('Pipe arrangement 1 = align 2 = stagger  :     ');
Readln(Arri);Writeln;
Write('Filling Ratio of Working fluids (F)   is =');Readln(Fi);  Writeln;
Write('Value of Beta                         is =');Readln(Betai);Writeln;
Write('Type of Bath');Writeln;
Write('    1 = BOTH BARE        ');Writeln;
Write('    2 = FIN AT CONDENSER ');Writeln;
Write('    3 = FIN AT EVAPORATOR ');Writeln;
Write('    4 = BOTH FIN         ');Writeln;
Write(' Select type of bath No.');Readln(Typi);Writeln;Writeln;
Write(' SELECT WORKING FLUIDS ');
```

```
  Writeln;
  Write('    1 = Acetone   temp. range -95.0  <= T (C) <= 180 ');Writeln;
  Write('    2 = Ammonia   temp. range -77.7  <= T (C) <=  90 ');Writeln;
  Write('    3 = Diphenyl  temp. range  12.0  <= T (C) <= 400 ');Writeln;
  Write('    4 = O-Dichlorobenzene temp. range -17.0 <= T (C) <= 340 ');Writeln;
  Write('    5 = Methanol  temp. range -97.56 <= T (C) <= 180 ');Writeln;
  Write('    6 = Toluene   temp. range -94.97 <= T (C) <= 260 ');Writeln;
  Write('    7 = Water     temp. range  0.01 <= T (C) <= 360 ');Writeln;
  Write('  Select working Fluids No.');
  Readln(kindi);
END;
PROCEDURE optinum;
  BEGIN
     assign (outfile,'c:\Economizer.txt');
     rewrite (outfile);
      inputdata;
     clrscr;
     Writeln('od':5,'hfin':7,'nf':3,'np':3,'nr':3,'sl':5,'st':7,'Lc':5,'Le':5,
           'Quse':9,'EE':7,'EbyC':9,'Teo':8);
     Writeln(outfile,'od':5,'hfin':7,'nf':3,'np':3,'nr':4,'sl':5,'st':8,'Lc':5,
          'Le':5,'Quse':9,'EE':7,'EbyC':9,'Teo':8);
      EbyCi  := 0;
      Effeni  := 0;
      EbyC    := 0;
      Effen   := 0;
      Thcon   := 63;
      tf      := 0.0004;
      F       := Fi;
      Beta    := Betai;
      Typ     := typi;
```

```
Kind     := kindi;
Arr      :=Arri;
Tci      := Tcii ;
Tei      := Teii;
Vfl      := Vfli ;
Vwa      := Vwai;
Odmin    :=Odmini;
Odmax    :=Odmaxi;
nrmin    :=nrmini;
nrmax    :=nrmaxi;
npmin    :=npmini;
npmax    :=npmaxi;
nfmin    :=nfmini;
nfmax    :=nfmaxi;
stnf     :=stnfi;
hofmin   :=hofmini;
hofmax   :=hofmaxi;
sthof    :=sthofi;
Lcmin    :=Lcmini;
Lcmax    :=Lcmaxi;
StLc     :=stLci;
Lamin    :=Lamini;
Lamax    :=Lamaxi;
StLa     :=stLai;
Lemin    :=Lemini;
Lemax    :=Lemaxi;
StLe     :=stLei;
for  odid := odmin to odmax do
   BEGIN
      IF odid = 1 THEN
```

```
            BEGIN
                OD   := 0.675*0.0254; {0.017}
                ID   := 0.493*0.0254;
                EbyCi := EbyC;
                Effeni:= Effen;
            END;
        IF odid = 2 THEN
            BEGIN
                OD   := 0.840*0.0254; {0.021}
                ID   := 0.622*0.0254;
                EbyCi := EbyC;
                Effeni:= Effen;
            END;
        IF odid = 3 THEN
            BEGIN
                OD   := 1.050*0.0254; {0.027}
                ID   := 0.824*0.0254;
                EbyCi := EbyC;
                Effeni:= Effen;
            END;
        IF odid = 4 THEN   {1 in}
            BEGIN
                OD   := 1.315*0.0254;   {0.033}
                ID   := 1.049*0.0254;
                EbyCi := EbyC;
                Effeni:= Effen;
            END;
    odf:=od+(hofmin-sthof)*2;
repeat
    odf:=odf+(sthof*2);
```

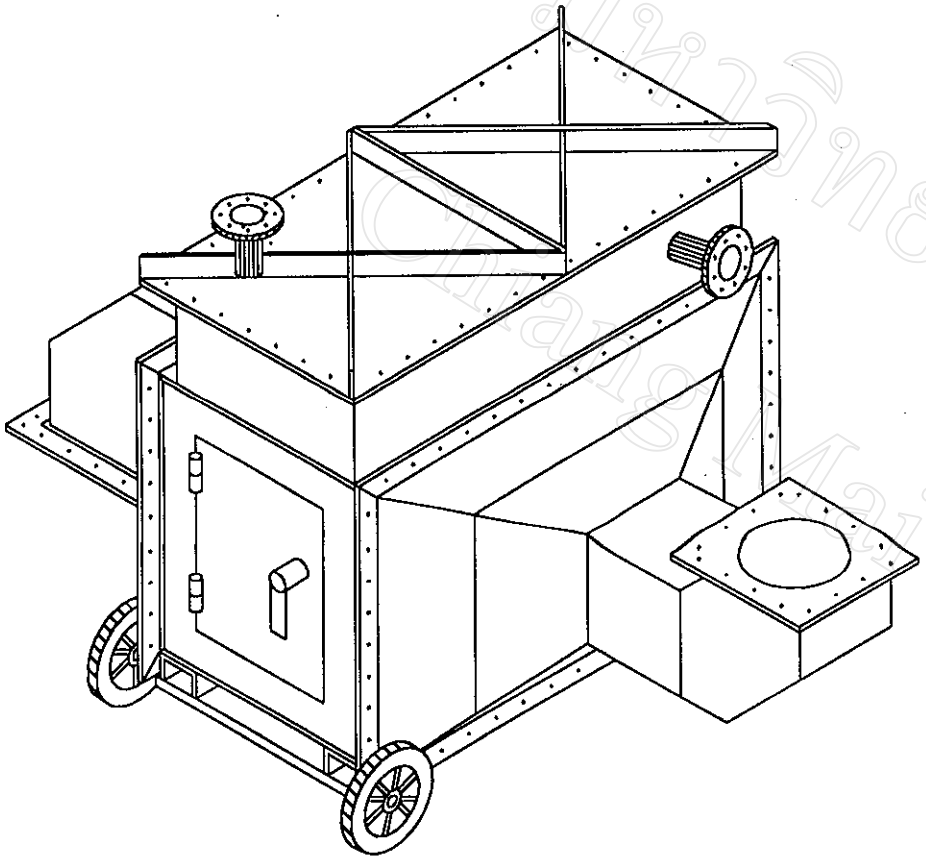
```
      nf:=nfmin-stnf;
repeat
        nf:=nf+stnf;
        sl:=od;
    repeat
          sl:=sl+0.5*od;
          IF odf < sl THEN
              BEGIN
                 st:=od;
        repeat
            st:=st+0.5*od;
              IF odf < st THEN
                BEGIN
                   np:=npmin-1;
             repeat
               np:=np+1;
               nr:=nrmin-1;
               repeat
                  nr:=nr+1;
                  Lc:=Lcmin-stLc;
                   repeat
                     Lc:=Lc+stLc;
                     La:=Lamin-stLa;
                       repeat
                          La:=La+stLa;
                          Le:=Lemin-stle;
                            repeat
                              Le:=Le+stle;
                calhp;
                Cost := ((Le+Lc)*Nohp*1000)+(((Sl*(Nr+1))*
```

```
                    (11*St)*2000*3)+((Sl*(Nr+1))*(Le+Lc)*2*2000));
                EbyC := Qtran/Cost;
                Effen:= Quse/Qmax ;
IF Effen >= 0.9*Effeni THEN
    BEGIN
  IF Ebyc >= 1.1*Ebyci THEN
     BEGIN
       IF Teo>= 110 THEN
         BEGIN
     Writeln(od:6:3,(odf-od)/2:6:3,nf:2:0,np:3,nr:3,sl:7:3,
     st:7:3,Lc:5:2,Le:5:1,Cmin1*(Tei-Teo):10:2,Effen:7:4,Ebyc:8:4,
     Teo:8:1);
     Writeln (outfile,od:6:3,(odf-od)/2:6:3,nf:2:0,np:3,nr:3,sl:7:3,
     st:7:3,Lc:5:2,Le:5:1,Cmin1*(Tei-Teo):10:2,Effen:7:4,Ebyc:8:4,
     Teo:8:1);
         END;
     EbyCi := EbyC;
     Effeni:= Effen;
     Teoi:= Teo;
      END;
     END;
 IF Effen >= 1.1*Effeni THEN
     BEGIN
   IF abs(Ebyc - Ebyci)<=0.1*Ebyci THEN
     BEGIN
       IF Teo>= 110 THEN
         BEGIN
     Writeln(od:6:3,(odf-od)/2:6:3,nf:2:0,np:3,nr:3,sl:7:3,
     st:7:3,Lc:5:2,Le:5:1,Cmin1*(Tei-Teo):10:2,Effen:7:4,Ebyc:8:4,
     Teo:8:1);
```

```
      Writeln (outfile,od:6:3,(odf-od)/2:6:3,nf:2:0,np:3,nr:3,sl:7:3,
      st:7:3,Lc:5:2,Le:5:1,Cmin1*(Tei-Teo): 10:2,Effen:7:4,Ebyc:8:4,
      Teo:8:1);
            END;
      EbyCi := EbyC;
      Effeni:= Effen;
      Teoi:= Teo;
        END;
      END;
   IF (Effen - Effeni)*1 >= 1.1*Effeni THEN
      BEGIN
     IF (Ebyc - Ebyci)*1 >=1.1*Ebyci THEN
       BEGIN
          IF Teo>= 110 THEN
            BEGIN
       Writeln(od:6:3,(odf-od)/2:6:3,nf:2:0,np:3,nr:3,sl:7:3,
       st:7:3,Lc:5:2,Le:5:1,Cmin1*(Tei-Teo):10:2,Effen:7:4,Ebyc:8:4,
       Teo:8:1);
       Writeln (outfile,od:6:3,(odf-od)/2:6:3,nf:2:0,np:3,nr:3,sl:7:3,
       st:7:3,Lc:5:2,Le:5:1,Cmin1*(Tei-Teo):10:2,Effen:7:4,Ebyc:8:4,
       Teo:8:1);
            END;
       EbyCi := EbyC;
       Effeni:= Effen;
       Teoi:= Teo;
         END;
       END;
   IF Teo <= 110 THEN
         BEGIN
           le := 100;
```

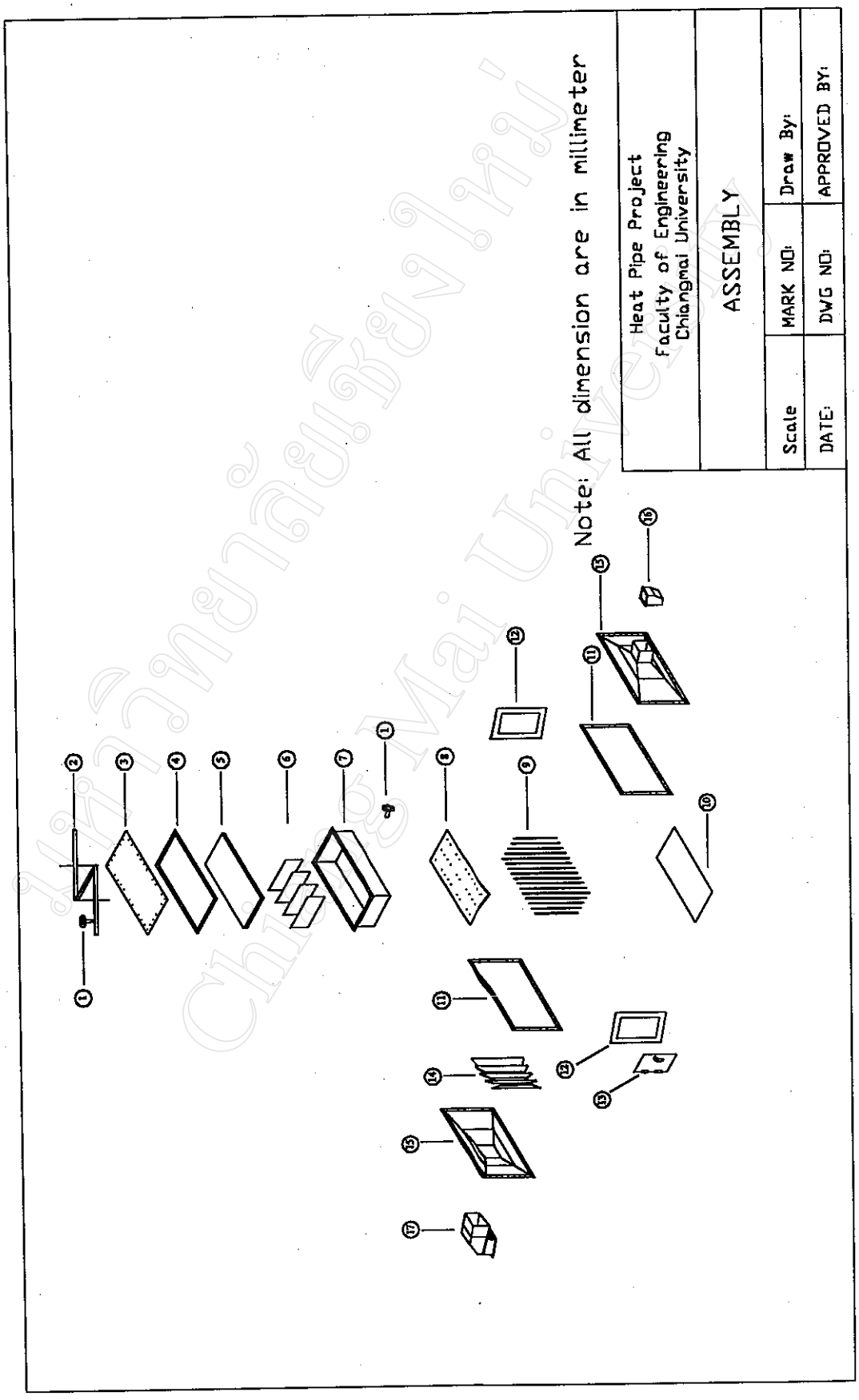
```
            END;
                                                    until Le>= Lemax;{Le}
                                                until La>=Lamax;{La}
                                              until Lc>=Lcmax;{Lc} {write('.');}
                                          until nr>=nrmax; {nr}
                                      until np>=npmax; {np}
                                    END;
                                  until st>=2.5*od;{st}
                                END;
                              until sl>=2.5*od;{sl}
                            until nf>=nfmax ;{nf}
                          until odf>=od+(hofmax*2);{odf}
                          END;
                          Writeln ('***************END OF RUN***************':60);
                        close (outfile);
                        END;
                        {main}
                        BEGIN
                            writeln; writeln; writeln('>>>>>>>>  SECECT  <<<<<<<<':34);
                            writeln;
                            writeln('RUN OPTINUM    = 1':30);
                            writeln('RUN SIMULATION  = 2':30);
                            writeln;
                            writeln('>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>':34);
                            readln(r);
                            IF r=1 THEN optinum;
                            IF r=2 THEN simecot;
                        END.
```

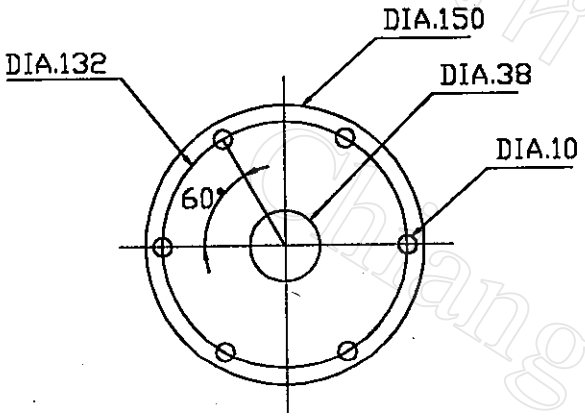
ภาคผนวก ค
แบบอีโคโนไมเซอร์

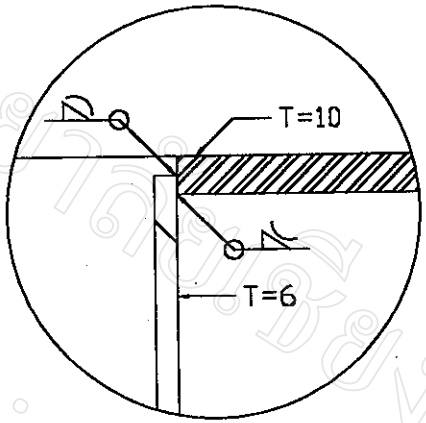


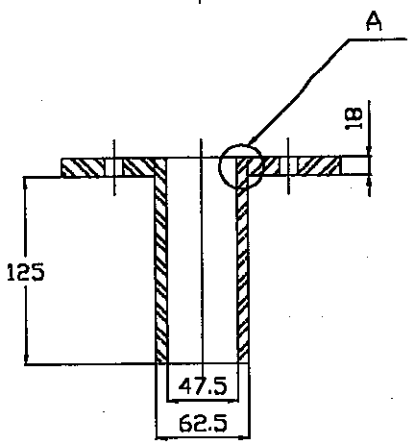
Note: All dimension are in millimeter

Heat Pipe Project Faculty of Engineering Chiangmai University		
Thermosyphon Economizer		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:


Note: All dimension are in millimeter
Heat Pipe Project
Faculty of Engineering
Chiangmai University
ASSEMBLY
Scale
MARK NO:
Draw By:
DATE:
DWG NO:
APPROVED BY:

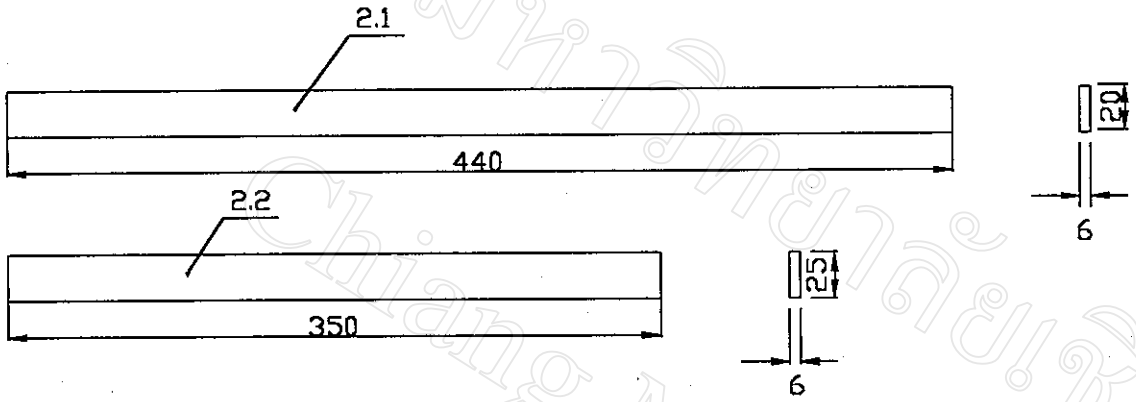


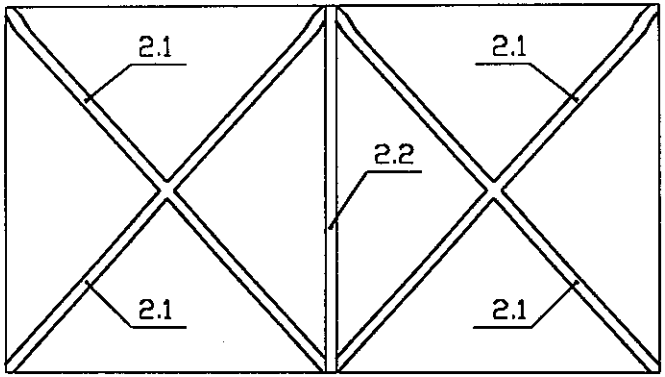




Note: All dimension are in millimeter

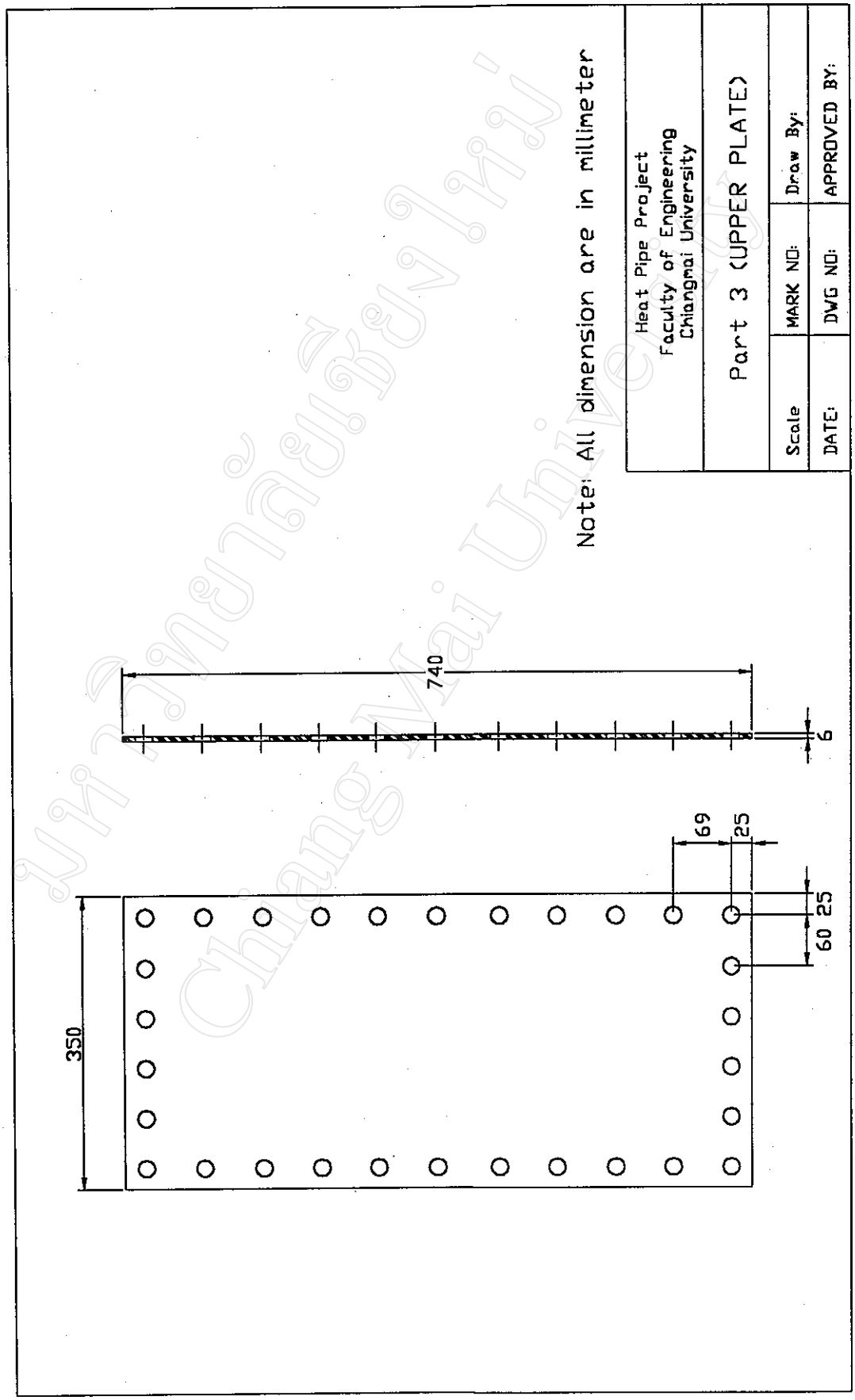
Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 1 (FLANGE)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:

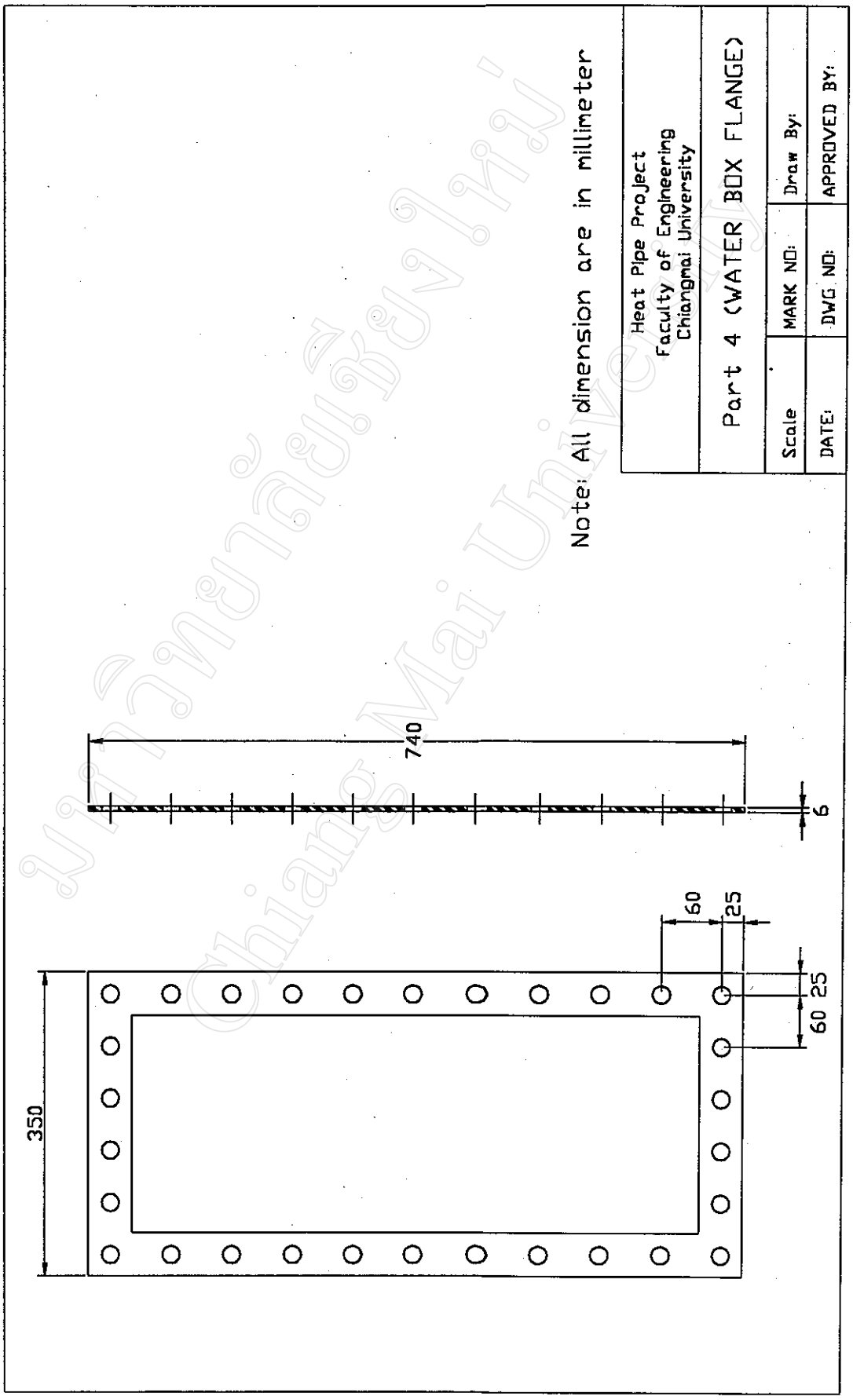


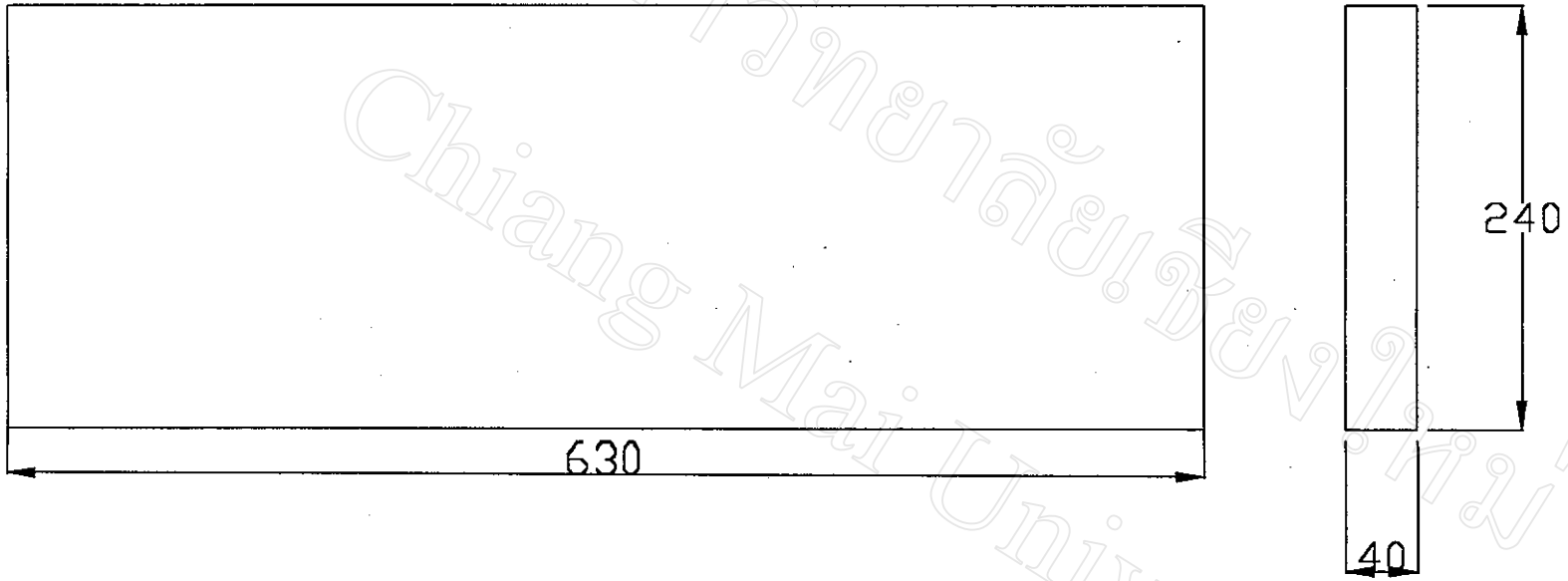


Note: All dimension are in millimeter

Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 2 (UPPER PLATE RIB)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:

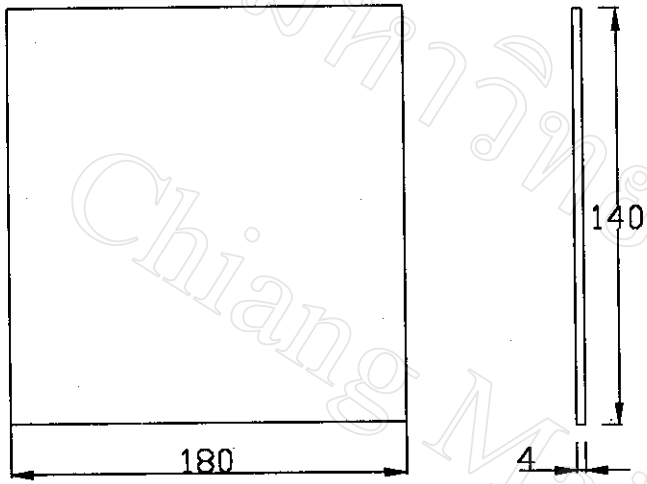

Note: All dimension are in millimeter
Heat Pipe Project
Faculty of Engineering
Chiangmai University
Part 3 (UPPER PLATE)
Scale
MARK NO:
Draw By:
DATE:
DWG NO:
APPROVED BY:
740
6
69
25
350
60
25

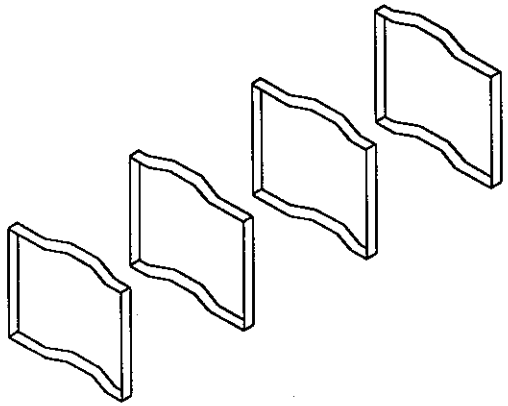

Note: All dimension are in millimeter
Heat Pipe Project
Faculty of Engineering
Chiangmai University
Part 4 (WATER BOX FLANGE)
Scale
MARK NO:
Draw By:
DATE:
DWG NO:
APPROVED BY:
740
6
60
25
350
60
25



Note: All dimension are in millimeter

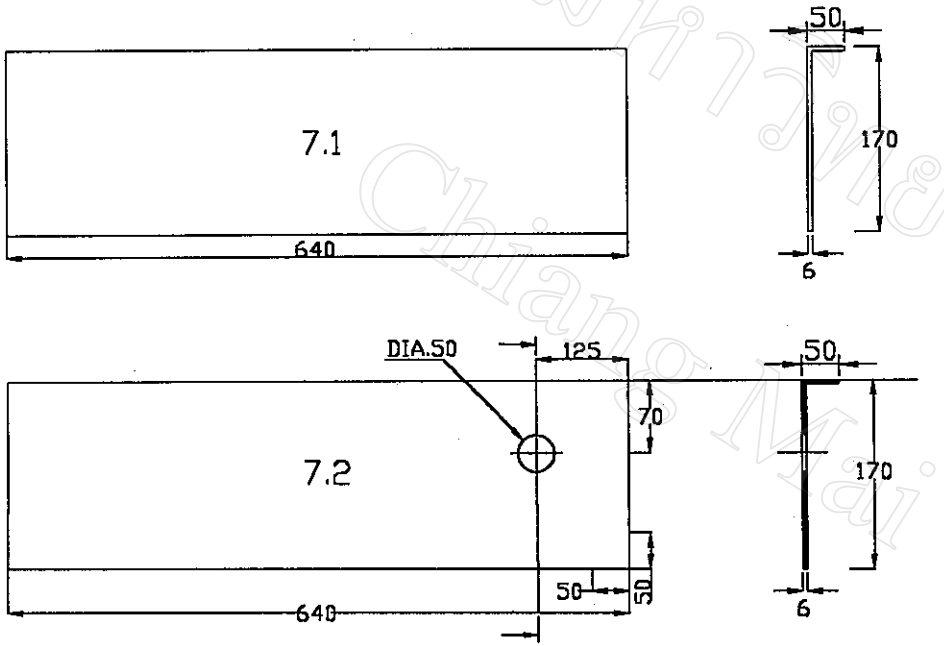
Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 5 (UPPER INSULATION)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:

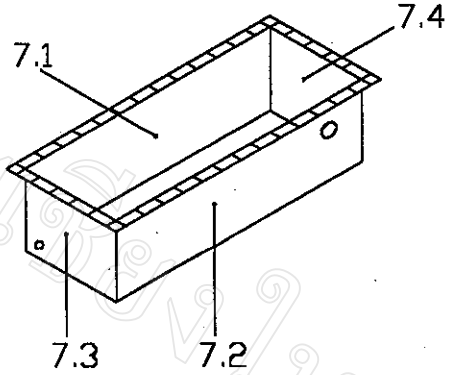


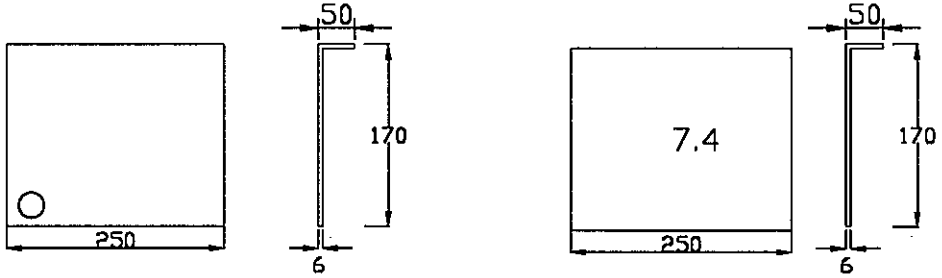


Note: All dimension are in millimeter

Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 6 (BUFFER PLATE)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:

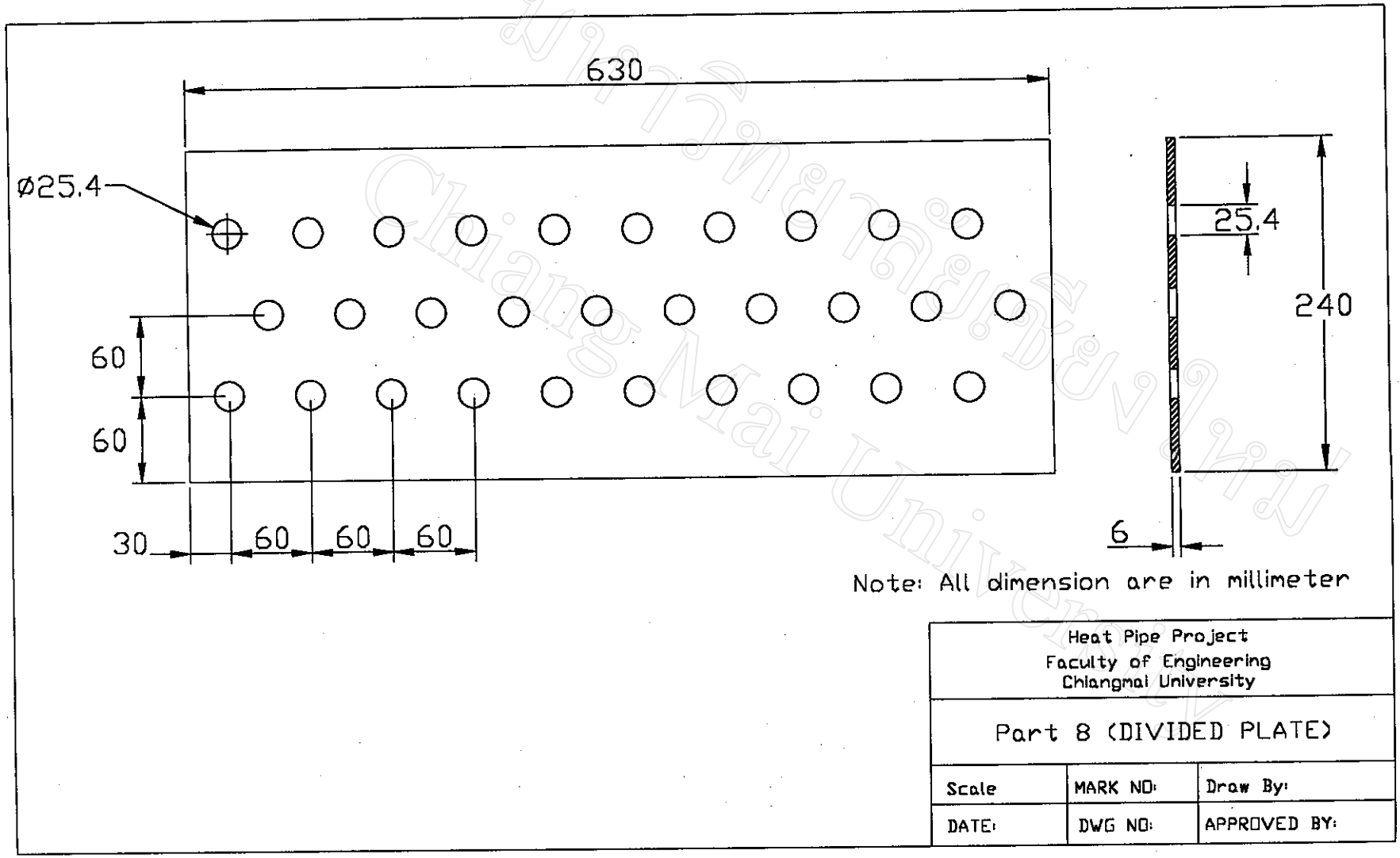


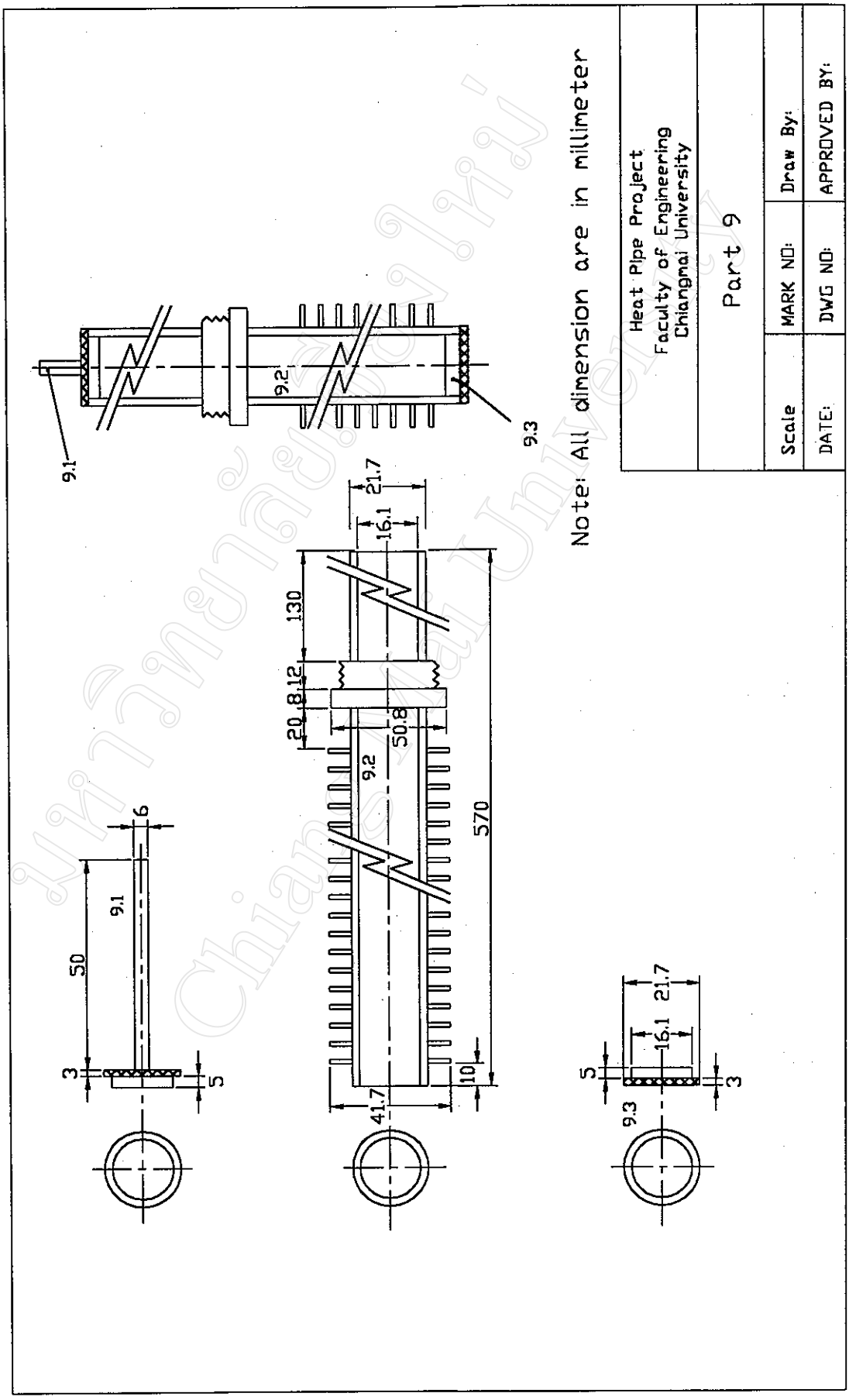


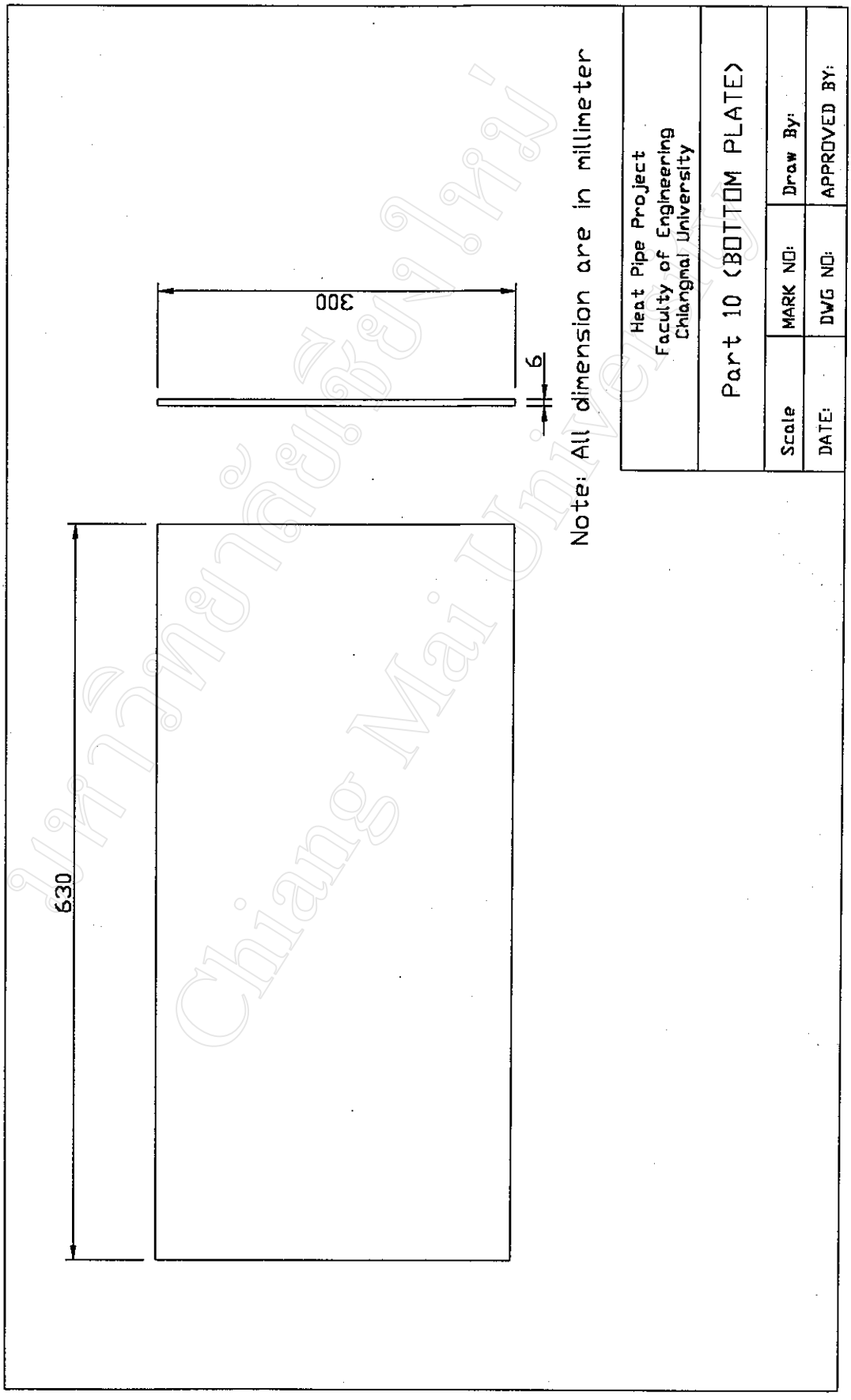


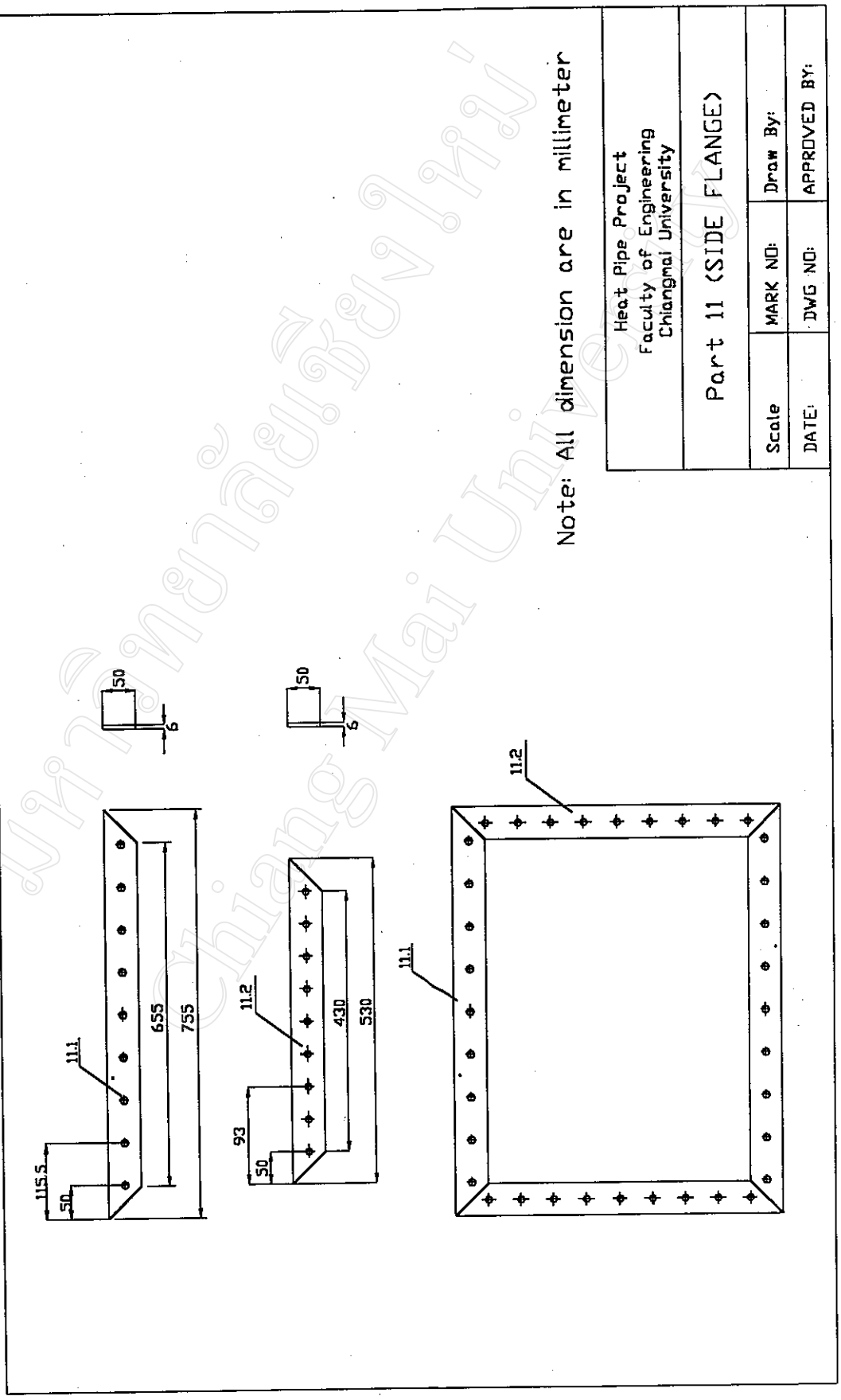
Note: All dimension are in millimeter

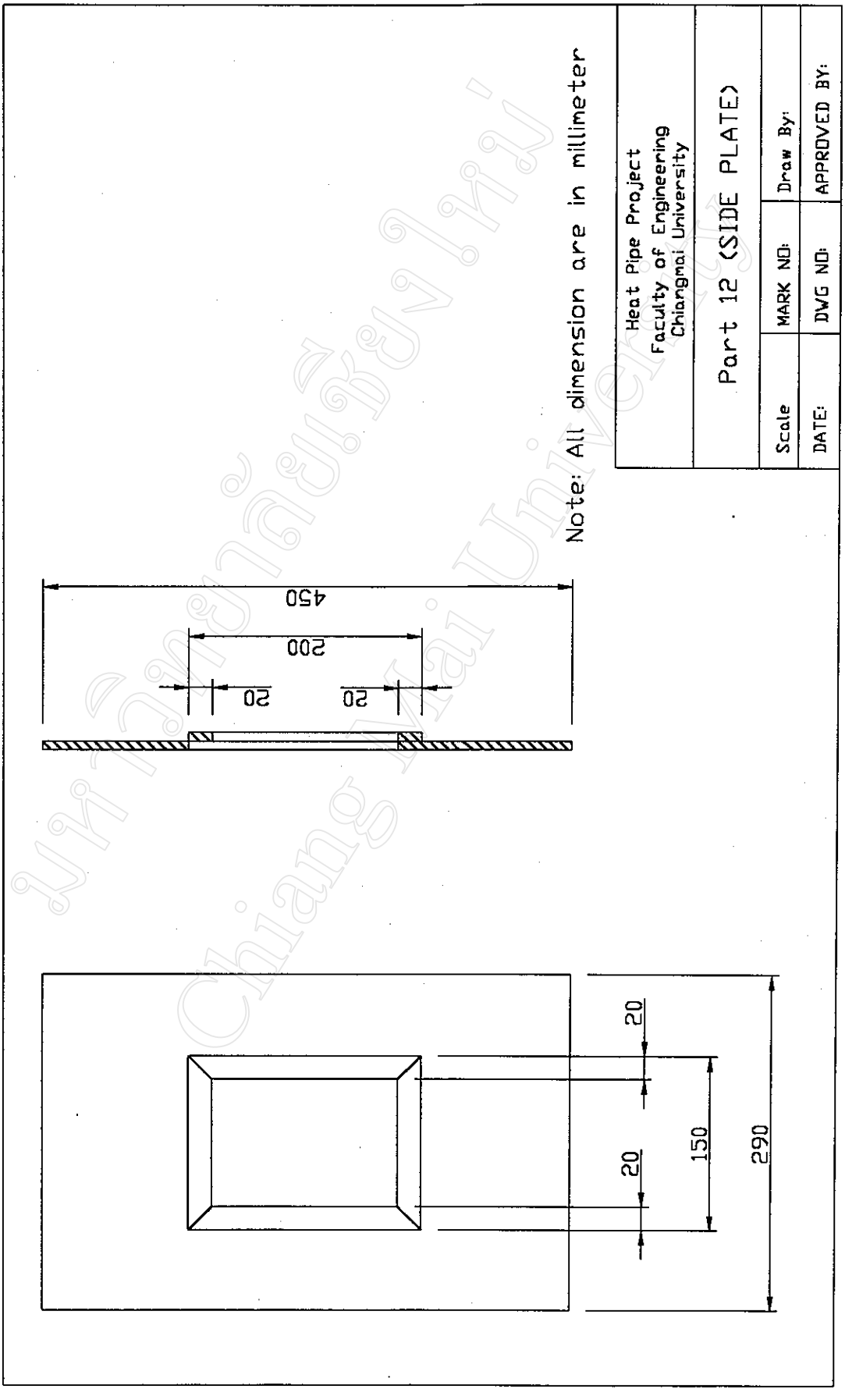
Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 7 (WATER BOX)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:

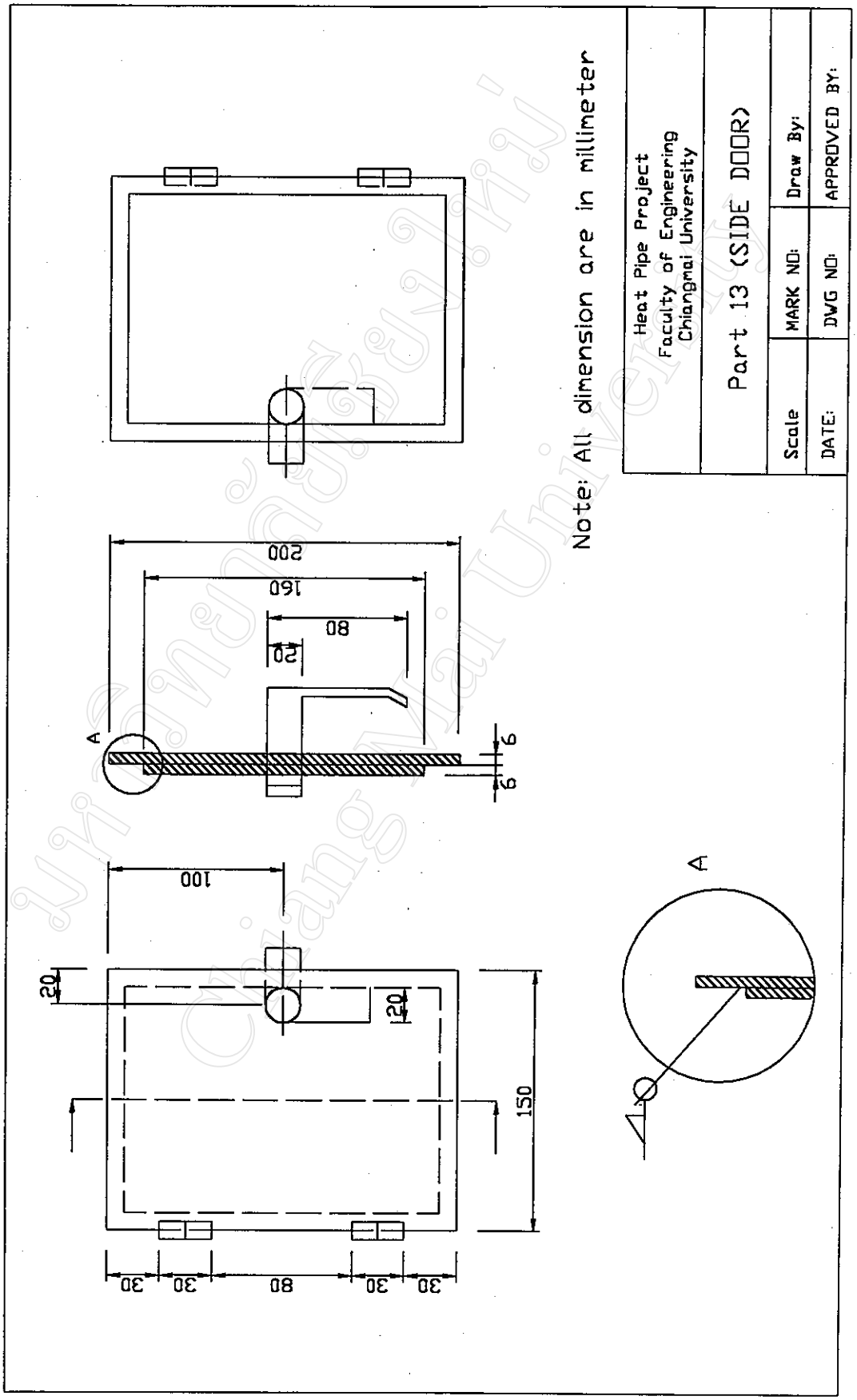


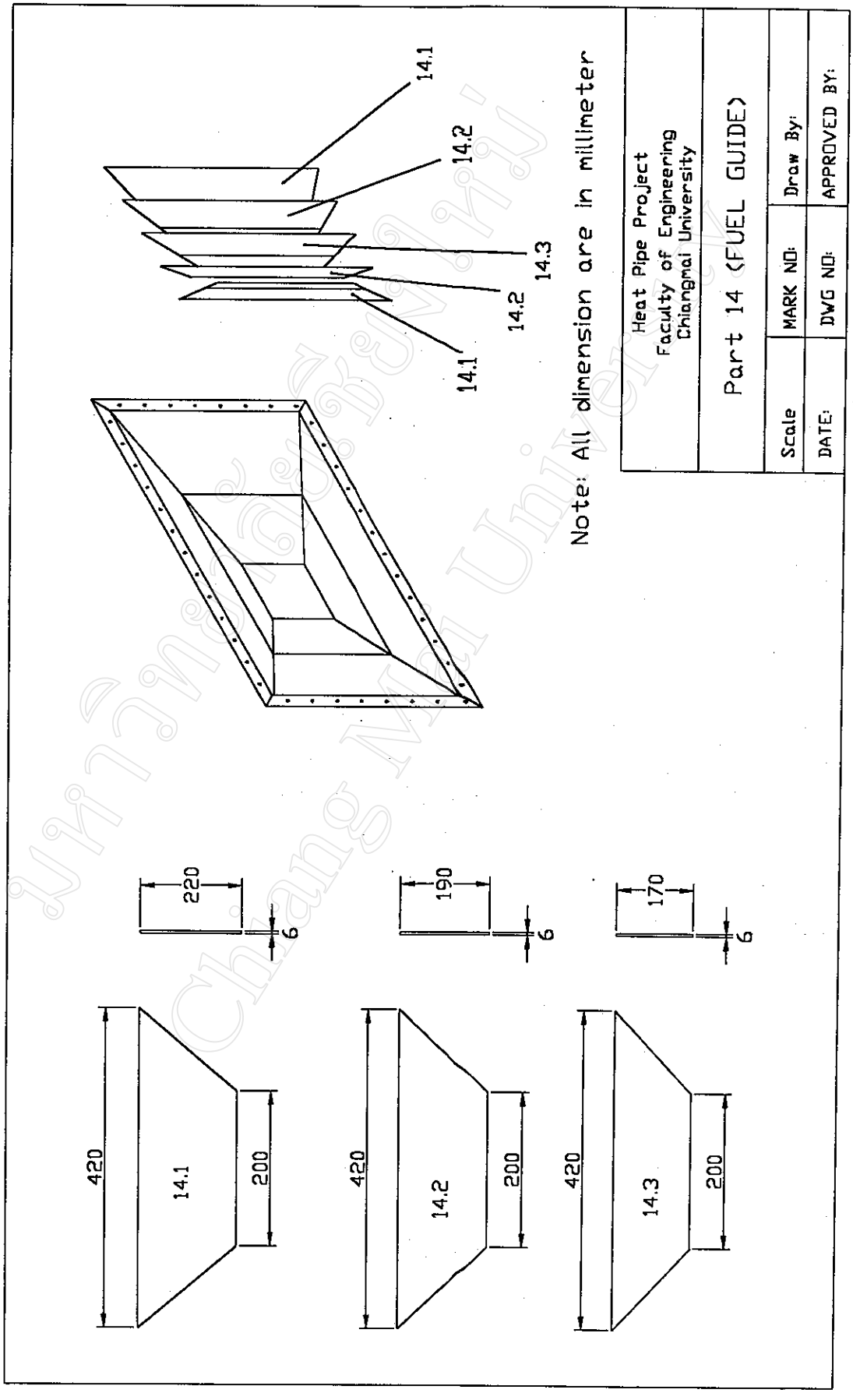

Note: All dimension are in millimeter
Heat Pipe Project
Faculty of Engineering
Chiangmai University
Part 9
Scale
MARK NO:
Draw By:
DATE:
DWG NO:
APPROVED BY:
9.1
9.2
9.3
6
50
9.1
3
5
130
21.7
16.1
20
8.12
50.8
570
41.7
10
5
21.7
16.1
9.3
3

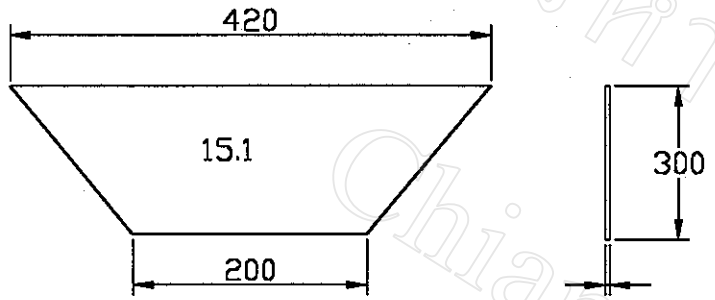


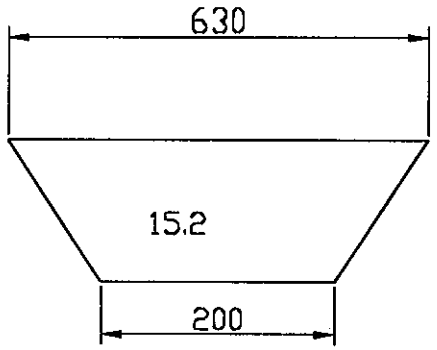

Note: All dimension are in millimeter
Heat Pipe Project
Faculty of Engineering
Chiangmai University
Part 11 (SIDE FLANGE)
Scale
MARK NO:
Draw By:
DATE:
DWG NO:
APPROVED BY:
50
6
50
6
11.1
655
755
115.5
50
11.2
430
530
93
50
11.2
11.1

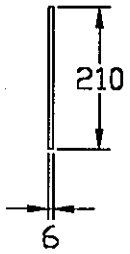


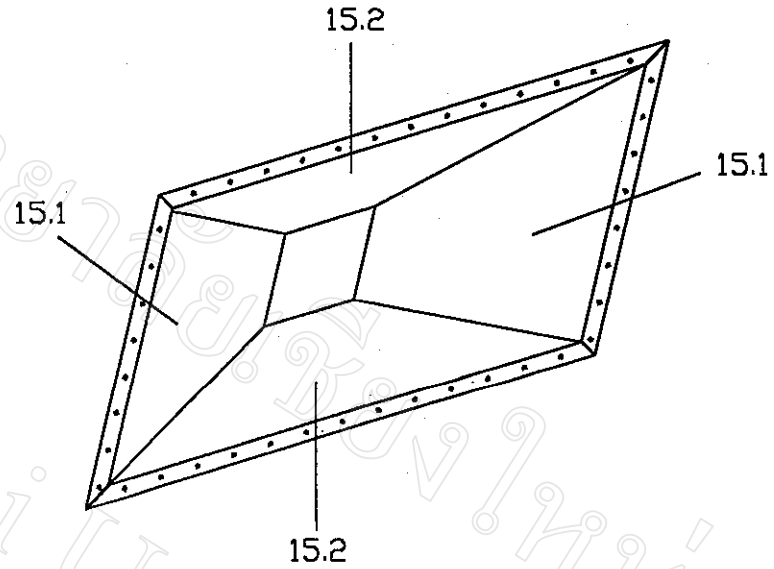

Note: All dimension are in millimeter
Heat Pipe Project
Faculty of Engineering
Chiangmai University
Part 13 (SIDE DOOR)
Scale
MARK NO:
Draw By:
DATE:
DWG NO:
APPROVED BY:
200
160
80
20
A
9
6
100
20
20
150
30
30
80
30
30
A


14.1
14.2
14.3
14.2
14.1
Note: All dimension are in millimeter
Heat Pipe Project
Faculty of Engineering
Chiangmai University
Part 14 (FUEL GUIDE)
Scale
MARK NO:
Draw By:
DATE:
DWG NO:
APPROVED BY:
220
6
190
6
170
6
420
14.1
200
420
14.2
200
420
14.3
200



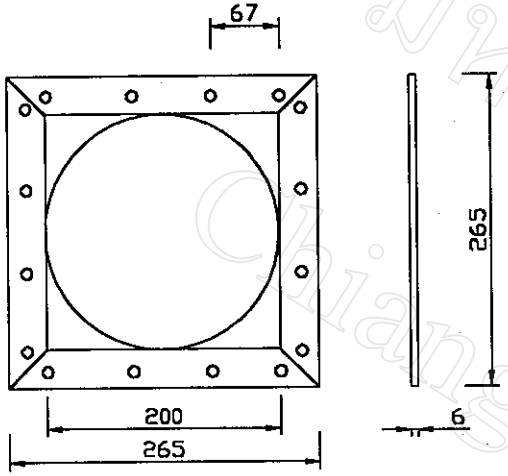


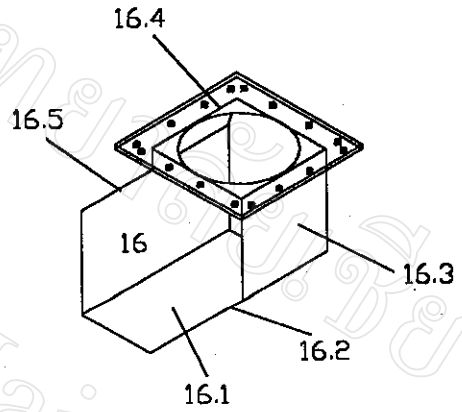


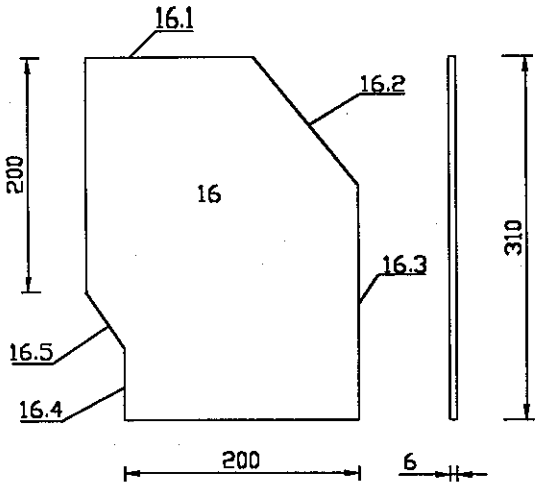


Note: All dimension are in millimeter

Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 15 (REDUCER)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:

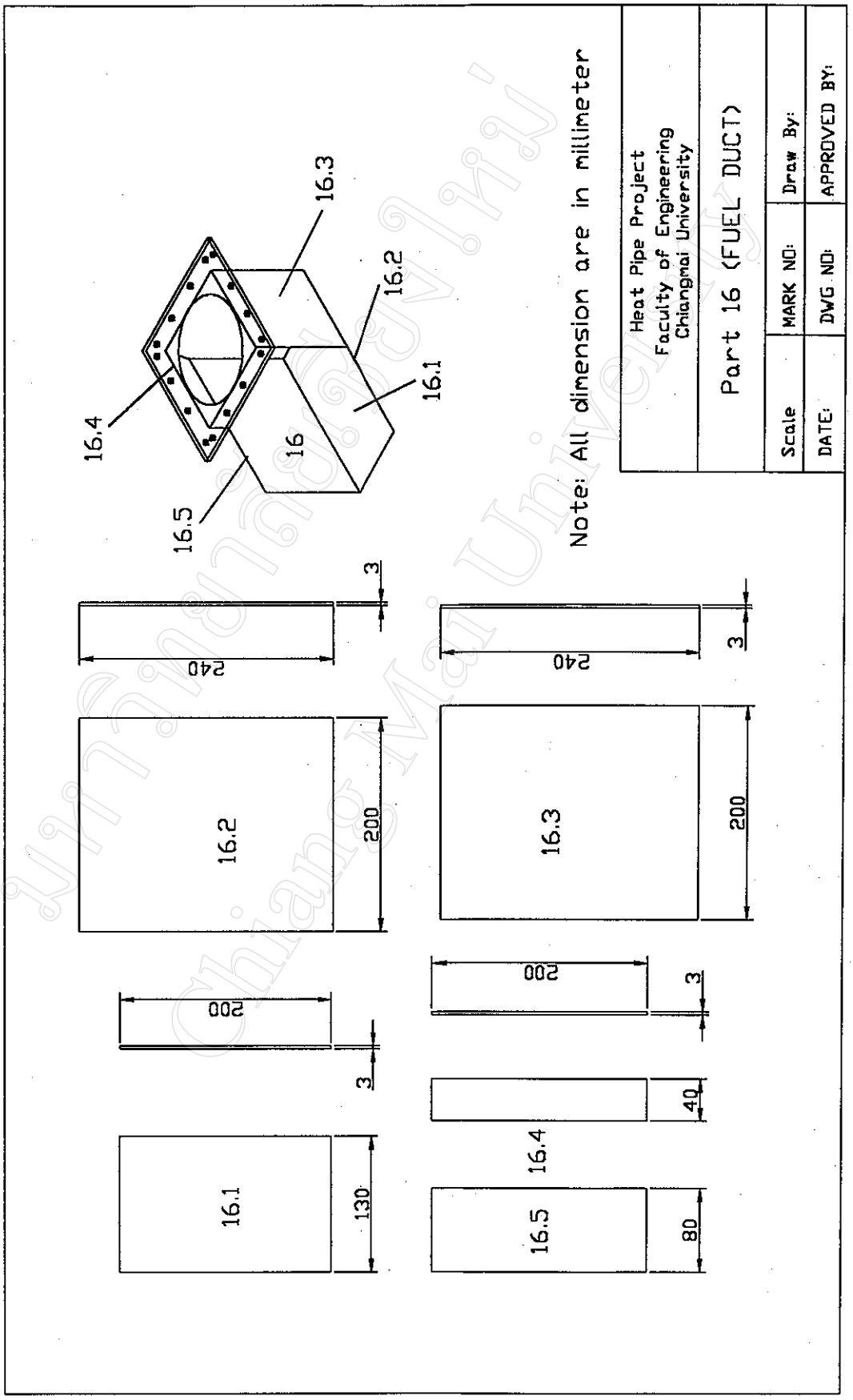


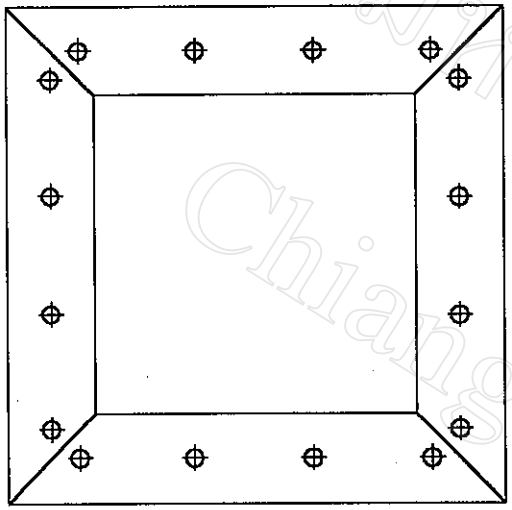


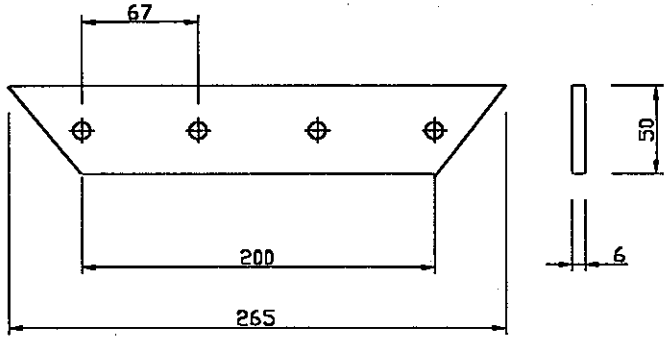


Note: All dimension are in millimeter

Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 16 (FUEL DUCT)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:

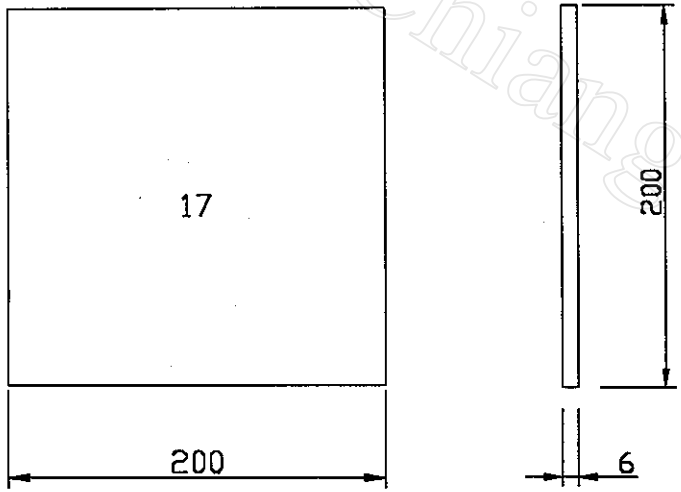

16.4
16.5
16
16.1
16.2
16.3
240
3
16.2
200
200
3
16.1
130
240
3
16.3
200
200
3
40
16.4
16.5
80
Note: All dimension are in millimeter
Heat Pipe Project
Faculty of Engineering
Chiangmai University
Part 16 (FUEL DUCT)
Scale
MARK NO:
Draw By:
DATE:
DWG NO:
APPROVED BY:

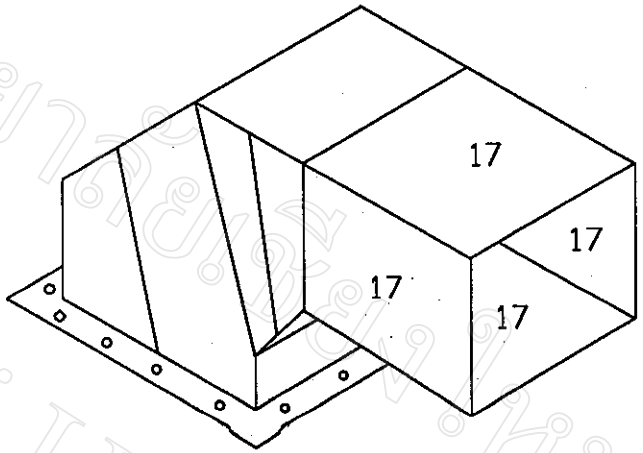




Note: All dimension are in millimeter

Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 17 (FUEL FLANGE)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:





Note: All dimension are in millimeter

Heat Pipe Project Faculty of Engineering Chiangmai University		
Part 17 (BEND)		
Scale	MARK NO:	Draw By:
DATE:	DWG NO:	APPROVED BY:

ภาคผนวก ง

ข้อมูลการทดสอบการทำงานของอีโคโนไมเซอร์แบบท่อความร้อน

ตาราง ผลการทดสอบการแปรอุณหภูมิก๊าซร้อนขาเข้าที่ อุณหภูมิก๊าซร้อน100c
อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	92.1	94.6	93.3	95.0	90.7	91.5	40.2	40.3	47.5	47.9	93.3	92.4	40.3	47.7
2	77.4	76.9	77.2	84.3	84.4	85.3	39.1	39.2	47.3	47.6	77.2	84.7	39.2	47.5
3	114.7	123.9	119.3	103.1	98.0	98.6	38.9	39	47.3	47.5	119.3	99.9	39.0	47.4
4	79.3	79.1	79.2	88.9	85.7	86.6	39.1	39.2	47.2	47.5	79.2	87.1	39.2	47.4
5	169.6	172.8	171.2	107.6	107.1	108.8	38.5	38.6	47.1	47.3	171.2	107.8	38.6	47.2
6	83.5	83.8	83.6	91.2	87.7	88.6	38.9	39.1	47.5	47.9	83.6	89.1	39.0	47.7
7	121.8	108.5	115.1	88.8	89.7	92.0	39.1	39.2	47.3	47.6	115.1	90.1	39.2	47.5
8	92.4	94.7	93.6	95.0	90.8	91.6	39.4	39.5	47.5	47.7	93.6	92.4	39.5	47.6
9	77.5	77.0	77.3	87.4	84.5	85.3	39.7	39.8	47.2	47.7	77.3	85.7	39.8	47.5
10	115.7	125.1	120.4	103.3	98.2	98.7	39.7	39.9	47.2	47.3	120.4	100.0	39.8	47.3
11	79.5	79.3	79.4	89.0	85.8	86.7	40	40.2	47.4	47.5	79.4	87.2	40.1	47.5
12	170.3	173.6	171.9	107.3	107.0	108.7	39.5	39.6	47.2	47.5	171.9	107.7	39.6	47.4
13	83.7	84.1	83.9	91.3	87.8	88.6	38.8	38.9	47.2	47.4	83.9	89.2	38.9	47.3
14	120.4	108.8	114.6	88.8	89.7	92.0	39	39.1	47.3	47.5	114.6	90.1	39.1	47.4
15	92.5	95.1	93.8	95.2	91.0	91.7	39.1	39.2	47.2	47.6	93.8	92.6	39.2	47.4
16	77.4	77.5	77.4	87.5	84.5	85.5	39.4	39.5	40.3	40.4	77.4	85.8	39.5	40.3

ตาราง ผลการทดสอบการแปรอุณหภูมิก๊าซร้อนขาเข้าที่ อุณหภูมิก๊าซร้อน120c
อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	85.1	84.8	84.9	94.5	91.5	92.2	40.9	41	50.9	51.2	84.9	92.7	41.0	51.1
2	192.7	200.9	196.8	120.1	118.7	120.2	41.2	41.5	51	51.2	196.8	119.7	41.4	51.1
3	92.5	93.1	92.8	99.1	95.5	96.4	39.9	40	51.4	51.7	92.8	97.0	40.0	51.6
4	124.4	111.5	117.9	94.5	95.1	97.3	39.4	39.5	51.4	51.7	117.9	95.6	39.5	51.6
5	120.3	127.9	124.1	110.5	105.2	105.7	39.5	39.6	51.4	51.8	124.1	107.1	39.6	51.6
6	86.8	86.5	86.6	95.9	92.7	93.5	39.8	39.9	51.8	52.2	86.6	94.0	39.9	52.0
7	185.6	191.9	188.7	116.8	115.8	117.6	40	40.2	51.7	51.8	188.7	116.7	40.1	51.8
8	96.9	98.1	97.5	101.6	97.5	98.4	40.2	40.5	51.9	52.4	97.5	99.1	40.4	52.2
9	85.1	86.1	85.6	94.4	91.2	91.9	39.7	39.8	51.9	52.1	85.6	92.5	39.8	52.0
10	136.9	148.8	142.9	116.2	110.4	110.9	39.6	39.8	52	52.2	142.9	112.5	39.7	52.1
11	88.8	88.6	88.7	97.3	93.9	94.6	39.9	40	52.3	52.6	88.7	95.2	40.0	52.5
12	175.1	178.9	177.0	112.4	111.8	113.5	40.2	40.3	52.3	52.3	177.0	112.6	40.3	52.3
13	100.5	102.5	101.5	103.4	98.9	99.7	40.1	40.2	52.3	52.7	101.5	100.7	40.2	52.5
14	85.7	85.2	85.4	95.2	91.9	92.6	38.9	39.1	52.3	52.6	85.4	93.2	39.0	52.5
15	154.2	171.7	162.9	121.6	115.8	116.2	39	39	52.1	52.5	162.9	117.8	39.0	52.3
16	90.5	90.5	90.5	98.6	95.0	95.8	39.3	39.5	52.6	52.9	90.5	96.4	39.4	52.8
17	164.6	163.3	163.9	108.0	108.0	110.0	39.6	39.8	52.6	52.7	163.9	108.6	39.7	52.7

ตาราง ผลการทดสอบการแปรอุณหภูมิก๊าซร้อนขาเข้าที่ อุณหภูมิก๊าซร้อน 160 c
อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	272.4	283.3	277.8	183.7	174.8	176.4	87.5	87.7	40.3	40.4	277.8	178.3	87.6	40.3
2	169.5	169.8	169.7	158.0	148.0	148.9	88.1	88.5	41.0	41.1	169.7	151.6	88.3	41.0
3	169.7	167.9	168.8	149.3	140.2	141.4	88.8	89.0	41.7	41.8	168.8	143.6	88.9	41.7
4	262.8	273.8	268.3	176.0	167.5	168.9	88.6	88.8	42.1	42.1	268.3	170.8	88.7	42.1
5	271.6	282.2	276.9	181.8	173.0	174.7	88.0	88.2	41.0	41.1	276.9	176.5	88.1	41.0
6	176.6	178.4	177.5	161.2	150.6	151.4	88.2	88.4	41.5	41.6	177.5	154.4	88.3	41.5
7	158.3	157.2	157.8	150.0	140.8	141.7	88.3	88.6	41.8	41.9	157.8	144.2	88.4	41.8
8	261.9	271.0	266.4	173.2	165.2	166.8	88.2	88.3	42.1	42.2	266.4	168.4	88.2	42.1
9	271.1	281.8	276.4	181.4	172.2	173.9	88.0	88.2	42.1	42.1	276.4	175.8	88.1	42.1
10	174.1	175.4	174.7	159.8	149.2	150.2	88.0	88.3	41.8	41.8	174.7	153.1	88.1	41.8
11	157.4	156.3	156.8	149.5	140.1	140.9	88.2	88.4	41.5	41.6	156.8	143.5	88.3	41.5
12	261.9	272.0	266.9	173.8	165.5	167.1	87.9	88.2	41.3	41.5	266.9	168.8	88.0	41.4
13	271.4	282.4	276.9	181.5	172.4	173.9	88.0	88.2	42.2	42.3	276.9	175.9	88.1	42.2
14	189.2	193.8	191.5	166.5	155.3	156.1	87.9	88.0	41.9	42.0	191.5	159.3	87.9	41.9
15	159.9	158.7	159.3	151.4	141.9	142.6	88.0	88.3	42.3	42.4	159.3	145.3	88.1	42.3
16	253.1	260.6	256.8	169.5	161.7	163.3	87.6	87.6	42.6	42.7	256.8	164.8	87.6	42.6
17	270.7	281.7	276.2	180.6	171.2	173.0	87.3	87.4	41.2	41.3	276.2	174.9	87.3	41.2
18	191.9	197.6	194.7	167.3	155.7	156.4	87.9	88.2	40.9	41.0	194.7	159.8	88.0	40.9
19	161.1	160.0	160.5	151.8	142.2	143.2	88.3	88.4	41.8	41.9	160.5	145.7	88.3	41.8

ตาราง ผลการทดสอบการแปรอุณหภูมิก๊าซร้อนขาเข้าที่ อุณหภูมิก๊าซร้อน 200c
อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	233.6	242.6	238.1	153.4	148.2	149.8	40.5	40.5	76.6	77.0	238.1	150.5	40.5	76.8
2	247.4	258.8	253.1	163.8	157.2	158.9	40.6	40.8	76.6	76.6	253.1	160.0	40.7	76.6
3	145.4	146.0	145.7	140.1	132.2	133.2	41.9	42.0	77.2	77.4	145.7	135.1	41.9	77.3
4	131.4	131.7	131.5	130.9	124.0	124.8	41.0	41.1	77.2	77.4	131.5	126.5	41.0	77.3
5	240.8	251.0	245.9	158.3	152.3	153.6	41.8	42.0	76.8	76.9	245.9	154.7	41.9	76.8
6	189.3	202.4	195.8	157.4	147.4	148.1	42.8	43.0	76.5	76.6	195.8	150.9	42.9	76.5
7	135.6	134.9	135.2	134.3	127.3	128.3	44.0	44.1	77.1	77.6	135.2	130.0	44.0	77.3
8	214.0	218.0	216.0	145.5	141.2	142.9	41.8	42.0	77.0	77.3	216.0	143.2	41.9	77.1
9	248.3	259.4	253.9	163.1	156.6	158.2	41.3	41.4	76.8	76.9	253.9	159.3	41.3	76.8
10	140.7	141.2	141.0	137.5	129.9	130.6	41.1	41.3	76.9	77.0	141.0	132.7	41.2	76.9
11	162.7	151.6	157.1	130.2	126.2	128.2	41.4	41.5	76.9	77.2	157.1	128.2	41.4	77.0
12	242.4	253.2	247.8	159.9	153.4	154.8	41.4	41.5	76.5	76.8	247.8	156.0	41.4	76.6
13	177.2	186.7	182.0	153.7	143.8	144.6	41.2	41.3	76.7	76.8	182.0	147.4	41.2	76.7
14	135.1	134.2	134.6	134.0	126.9	127.9	41.1	41.2	76.9	77.0	134.6	129.6	41.1	76.9
15	222.4	227.0	224.7	148.7	143.9	145.6	41.4	41.5	76.6	76.9	224.7	146.1	41.4	76.7
16	247.6	258.7	253.2	163.8	157.0	158.6	41.4	41.5	76.2	76.5	253.2	159.8	41.4	76.3
17	144.1	144.4	144.2	139.4	131.4	132.2	41.4	41.5	76.9	77.0	144.2	134.3	41.4	76.9
18	143.6	141.2	142.4	131.0	123.9	125.1	41.2	41.3	76.9	77.0	142.4	126.7	41.2	76.9
19	244.6	255.0	249.8	159.9	153.5	155.0	41.2	41.3	76.2	76.6	249.8	156.1	41.2	76.4

ตาราง ผลการทดสอบการแปรอุณหภูมิก๊าซร้อนขาเข้าที่ อุณหภูมิก๊าซร้อน 240 c
อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	272.4	283.3	277.8	183.7	174.8	176.4	87.5	87.7	40.3	40.4	277.8	178.3	87.6	40.3
2	169.5	169.8	169.7	158.0	148.0	148.9	88.1	88.5	41.0	41.1	169.7	151.6	88.3	41.0
3	169.7	167.9	168.8	149.3	140.2	141.4	88.8	89.0	41.7	41.8	168.8	143.6	88.9	41.7
4	262.8	273.8	268.3	176.0	167.5	168.9	88.6	88.8	42.1	42.1	268.3	170.8	88.7	42.1
5	271.6	282.2	276.9	181.8	173.0	174.7	88.0	88.2	41.0	41.1	276.9	176.5	88.1	41.0
6	176.6	178.4	177.5	161.2	150.6	151.4	88.2	88.4	41.5	41.6	177.5	154.4	88.3	41.5
7	158.3	157.2	157.8	150.0	140.8	141.7	88.3	88.6	41.8	41.9	157.8	144.2	88.4	41.8
8	261.9	271.0	266.4	173.2	165.2	166.8	88.2	88.3	42.1	42.2	266.4	168.4	88.2	42.1
9	271.1	281.8	276.4	181.4	172.2	173.9	88.0	88.2	42.1	42.1	276.4	175.8	88.1	42.1
10	174.1	175.4	174.7	159.8	149.2	150.2	88.0	88.3	41.8	41.8	174.7	153.1	88.1	41.8
11	157.4	156.3	156.8	149.5	140.1	140.9	88.2	88.4	41.5	41.6	156.8	143.5	88.3	41.5
12	261.9	272.0	266.9	173.8	165.5	167.1	87.9	88.2	41.3	41.5	266.9	168.8	88.0	41.4
13	271.4	282.4	276.9	181.5	172.4	173.9	88.0	88.2	42.2	42.3	276.9	175.9	88.1	42.2
14	189.2	193.8	191.5	166.5	155.3	156.1	87.9	88.0	41.9	42.0	191.5	159.3	87.9	41.9
15	159.9	158.7	159.3	151.4	141.9	142.6	88.0	88.3	42.3	42.4	159.3	145.3	88.1	42.3
16	253.1	260.6	256.8	169.5	161.7	163.3	87.6	87.6	42.6	42.7	256.8	164.8	87.6	42.6
17	270.7	281.7	276.2	180.6	171.2	173.0	87.3	87.4	41.2	41.3	276.2	174.9	87.3	41.2
18	191.9	197.6	194.7	167.3	155.7	156.4	87.9	88.2	40.9	41.0	194.7	159.8	88.0	40.9
19	161.1	160.0	160.5	151.8	142.2	143.2	88.3	88.4	41.8	41.9	160.5	145.7	88.3	41.8
20	250.9	258.0	254.5	168.1	160.5	162.0	87.9	87.9	41.1	41.1	254.5	163.5	87.9	41.1
21	270.1	280.5	275.3	179.7	170.4	172.1	87.1	87.2	42.4	42.5	275.3	174.1	87.1	42.4
22	205.9	216.1	211.0	172.5	160.2	161.0	87.2	87.4	41.2	41.4	211.0	164.5	87.3	41.3
23	161.4	160.4	160.9	152.8	142.8	143.7	87.6	87.6	41.8	41.9	160.9	146.4	87.6	41.8
24	242.2	247.3	244.7	164.9	157.5	159.3	87.6	87.9	41.8	41.9	244.7	160.6	87.7	41.8

ตาราง ผลการทดสอบการแปรปริมาณอัตราการไหลก๊าซร้อนที่ อุณหภูมิก๊าซร้อน 231 c อุณหภูมิน้ำขาเข้า 40c อัตราการไหลก๊าซร้อน 400 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										อุณหภูมิเฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	200.2	199.9	196.3	146.6	150.1	152.9	38.6	38.6	77.3	77.0	198.8	149.9	38.6	77.2
2	274.6	287.3	299.5	160.3	162.4	164.5	38.8	38.8	77.2	77.0	287.1	162.4	38.8	77.1
3	197.9	197.6	193.4	145.9	149.2	152.3	40.3	40.4	77.5	77.8	196.3	149.1	40.4	77.7
4	277.8	291.7	303.1	161.8	163.4	165.4	42.1	42.2	77.5	77.4	290.9	163.5	42.2	77.5
5	199.1	200.1	195.1	146.4	149.9	152.8	41.1	41.2	77.6	77.2	198.1	149.7	41.2	77.4
6	277.2	287.9	301.9	160.9	163.2	165.2	40.7	40.8	77.4	77.5	289.0	163.1	40.8	77.5
7	197.6	197.6	193.3	145.9	149.5	152.8	40.7	40.8	77.5	77.4	196.2	149.4	40.8	77.5
8	274.1	290.5	302.3	161.0	163.6	165.5	40.8	40.8	77.5	77.5	289.0	163.4	40.8	77.5
9	195.0	194.7	190.7	145.4	148.9	152.3	40.8	40.9	77.8	77.6	193.5	148.9	40.9	77.7
10	279.1	291.3	305.8	161.9	164.3	166.4	41.0	41.1	77.5	77.5	292.1	164.2	41.1	77.5
11	200.0	202.5	196.3	147.5	150.9	154.0	41.1	41.1	77.8	77.8	199.6	150.8	41.1	77.8
12	268.0	283.8	294.7	160.3	162.8	164.7	41.2	41.3	77.9	77.8	282.2	162.6	41.3	77.9
13	199.6	202.9	195.8	147.4	150.7	154.0	40.9	41.0	78.5	78.1	199.4	150.7	41.0	78.3
14	275.1	285.2	301.6	161.2	163.3	165.6	39.5	39.5	78.5	78.2	287.3	163.4	39.5	78.4
15	198.8	199.0	194.8	146.9	150.2	153.4	39.1	39.1	78.7	78.5	197.5	150.2	39.1	78.6
16	274.8	291.9	306.1	162.6	164.7	166.6	39.9	40.0	78.6	78.7	290.9	164.6	40.0	78.7
17	179.3	197.9	194.0	146.8	150.2	153.7	40.5	40.5	78.8	78.6	190.4	150.2	40.5	78.7
18	276.5	293.4	305.9	162.9	164.9	167.1	41.1	41.1	78.8	78.7	291.9	165.0	41.1	78.8
19	197.7	198.0	194.0	147.1	150.5	153.7	41.5	41.6	79.1	78.8	196.6	150.4	41.6	79.0
20	281.5	292.7	304.6	162.7	165.2	167.5	41.4	41.5	78.5	78.6	292.9	165.1	41.5	78.6
21	197.7	197.0	194.1	147.0	150.5	154.0	40.5	40.5	78.8	78.7	196.3	150.5	40.5	78.8
22	278.1	294.2	307.6	162.3	164.4	166.9	40.1	40.1	78.6	78.5	293.3	164.5	40.1	78.6
23	197.6	197.9	193.5	146.3	149.6	153.3	39.8	39.9	78.9	78.8	196.3	149.7	39.9	78.9
24	283.0	299.2	314.1	163.8	166.1	168.2	39.5	39.5	78.5	78.6	298.8	166.0	39.5	78.6

ตาราง ผลการทดสอบการแปรปริมาณอัตราการไหลก๊าซร้อนที่ อุณหภูมิก๊าซร้อน 231 c อุณหภูมิน้ำขาเข้า 40c อัตราการไหลก๊าซร้อน 550 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										อุณหภูมิเฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	194.8	191.2	187.2	151.6	155.4	158.4	39.4	39.4	81.3	81.2	191.1	155.1	39.4	81.3
2	241.8	250.1	254.1	158.4	161.7	164.1	39.3	39.3	81.5	81.5	248.7	161.4	39.3	81.5
3	235.7	235.6	228.3	161.3	165.2	167.3	39.0	39.1	81.8	81.7	233.2	164.6	39.1	81.8
4	170.2	166.9	165.4	143.0	146.1	150.1	40.7	40.8	82.0	81.9	167.5	146.4	40.8	82.0
5	285.0	292.0	285.5	171.1	174.1	175.1	39.9	39.9	82.2	82.1	287.5	173.4	39.9	82.2
6	170.7	167.6	165.3	143.5	146.8	150.5	39.9	39.9	82.4	82.4	167.9	146.9	39.9	82.4
7	290.0	298.6	297.5	172.2	175.7	177.0	40.4	40.5	82.1	82.1	295.4	175.0	40.5	82.1
8	177.7	174.0	171.7	146.4	149.8	153.3	41.0	41.1	82.4	82.4	174.5	149.8	41.1	82.4
9	275.4	289.2	289.1	168.3	171.5	173.2	40.5	40.5	82.5	82.1	284.6	171.0	40.5	82.3
10	207.3	203.0	198.6	155.1	159.2	161.7	39.9	40.0	82.6	82.1	203.0	158.7	40.0	82.4
11	216.1	222.2	225.5	153.5	157.0	160.3	40.3	40.1	82.8	82.7	221.3	156.9	40.2	82.8
12	287.3	292.2	285.0	172.4	175.6	176.8	40.1	40.1	82.4	82.3	288.2	174.9	40.1	82.4
13	173.6	169.8	169.0	144.6	148.1	151.8	40.2	40.3	82.8	82.7	170.8	148.2	40.3	82.8
14	291.4	303.7	300.0	172.9	176.7	178.0	40.2	40.3	82.4	82.7	298.4	175.9	40.3	82.6
15	173.6	170.5	169.1	144.3	147.7	151.2	40.3	40.4	82.3	82.5	171.1	147.7	40.4	82.4
16	291.4	300.1	298.4	171.7	175.2	177.0	40.5	40.5	82.1	82.1	296.6	174.6	40.5	82.1
17	179.6	175.8	173.5	147.1	150.7	154.1	40.6	40.6	82.6	82.5	176.3	150.6	40.6	82.6
18	275.8	286.4	286.5	167.8	171.2	173.0	38.3	38.4	82.6	82.5	282.9	170.7	38.4	82.6
19	212.4	209.4	204.2	156.6	160.7	163.6	38.7	38.7	82.7	82.7	208.7	160.3	38.7	82.7
20	202.5	208.6	212.5	151.4	155.0	158.6	39.5	39.9	82.9	83.0	207.9	155.0	39.7	83.0
21	241.8	240.5	233.3	162.6	166.3	168.7	40.3	40.4	83.0	83.0	238.5	165.9	40.4	83.0
22	171.7	168.4	166.6	143.7	147.1	150.9	41.1	41.2	83.3	83.3	168.9	147.2	41.2	83.3

ตาราง ผลการทดสอบการแปรปริมาณอัตราการไหลก๊าซร้อนที่ อุณหภูมิก๊าซร้อน 231 c อุณหภูมิน้ำขาเข้า 40c อัตราการไหลก๊าซร้อน 700 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										อุณหภูมิเฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	220.4	217.9	209.4	165.3	169.7	172.6	40.5	40.6	87.1	86.7	215.9	169.2	40.6	86.9
2	171.4	170.4	165.7	148.5	152.3	157.5	40.7	40.7	88.1	88.0	169.2	152.8	40.7	88.1
3	281.8	287.8	280.9	178.0	182.3	185.7	40.8	40.8	87.9	87.9	283.5	182.0	40.8	87.9
4	174.5	173.2	168.0	150.2	153.9	158.3	40.2	40.2	88.6	88.3	171.9	154.1	40.2	88.5
5	278.4	285.4	280.2	177.1	181.0	184.7	40.3	40.3	88.6	88.6	281.3	180.9	40.3	88.6
6	286.0	291.7	285.3	182.0	186.8	189.7	40.4	40.4	88.0	87.6	287.7	186.2	40.4	87.8
7	179.0	177.5	171.5	152.9	156.2	160.8	40.5	40.6	89.3	89.0	176.0	156.6	40.6	89.2
8	275.0	282.0	275.8	175.4	179.2	182.8	40.3	40.4	89.3	89.5	277.6	179.1	40.4	89.4
9	286.0	291.4	284.8	182.4	187.0	189.7	40.7	40.8	89.4	89.2	287.4	186.4	40.8	89.3
10	184.2	182.5	176.8	155.5	159.4	163.4	40.6	40.7	89.6	89.4	181.2	159.4	40.7	89.5
11	266.0	272.6	268.4	172.5	176.2	180.2	40.5	40.6	89.8	89.8	269.0	176.3	40.6	89.8
12	282.6	288.9	282.4	181.2	186.0	188.6	40.5	40.5	89.2	89.3	284.6	185.3	40.5	89.3
13	178.1	176.9	171.4	153.0	156.0	161.0	40.3	40.3	91.3	91.4	175.5	156.7	40.3	91.4
14	278.2	284.7	277.5	177.7	181.5	185.3	40.4	40.5	91.3	91.2	280.1	181.5	40.5	91.3
15	286.2	292.3	285.5	183.5	188.2	190.9	40.4	40.5	91.1	90.8	288.0	187.5	40.5	91.0
16	182.8	181.2	175.4	155.4	159.1	163.4	40.5	40.6	92.5	92.2	179.8	159.3	40.6	92.4
17	272.9	280.0	275.4	176.0	179.6	183.4	40.5	40.5	93.2	92.9	276.1	179.7	40.5	93.1
18	284.7	291.0	284.4	183.1	187.9	190.7	40.3	40.3	91.4	91.5	286.7	187.2	40.3	91.5
19	189.8	187.6	181.3	158.5	162.2	166.4	40.6	40.7	92.9	92.5	186.2	162.4	40.7	92.7
20	256.5	264.3	260.2	171.1	174.9	178.6	40.6	40.6	93.5	93.1	260.3	174.9	40.6	93.3

ตาราง ผลการทดสอบการแปรอุณหภูมิน้ำขาเข้าที่ อุณหภูมิก๊าซร้อน 231 c
อุณหภูมิน้ำขาเข้า 15 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	272.9	267.9	268	175.3	171.4	167.2	14.8	14.9	72.1	72	269.6	171.3	14.85	72.05
2	286.8	279.6	280.9	183.5	179.6	174.7	14.8	14.9	71.7	72.1	282.4	179.3	14.85	71.9
3	175.3	170.8	176.3	156.2	151.2	146.8	16.4	16.6	72.3	72.5	174.1	151.4	16.5	72.4
4	273.1	268.3	268.2	175.1	170.8	166.9	17.7	17.7	71.9	72	269.9	170.9	17.7	71.95
5	285.4	278.7	280.2	183.1	179.5	174.4	16.5	16.6	71.6	71.8	281.4	179	16.55	71.7
6	176.4	171.5	177.3	156.2	151.6	147.2	15.2	15.5	72.1	72.2	175.1	151.7	15.35	72.15
7	272.2	268	266.9	174.8	170.9	167	15.2	15.2	71.8	72.2	269	170.9	15.2	72
8	287	279.6	281.2	183.6	179.7	174.9	15.3	15.4	71.4	71.8	282.6	179.4	15.35	71.6
9	176.5	171.3	176.8	156.6	151.4	147.2	15.5	15.6	72.1	72.3	174.9	151.7	15.55	72.2
10	270.7	265.8	265.6	174.6	170.7	166.7	15.4	15.5	71.6	72	267.4	170.7	15.45	71.8
11	285.5	278.8	279.2	183.2	179.5	174.5	15.8	15.8	71.3	71.7	281.2	179.1	15.8	71.5
12	172.2	168	172.9	154.4	149.1	145.1	15.1	15.1	71.6	72	171	149.5	15.1	71.8
13	276.3	271.2	270.8	176.3	172.6	168.4	15.3	15.4	71.2	71.6	272.8	172.4	15.35	71.4
14	287.2	279.9	281.3	183.6	179.4	173.6	15.6	15.7	71.1	71.4	282.8	178.9	15.65	71.25
15	169.7	165.9	170.9	153.1	147.5	143.7	15.5	15.6	71.4	71.6	168.8	148.1	15.55	71.5
16	277.4	271.8	73.3	178	173.9	169.4	15.1	15.1	71.2	71.4	207.5	173.8	15.1	71.3
17	184.2	178.3	184.5	159.1	154	149.1	15.3	15.4	71.4	71.4	182.3	154.1	15.35	71.4
18	239.9	237.5	238.7	165	161	157.8	15.5	15.6	70.8	71.4	238.7	161.3	15.55	71.1
19	283.7	276.6	277.4	181.3	177	172	15.9	16	70.5	70.7	279.2	176.8	15.95	70.6
20	173.3	168.6	174.2	155.1	150	146	15.1	15.1	71.1	71.4	172	150.4	15.1	71.25
21	273.5	268.2	268.1	175.2	171.1	167.1	15.1	15.1	71	71.3	269.9	171.1	15.1	71.15
22	284	277.8	279	183	179.1	174.4	15.3	15.3	71.1	71.3	280.3	178.8	15.3	71.2
23	265.6	254.6	255.8	179.9	175.2	169	15.5	15.5	71.7	72	258.7	174.7	15.5	71.85
24	170	166.2	170.5	153.5	148.4	144.5	15.2	15.2	72.4	72.6	168.9	148.8	15.2	72.5
25	283.7	276.7	277.5	180.3	176.6	171.8	14.7	14.9	72	72.3	279.3	176.2	14.8	72.15
26	172.5	168.4	173.3	154.3	149.2	145.1	15.5	15.5	71.9	72.4	171.4	149.5	15.5	72.15
27	274	269.5	269.1	175.4	171.8	167.3	14.7	14.7	71.4	71.7	270.9	171.5	14.7	71.55
28	226.9	218.6	222	170.3	165.1	159.2	15.4	15.5	70.6	71.2	222.5	164.9	15.45	70.9
29	165.6	161.6	166.3	150.5	144.6	141.3	15.3	15.4	70.7	70.7	164.5	145.5	15.35	70.7
30	279.9	273.8	275.3	179	175.2	170.3	15.4	15.5	69.9	70.2	276.3	174.8	15.45	70.05

ตาราง ผลการทดสอบการแปรอุณหภูมิน้ำขาเข้าที่ อุณหภูมิก๊าซร้อน 231 c
อุณหภูมิน้ำขาเข้า 25 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	196.7	190.4	195.9	163.8	158.9	153.6	25.1	25.1	76.8	76.8	194.3	158.8	25.1	76.8
2	187.9	188.6	194.5	155.4	151.9	149.2	24.9	24.9	76.8	77.0	190.3	152.2	24.9	76.9
3	279.3	273.6	274.4	180.2	176.2	171.6	25.1	25.1	76.2	76.6	275.8	176.0	25.1	76.4
4	173.6	169.2	174.5	156.1	151.0	146.8	25.3	25.4	76.7	76.8	172.4	151.3	25.4	76.8
5	259.8	255.3	254.3	169.9	166.4	162.9	24.7	24.8	76.3	76.7	256.5	166.4	24.8	76.5
6	283.4	275.7	275.8	181.7	177.7	173.3	25.0	25.0	76.0	76.0	278.3	177.6	25.0	76.0
7	169.9	165.2	170.8	154.3	149.3	145.3	25.1	25.1	76.3	76.6	168.6	149.6	25.1	76.5
8	268.3	263.8	263.2	173.5	169.7	165.9	25.0	25.0	76.1	76.5	265.1	169.7	25.0	76.3
9	281.9	275.1	275.8	182.1	178.3	173.8	24.8	24.8	76.0	76.2	277.6	178.1	24.8	76.1
10	170.3	167.4	171.8	154.9	150.2	145.9	24.9	25.0	76.6	76.9	169.8	150.3	25.0	76.8
11	267.1	262.0	261.4	173.3	169.4	165.9	25.1	25.1	76.8	76.6	263.5	169.5	25.1	76.7
12	282.7	276.3	277.4	182.4	178.9	174.4	25.2	25.2	76.1	76.4	278.8	178.6	25.2	76.3
13	172.2	168.5	173.4	155.7	150.9	146.8	25.3	25.3	76.7	77.0	171.4	151.1	25.3	76.9
14	270.0	265.3	265.0	174.0	170.3	166.5	25.1	25.2	76.6	77.0	266.8	170.3	25.2	76.8
15	283.3	276.7	277.4	182.9	179.5	174.8	24.9	24.9	76.1	76.6	279.1	179.1	24.9	76.4
16	173.9	169.4	175.2	156.6	151.8	147.6	24.7	24.7	77.2	77.3	172.8	152.0	24.7	77.3
17	267.5	262.6	262.0	173.4	169.7	166.2	24.8	24.8	77.3	77.4	264.0	169.8	24.8	77.4
18	283.5	276.4	278.0	183.1	179.7	175.0	25.0	25.0	76.9	77.3	279.3	179.3	25.0	77.1
19	176.1	172.0	177.0	157.7	152.9	148.8	25.4	25.4	77.4	77.8	175.0	153.1	25.4	77.6
20	264.1	259.5	258.2	172.5	168.8	165.2	25.5	25.6	77.7	77.8	260.6	168.8	25.6	77.8
21	283.4	276.9	278.3	183.1	179.6	174.9	24.7	24.7	77.3	77.7	279.5	179.2	24.7	77.5
22	178.4	173.4	179.1	158.6	153.9	149.5	25.0	25.0	77.8	78.1	177.0	154.0	25.0	78.0
23	261.7	256.9	256.5	171.9	168.4	164.9	25.1	25.1	77.6	78.0	258.4	168.4	25.1	77.8
24	285.1	278.8	279.9	183.7	180.0	175.1	25.1	25.1	77.4	77.7	281.3	179.6	25.1	77.6
25	179.0	174.7	180.2	159.2	154.3	149.8	24.7	24.7	78.2	78.1	178.0	154.4	24.7	78.2
26	260.4	256.2	255.9	171.6	168.0	164.7	24.9	24.9	78.1	78.3	257.5	168.1	24.9	78.2
27	284.8	278.1	278.8	183.6	179.7	175.1	25.1	25.1	77.7	77.8	280.6	179.5	25.1	77.8
28	179.9	175.8	180.8	159.5	154.7	150.3	25.2	25.3	78.4	78.5	178.8	154.8	25.3	78.5
29	259.4	255.7	254.6	171.7	168.1	164.5	26.9	26.8	77.1	78.1	256.6	168.1	26.9	77.6
30	285.7	278.8	279.4	184.2	180.9	175.8	25.7	25.7	77.8	77.8	281.3	180.3	25.7	77.8

ตาราง ผลการทดสอบการแปรอุณหภูมิน้ำขาเข้าที่ อุณหภูมิก๊าซร้อน 231 c
อุณหภูมิน้ำขาเข้า 35 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	250.0	247.6	246.9	170.2	166.9	163.7	35.0	35.0	85.1	85.5	248.2	166.9	35.0	85.3
2	281.8	275.5	276.5	183.5	180.2	175.6	35.0	35.0	85.2	85.2	277.9	179.8	35.0	85.2
3	182.0	176.9	182.3	161.3	156.8	152.1	35.1	35.1	85.5	85.6	180.4	156.7	35.1	85.6
4	247.1	244.7	244.5	169.7	166.2	163.1	35.2	35.2	86.0	86.2	245.4	166.3	35.2	86.1
5	282.3	275.8	276.4	183.9	180.2	175.8	35.3	35.4	85.8	86.2	278.2	180.0	35.4	86.0
6	183.7	178.3	184.2	162.2	157.5	153.0	35.8	35.8	85.8	85.6	182.1	157.6	35.8	85.7
7	241.7	238.9	238.8	168.1	165.0	161.7	35.2	35.1	85.9	86.2	239.8	164.9	35.2	86.1
8	282.2	275.1	276.7	183.9	180.2	175.7	34.5	34.5	85.3	85.4	278.0	179.9	34.5	85.4
9	185.7	181.2	186.2	162.9	158.4	153.7	34.5	34.6	85.6	85.3	184.4	158.3	34.6	85.5
10	237.7	235.6	236.1	167.5	164.0	161.0	34.6	34.7	85.7	85.8	236.5	164.2	34.7	85.8
11	281.5	274.2	275.3	183.7	180.0	175.6	34.7	34.7	84.7	85.2	277.0	179.8	34.7	85.0
12	189.4	184.0	189.4	164.1	159.4	154.7	34.8	34.8	85.0	85.4	187.6	159.4	34.8	85.2
13	233.1	231.8	232.1	166.2	163.2	160.3	35.0	35.0	85.4	85.8	232.3	163.2	35.0	85.6
14	283.3	276.3	277.7	183.9	180.4	175.7	35.1	35.1	84.9	85.2	279.1	180.0	35.1	85.1
15	190.9	185.0	191.0	164.8	160.0	155.1	35.2	35.3	85.3	85.5	189.0	160.0	35.3	85.4
16	225.9	224.1	225.2	165.2	161.9	159.1	35.6	35.7	85.8	85.8	225.1	162.1	35.7	85.8
17	281.8	275.0	275.1	183.7	179.9	175.6	35.3	35.3	84.8	85.3	277.3	179.7	35.3	85.1
18	193.3	187.8	193.4	165.5	161.0	156.0	35.2	35.2	85.2	85.1	191.5	160.8	35.2	85.2
19	218.9	217.9	220.6	163.8	160.6	157.9	35.4	35.4	85.5	85.5	219.1	160.8	35.4	85.5
20	283.1	276.2	277.0	184.0	180.2	175.8	35.4	35.4	84.9	85.4	278.8	180.0	35.4	85.2
21	195.7	189.3	194.8	166.2	161.6	156.6	35.4	35.4	84.9	85.0	193.3	161.5	35.4	85.0
22	209.3	209.2	213.6	162.3	158.7	156.1	35.4	35.3	85.3	85.7	210.7	159.0	35.4	85.5
23	281.9	275.4	276.5	183.7	179.9	175.5	35.1	35.1	84.7	85.2	277.9	179.7	35.1	85.0
24	199.2	193.0	198.8	167.5	162.7	157.5	35.0	35.0	85.4	85.4	197.0	162.6	35.0	85.4
25	202.7	203.0	206.5	161.0	157.9	155.0	37.0	36.9	85.1	85.4	204.1	158.0	37.0	85.3

ตาราง ผลการทดสอบการแปรอุณหภูมิน้ำขาเข้าที่ อุณหภูมิก๊าซร้อน 231 c
อุณหภูมิน้ำขาเข้า 45 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	276.0	269.6	270.3	181.4	178.2	173.7	46.5	46.5	92.0	92.7	272.0	177.8	46.5	92.4
2	283.8	276.7	277.8	187.1	184.0	179.3	46.5	46.5	93.2	92.9	279.4	183.5	46.5	93.1
3	167.6	163.3	168.5	156.4	151.8	148.0	45.7	45.6	94.2	94.9	166.5	152.1	45.7	94.6
4	277.6	271.2	271.8	181.3	178.0	173.4	45.6	45.6	93.7	93.6	273.5	177.6	45.6	93.7
5	284.5	277.9	278.6	187.2	183.9	179.1	45.3	45.3	92.4	92.5	280.3	183.4	45.3	92.5
6	167.7	163.3	168.2	156.6	151.8	147.9	45.0	45.0	93.6	93.9	166.4	152.1	45.0	93.8
7	274.8	268.9	269.6	180.3	176.9	172.8	45.0	45.0	93.5	93.6	271.1	176.7	45.0	93.6
8	282.5	276.4	277.2	186.4	183.2	178.4	44.9	44.9	91.9	92.2	278.7	182.7	44.9	92.1
9	168.2	164.1	169.3	156.8	152.3	148.4	45.0	44.9	93.5	93.6	167.2	152.5	45.0	93.6
10	273.7	268.1	268.7	179.5	176.4	172.1	44.7	44.7	93.4	93.5	270.2	176.0	44.7	93.5
11	282.0	275.1	276.0	186.3	183.1	178.4	45.1	45.1	91.5	91.9	277.7	182.6	45.1	91.7
12	167.8	164.2	169.4	157.1	152.5	148.5	44.3	44.3	93.2	93.0	167.1	152.7	44.3	93.1
13	271.8	265.9	265.9	178.9	175.4	171.4	44.1	44.1	93.2	93.1	267.9	175.2	44.1	93.2
14	280.9	273.7	274.6	186.1	182.8	178.0	44.1	44.1	92.5	92.7	276.4	182.3	44.1	92.6
15	168.0	164.9	169.2	157.2	152.7	148.0	44.5	44.4	93.0	93.4	167.4	152.6	44.5	93.2
16	270.7	264.7	264.5	178.2	174.6	170.8	44.0	44.0	93.5	93.8	266.6	174.5	44.0	93.7
17	281.3	273.4	275.6	185.7	182.5	177.9	44.3	44.3	92.2	92.6	276.8	182.0	44.3	92.4
18	169.4	165.3	170.9	157.8	153.3	149.2	44.3	44.3	92.5	93.0	168.5	153.4	44.3	92.8
19	271.2	256.6	265.1	177.9	174.7	170.7	44.4	44.4	92.6	93.2	264.3	174.4	44.4	92.9
20	282.2	275.7	276.8	186.1	182.8	178.1	44.5	44.5	92.2	92.4	278.2	182.3	44.5	92.3
21	170.6	166.6	172.0	158.2	153.6	149.5	45.9	45.9	92.4	92.5	169.7	153.8	45.9	92.5
22	269.7	264.8	264.8	177.6	174.0	170.4	48.3	48.2	92.2	92.6	266.4	174.0	48.3	92.4
23	281.5	275.0	276.4	185.7	182.6	177.7	46.4	46.4	90.3	91.0	277.6	182.0	46.4	90.7
24	171.5	167.2	172.5	158.7	154.0	149.8	45.9	45.9	91.3	91.6	170.4	154.2	45.9	91.5
25	267.6	262.8	263.1	176.9	173.6	169.7	45.9	45.9	91.5	91.6	264.5	173.4	45.9	91.6
26	282.5	275.9	276.8	185.7	182.4	177.7	45.6	45.6	90.2	90.6	278.4	181.9	45.6	90.4
27	172.6	168.4	174.0	159.0	154.5	150.3	45.6	45.6	91.4	91.4	171.7	154.6	45.6	91.4
28	264.1	259.6	259.6	176.0	172.5	168.8	44.9	44.9	91.7	92.3	261.1	172.4	44.9	92.0
29	283.4	277.0	277.9	186.1	183.1	178.0	45.3	45.3	91.4	91.6	279.4	182.4	45.3	91.5
30	173.7	168.7	174.5	159.9	155.1	151.1	44.6	44.7	92.1	92.6	172.3	155.4	44.7	92.4

ตาราง ผลการทดสอบการแปรปริมาณน้ำขาเข้าที่ อุณหภูมิก๊าซร้อน 231 c
อุณหภูมิน้ำขาเข้า 40c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	177.3	175.2	170.0	153.3	156.8	160.7	40.4	40.5	87.6	87.1	174.2	156.9	40.5	87.4
2	260.9	268.7	264.5	170.8	174.5	178.0	40.0	40.1	88.2	87.8	264.7	174.4	40.1	88.0
3	283.4	289.3	283.3	181.3	185.7	188.3	39.2	39.3	87.9	87.8	285.3	185.1	39.3	87.9
4	173.0	171.5	166.4	151.6	155.0	159.1	38.7	38.8	88.1	87.9	170.3	155.2	38.8	88.0
5	271.8	278.7	273.7	174.6	178.2	171.6	39.3	39.3	88.7	88.7	274.7	174.8	39.3	88.7
6	285.3	290.8	284.7	182.3	186.4	189.4	40.6	40.6	88.6	88.2	286.9	186.0	40.6	88.4
7	170.9	169.2	164.5	150.6	154.0	158.1	39.9	40.0	89.0	88.7	168.2	154.2	40.0	88.9
8	276.1	282.2	276.3	176.1	179.9	183.1	39.4	39.5	88.9	88.9	278.2	179.7	39.5	88.9
9	277.7	275.8	266.0	178.8	182.2	184.4	39.0	39.1	88.4	88.2	273.2	181.8	39.1	88.3
10	169.0	167.6	163.1	149.5	152.5	156.8	38.9	39.0	88.6	88.7	166.6	152.9	39.0	88.7
11	279.3	284.8	278.6	177.7	181.7	184.8	39.5	39.6	88.7	88.3	280.9	181.4	39.6	88.5
12	234.1	230.4	221.7	169.4	173.1	176.0	40.7	40.8	88.5	88.3	228.7	172.8	40.8	88.4
13	167.8	166.3	161.8	148.6	151.7	156.0	39.7	39.7	88.6	88.4	165.3	152.1	39.7	88.5
14	279.6	285.7	279.0	178.5	182.4	186.0	39.3	39.4	88.1	88.1	281.4	182.3	39.4	88.1
15	203.9	200.5	198.8	162.1	166.0	169.3	39.2	39.3	88.3	88.3	201.1	165.8	39.3	88.3
16	195.9	203.5	202.7	156.0	159.8	164.1	39.8	39.9	88.6	88.3	200.7	160.0	39.9	88.5
17	282.0	287.1	280.9	179.9	184.0	187.0	40.2	40.2	88.4	88.2	283.3	183.6	40.2	88.3
18	189.5	186.7	180.7	157.9	161.7	165.4	39.5	39.6	88.4	88.1	185.6	161.7	39.6	88.3
19	235.1	242.4	240.5	164.4	167.8	171.6	39.5	39.5	88.7	88.4	239.3	167.9	39.5	88.6
20	283.0	288.5	282.2	180.6	184.7	187.9	39.4	39.4	87.9	87.8	284.6	184.4	39.4	87.9

ตาราง ผลการทดสอบการแปรปริมาณน้ำขาเข้าที่ อุณหภูมิก๊าซร้อน 231 c
อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 5 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	265.5	272.5	268.4	167.4	171.1	174.9	39.9	40.0	64.1	64.0	268.8	171.1	40.0	64.1
2	282.5	287.9	281.5	176.4	180.7	183.7	39.8	39.9	64.9	64.5	284.0	180.3	39.9	64.7
3	168.9	167.3	163.2	145.3	148.7	152.9	39.9	39.9	65.4	65.5	166.5	149.0	39.9	65.5
4	272.9	279.0	273.6	169.8	174.0	177.5	39.8	39.9	64.1	64.1	275.2	173.8	39.9	64.1
5	283.9	289.2	282.0	176.7	180.8	183.1	39.7	39.8	65.3	64.7	285.0	180.2	39.8	65.0
6	167.0	165.5	161.3	144.0	147.6	151.9	39.9	40.0	65.2	65.3	164.6	147.8	40.0	65.3
7	275.4	281.5	275.8	171.6	175.7	179.1	39.9	40.0	64.4	64.0	277.6	175.5	40.0	64.2
8	236.5	233.4	224.0	164.8	168.7	171.6	39.8	39.9	65.2	65.0	231.3	168.4	39.9	65.1
9	164.6	163.1	159.4	142.9	146.3	150.9	40.1	40.2	65.0	65.1	162.4	146.7	40.2	65.1
10	277.0	282.8	276.9	172.8	177.2	180.5	39.7	39.8	64.1	63.6	278.9	176.8	39.8	63.9
11	203.8	200.5	193.4	156.9	161.0	164.8	39.1	39.2	65.6	65.2	199.2	160.9	39.2	65.4
12	183.3	189.8	190.2	148.4	152.4	157.1	39.9	40.0	64.7	64.7	187.8	152.6	40.0	64.7
13	279.7	285.2	279.4	174.0	178.6	181.5	40.3	40.3	64.2	63.6	281.4	178.0	40.3	63.9
14	186.7	183.5	177.9	152.0	156.1	160.0	40.3	40.3	65.6	65.0	182.7	156.0	40.3	65.3
15	229.6	237.6	235.6	157.7	161.3	165.5	39.8	39.9	64.0	64.1	234.3	161.5	39.9	64.1
16	281.5	286.8	280.6	174.8	179.1	182.4	39.9	39.9	63.8	63.6	283.0	178.8	39.9	63.7
17	178.2	176.0	170.8	149.2	152.9	157.2	39.8	39.9	65.0	64.7	175.0	153.1	39.9	64.9
18	256.4	263.7	259.8	164.1	168.0	171.8	39.9	40.0	63.4	63.1	260.0	168.0	40.0	63.3
19	281.9	286.6	280.6	175.7	179.9	183.1	39.7	39.8	63.5	63.1	283.0	179.6	39.8	63.3
20	172.5	170.8	166.0	147.0	150.5	154.8	39.7	39.8	64.4	64.0	169.8	150.8	39.8	64.2

ตาราง ผลการทดสอบการแปรปริมาณน้ำขาเข้าที่ อุณหภูมิก๊าซร้อน 231 c

อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 8 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo	Teo	Teo	Tci 1	Tci2	Tco	Tco	Tei	Teo	Tci	Tco
1	262.6	270.9	265.6	163.6	167.4	171.4	40.2	40.2	55.0	54.7	266.4	167.5	40.2	54.9
2	280.9	286.7	280.1	173.1	177.5	181.0	39.9	40.0	56.4	55.7	282.6	177.2	40.0	56.1
3	166.2	164.6	160.0	142.3	145.8	150.1	39.9	40.0	56.4	56.1	163.6	146.1	40.0	56.3
4	270.8	276.4	271.1	166.4	170.3	174.0	40.1	40.1	54.6	54.5	272.8	170.2	40.1	54.6
5	253.4	249.9	240.4	165.3	169.4	172.3	39.9	39.9	56.1	55.8	247.9	169.0	39.9	56.0
6	162.7	161.1	156.8	140.0	143.4	148.0	39.9	40.0	55.8	55.8	160.2	143.8	40.0	55.8
7	276.4	281.5	276.3	169.4	173.8	177.2	40.1	40.2	54.9	54.5	278.1	173.5	40.2	54.7
8	215.0	211.7	204.1	157.3	161.5	165.1	40.2	40.2	56.7	56.4	210.3	161.3	40.2	56.6
9	161.4	160.3	157.1	139.5	143.5	148.4	39.9	39.9	55.7	55.5	159.6	143.8	39.9	55.6
10	278.9	282.9	277.7	170.8	175.1	178.4	39.8	39.9	55.2	55.1	279.8	174.8	39.9	55.2
11	192.3	198.5	182.9	151.6	155.7	159.6	39.9	39.9	56.7	56.6	191.2	155.6	39.9	56.7
12	212.0	218.9	218.5	151.6	155.1	159.7	40.2	40.2	55.6	55.4	216.5	155.5	40.2	55.5
13	280.2	285.5	279.8	171.8	176.4	179.9	40.2	40.2	55.5	55.1	281.8	176.0	40.2	55.3
14	179.7	177.0	171.8	147.8	151.7	155.8	40.1	40.2	57.2	56.7	176.2	151.8	40.2	57.0
15	247.4	256.2	252.3	159.7	163.2	167.2	39.8	39.9	55.5	55.2	252.0	163.4	39.9	55.4
16	280.7	285.5	280.1	172.7	177.1	180.5	40.0	40.0	55.9	55.7	282.1	176.8	40.0	55.8
17	172.5	170.4	165.6	145.1	148.8	153.3	40.1	40.1	57.0	56.9	169.5	149.1	40.1	57.0
18	260.6	267.1	263.8	163.4	167.3	171.0	40.1	40.2	55.3	54.9	263.8	167.2	40.2	55.1
19	282.3	287.9	281.5	173.6	178.1	181.3	40.2	40.2	56.3	56.1	283.9	177.7	40.2	56.2
20	168.7	166.9	162.2	143.6	147.0	151.5	40.0	40.0	57.0	56.5	165.9	147.4	40.0	56.8

ตาราง ผลการทดสอบการแปรปริมาณน้ำขาเข้าที่ อุณหภูมิก๊าซร้อน 231 c

อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 12 l/min

เวลา	อุณหภูมิ										เฉลี่ย			
(นาที)	Tei 1	Tei 2	Tei 3	Teo 1	Teo 2	Teo 3	Tci 1	Tci2	Tco 1	Tco 2	Tei	Teo	Tci	Tco
1	168.4	166.5	160.9	142.3	146.2	149.7	40.2	40.2	51.6	51.9	165.3	146.1	40.2	51.8
2	255.5	262.0	258.0	159.9	163.7	167.0	40.1	40.2	49.4	49.7	258.5	163.5	40.2	49.6
3	277.8	283.2	276.1	170.1	174.7	177.7	40.0	40.0	51.0	50.9	279.0	174.2	40.0	51.0
4	168.7	166.7	161.4	142.5	146.4	150.2	40.0	40.1	51.7	52.0	165.6	146.4	40.1	51.9
5	255.2	261.7	258.5	159.8	163.8	167.1	40.1	40.1	49.4	50.0	258.5	163.6	40.1	49.7
6	277.0	282.2	276.4	170.0	174.7	177.7	39.9	39.9	51.0	51.0	278.5	174.1	39.9	51.0
7	170.1	167.6	162.4	142.7	146.8	151.5	40.0	40.1	51.4	52.0	166.7	147.0	40.1	51.7
8	254.7	261.4	257.7	159.5	163.5	166.9	40.0	40.0	49.5	50.0	257.9	163.3	40.0	49.8
9	278.4	281.8	276.4	170.3	174.8	177.7	39.9	39.9	50.9	51.1	278.9	174.3	39.9	51.0
10	171.6	169.0	163.7	143.6	147.5	151.2	40.1	40.1	51.7	52.1	168.1	147.4	40.1	51.9
11	252.1	259.7	256.3	159.1	162.9	166.5	40.0	40.0	49.4	50.1	256.0	162.8	40.0	49.8
12	277.1	281.6	275.3	170.1	174.7	177.8	40.0	40.1	50.9	50.8	278.0	174.2	40.1	50.9
13	172.5	169.8	164.6	143.9	148.0	152.0	40.2	40.3	51.9	52.3	169.0	148.0	40.3	52.1
14	250.5	257.5	254.0	158.6	162.4	166.2	40.2	40.3	49.8	50.4	254.0	162.4	40.3	50.1
15	279.4	283.6	276.5	170.4	175.1	178.2	40.0	40.0	51.1	51.0	279.8	174.6	40.0	51.1
16	167.6	165.2	160.6	141.7	145.4	149.7	40.0	40.0	51.6	51.8	164.5	145.6	40.0	51.7
17	261.9	268.1	263.6	162.1	165.9	169.7	40.2	40.2	49.7	50.0	264.5	165.9	40.2	49.9
18	278.7	282.9	276.9	170.9	175.5	178.8	40.0	40.1	51.1	51.2	279.5	175.1	40.1	51.2
19	165.5	163.3	159.2	140.8	144.5	148.7	40.0	40.1	51.0	51.6	162.7	144.7	40.1	51.3
20	268.2	274.7	269.4	164.3	168.6	172.0	39.9	39.9	49.5	49.8	270.8	168.3	39.9	49.7

ตาราง แสดงที่สภาวะการทำงานจริงอุณหภูมิก๊าซร้อน 23.1 c

อุณหภูมิน้ำขาเข้า 40 c อัตราการไหลก๊าซร้อน 692.72 m^3/hr อัตราการไหลน้ำ 2.6 l/min

เวลา	อุณหภูมิ										อุณหภูมิเฉลี่ย			
(วินาที)	Tei 1	Tei 2	Tei 3	Teo 1	Teo 2	Teo 3	Tci 1	Tci 2	Tco 1	Tco 2	Tei	Teo	Tci	Tco
0	28.8	28.7	28.7	29.1	29.1	29.1	30.1	30.1	30.0	30.1	28.7	29.1	30.1	30.1
3	99.1	108.8	114.1	48.1	48.3	48.3	30.4	30.4	30.2	30.2	107.3	48.2	30.4	30.2
6	198.7	201.7	204.2	114.4	112.2	112.3	30.7	30.7	34.0	35.3	201.5	113.0	30.7	34.7
9	216.1	220.1	218.9	137.7	133.9	134.2	31.3	31.3	39.9	38.7	218.4	135.3	31.3	39.3
12	143.1	151.3	154.0	108.8	106.9	107.5	32.9	32.9	43.2	43.4	149.5	107.7	32.9	43.3
15	227.3	231.3	228.7	147.1	144.2	145.2	34.9	34.9	48.7	48.8	229.1	145.5	34.9	48.8
18	103.2	103.2	99.5	111.4	109.5	109.6	37.3	37.3	55.6	55.7	102.0	110.2	37.3	55.7
21	234.6	239.8	236.5	152.6	150.5	151.3	40.2	40.2	57.3	57.3	237.0	151.5	40.2	57.3
24	110.6	110.3	107.5	117.9	116.8	116.8	40.3	40.3	63.7	64.0	109.5	117.2	40.3	63.9
27	234.5	239.3	236.0	149.7	149.2	149.0	39.5	39.5	62.1	61.9	236.6	149.3	39.5	62.0
30	249.9	254.0	249.5	163.3	162.2	163.0	42.5	42.5	67.6	67.6	251.1	162.8	42.5	67.6
33	260.2	264.3	258.7	170.4	169.1	169.0	41.5	41.5	75.6	75.7	261.1	169.5	41.5	75.7
36	122.9	122.7	119.9	124.8	125.6	126.0	40.9	41.0	78.0	78.1	121.8	125.5	41.0	78.1
39	182.8	178.5	171.3	141.8	142.1	142.0	41.0	41.0	73.5	73.8	177.5	142.0	41.0	73.7
42	123.0	121.4	117.4	123.6	124.9	124.0	41.5	41.6	70.4	70.4	120.6	124.2	41.6	70.4
45	114.8	114.3	111.2	120.9	122.1	122.0	40.8	40.8	69.8	69.8	113.4	121.7	40.8	69.8
48	163.4	171.7	173.3	125.2	127.2	125.2	41.1	41.1	66.6	67.2	169.5	125.9	41.1	66.9
51	102.0	101.8	99.3	109.7	111.5	108.0	41.0	41.0	64.6	64.2	101.0	109.7	41.0	64.4
54	240.8	245.7	241.5	157.3	157.5	155.6	41.0	41.1	63.5	63.5	242.7	156.8	41.1	63.5
57	119.0	118.4	115.1	124.6	125.6	122.9	41.5	41.5	69.5	69.5	117.5	124.4	41.5	69.5
60	103.0	102.6	100.5	110.4	112.5	108.5	41.3	41.3	66.8	67.1	102.0	110.5	41.3	67.0
63	93.5	92.9	91.3	102.3	105.0	100.4	40.8	40.8	62.1	62.2	92.6	102.6	40.8	62.2
66	85.9	85.5	83.8	95.5	98.4	93.2	40.9	40.9	57.0	57.7	85.1	95.7	40.9	57.4
69	80.0	79.8	78.3	90.0	92.9	87.4	41.3	41.4	53.0	54.0	79.4	90.1	41.4	53.5
72	80.5	79.9	77.9	89.1	91.8	87.0	41.0	41.1	50.5	51.2	79.4	89.3	41.1	50.9
75	71.8	71.4	70.6	82.1	84.9	79.7	41.1	41.1	49.2	49.7	71.3	82.2	41.1	49.5
78	206.8	212.1	211.2	123.6	125.4	122.3	40.9	40.9	47.8	48.5	210.0	123.8	40.9	48.2
81	91.9	91.6	89.7	105.1	105.4	104.0	40.8	40.8	52.9	53.2	91.1	104.8	40.8	53.1

84	80.9	80.9	79.4	92.5	94.1	90.9	41.1	41.1	51.3	51.7	80.4	92.5	41.1	51.5
87	227.1	231.1	230.5	146.1	145.2	146.1	40.8	40.8	53.8	53.8	229.6	145.8	40.8	53.8
90	105.3	105.1	102.5	115.1	115.3	113.9	40.8	40.8	60.4	60.4	104.3	114.8	40.8	60.4
93	92.1	92.2	90.0	101.5	103.0	100.2	41.0	41.1	58.2	58.5	91.4	101.6	41.1	58.4
96	234.1	239.2	236.2	152.2	151.9	150.9	41.0	41.1	58.6	58.8	236.5	151.7	41.1	58.7
99	113.7	113.7	110.6	120.6	121.0	119.1	40.3	40.4	65.2	65.3	112.7	120.2	40.4	65.3
102	97.8	97.6	95.6	106.2	107.9	104.6	40.8	40.8	62.6	62.8	97.0	106.2	40.8	62.7
105	229.0	232.9	231.9	146.0	146.8	144.3	40.8	40.4	59.4	59.4	231.3	145.7	40.6	59.4
108	200.2	196.7	189.0	150.2	149.5	146.7	40.5	40.5	65.4	65.3	195.3	148.8	40.5	65.4
111	106.6	106.6	104.0	112.2	114.2	110.6	41.0	41.1	65.0	65.2	105.7	112.3	41.1	65.1
114	199.4	207.6	207.8	134.2	135.7	133.6	41.2	41.2	62.0	62.5	204.9	134.5	41.2	62.3
117	112.6	112.4	109.4	120.6	119.4	117.8	40.7	40.7	64.6	64.7	111.5	119.3	40.7	64.7
120	152.7	161.9	163.8	121.3	123.6	121.6	41.2	41.2	62.3	62.3	159.5	122.2	41.2	62.3
123	246.8	251.8	247.7	162.2	160.5	162.0	40.4	40.5	65.4	65.4	248.8	161.6	40.5	65.4
126	114.6	114.4	112.0	119.3	121.0	117.5	40.5	40.6	68.5	68.7	113.7	119.3	40.6	68.6
129	154.3	162.7	164.7	123.3	125.9	123.6	40.8	40.8	65.2	65.5	160.6	124.3	40.8	65.4
132	204.1	200.4	192.7	152.0	151.9	148.1	40.7	40.8	66.8	66.8	199.1	150.7	40.8	66.8
135	162.9	172.2	172.9	129.1	131.6	129.5	41.6	41.6	66.7	66.9	169.3	130.1	41.6	66.8
138	253.3	257.9	154.5	167.6	167.3	165.4	40.8	40.8	70.3	70.1	221.9	166.8	40.8	70.2
141	134.2	133.8	130.5	133.8	135.3	131.7	40.8	40.8	76.6	76.6	132.8	133.6	40.8	76.6
144	170.3	178.4	179.5	133.9	136.7	133.8	40.8	41.0	73.8	74.0	176.1	134.8	40.9	73.9
147	259.1	264.1	259.3	171.2	171.5	169.0	41.1	41.1	74.2	74.1	260.8	170.6	41.1	74.2
150	139.6	139.3	135.9	137.5	139.3	135.2	41.4	41.5	79.9	80.0	138.3	137.3	41.5	80.0
153	122.0	121.6	119.1	122.9	126.2	120.6	41.6	41.7	77.2	77.4	120.9	123.2	41.7	77.3
156	246.5	251.7	248.1	159.6	161.3	157.2	41.8	41.8	71.0	71.4	248.8	159.4	41.8	71.2
159	130.2	129.7	126.5	131.2	133.3	129.0	40.9	41.0	73.8	74.0	128.8	131.2	41.0	73.9
162	114.0	113.5	111.0	117.5	121.0	115.4	39.7	39.8	71.4	71.5	112.8	118.0	39.8	71.5
165	241.8	246.3	243.1	155.7	157.4	153.3	38.6	38.6	65.9	66.4	243.7	155.5	38.6	66.2
168	216.7	212.7	204.1	159.2	159.6	155.0	41.8	41.8	71.0	71.1	211.2	157.9	41.8	71.1
171	120.0	120.0	117.2	121.4	124.6	119.3	40.2	40.2	71.0	71.3	119.1	121.8	40.2	71.2
174	253.4	257.5	253.5	166.2	167.1	164.0	39.5	39.5	69.4	69.5	254.8	165.8	39.5	69.5
177	135.3	134.8	131.8	134.5	136.5	132.1	40.9	40.9	75.2	75.4	134.0	134.4	40.9	75.3
180	117.9	117.3	115.1	120.2	123.6	110.0	42.1	42.1	72.6	73.0	116.8	117.9	42.1	72.8

183	158.2	165.5	168.1	126.6	129.8	126.4	41.5	41.6	66.8	67.5	163.9	127.6	41.6	67.2
186	108.2	108.2	106.3	114.1	117.4	112.2	40.4	40.4	63.7	64.5	107.6	114.6	40.4	64.1
189	98.6	98.4	96.9	106.2	109.5	103.9	41.2	41.2	60.7	61.0	98.0	106.5	41.2	60.9
192	92.0	91.5	90.1	100.2	103.8	97.9	41.1	41.2	56.8	57.6	91.2	100.6	41.2	57.2
195	86.1	85.8	84.5	94.9	98.5	92.4	40.8	40.8	53.6	54.4	85.5	95.3	40.8	54.0
198	87.6	86.9	85.1	95.0	98.0	92.7	40.0	40.0	51.3	51.8	86.5	95.2	40.0	51.6
201	153.4	152.1	148.1	109.4	111.5	105.7	39.9	39.9	49.3	50.6	151.2	108.9	39.9	50.0
204	90.0	90.1	89.3	100.5	103.3	98.2	43.3	43.3	61.4	59.5	89.8	100.7	43.3	60.5
207	70.4	68.6	71.4	83.3	86.2	81.1	41.8	41.8	48.9	49.4	70.1	83.5	41.8	49.2
210	68.9	68.8	68.0	77.6	80.4	75.1	39.7	39.7	46.7	47.4	68.6	77.7	39.7	47.1
213	66.1	66.0	65.5	73.8	76.6	71.4	40.3	40.3	46.1	46.3	65.9	73.9	40.3	46.2
216	63.9	63.8	63.2	70.7	73.5	68.5	39.9	39.9	45.2	45.8	63.6	70.9	39.9	45.5
219	74.8	73.6	72.1	77.9	80.0	77.0	39.1	39.2	45.3	45.2	73.5	78.3	39.2	45.3
222	220.7	224.5	223.8	139.1	138.8	138.0	38.6	45.6	47.5	45.2	223.0	138.6	42.1	46.4
225	86.4	86.5	85.3	99.2	99.3	98.3	39.4	39.4	50.9	51.0	86.1	98.9	39.4	51.0
228	77.8	77.9	76.9	89.0	90.1	87.4	40.2	40.3	49.1	49.6	77.5	88.8	40.3	49.4
231	71.9	71.8	70.8	81.7	83.4	79.8	39.9	39.9	47.7	48.4	71.5	81.6	39.9	48.1
234	67.9	67.7	67.1	76.3	78.2	74.3	40.0	40.0	46.6	47.1	67.6	76.3	40.0	46.9
237	109.9	118.3	123.3	84.9	87.1	85.4	39.6	39.6	45.8	46.3	117.2	85.8	39.6	46.1
240	83.9	83.5	82.1	97.1	96.8	96.6	40.5	40.5	48.0	48.2	83.2	96.8	40.5	48.1
243	73.2	73.2	72.3	85.8	83.6	85.8	39.7	39.7	47.1	47.4	72.9	85.1	39.7	47.3
246	68.9	68.9	67.9	77.9	79.3	76.2	40.3	40.3	46.6	46.8	68.6	77.8	40.3	46.7
249	219.1	222.2	222.4	137.6	137.0	137.0	40.3	40.3	48.1	48.1	221.2	137.2	40.3	48.1
252	202.6	198.4	191.5	145.0	142.7	141.9	39.8	39.8	56.7	56.7	197.5	143.2	39.8	56.7
255	93.5	93.8	91.7	102.7	103.2	101.7	39.7	39.8	56.3	56.4	93.0	102.5	39.8	56.4
258	235.0	237.6	235.6	151.7	150.9	150.5	40.0	40.1	57.1	57.2	236.1	151.0	40.1	57.2
261	101.6	101.4	99.6	109.8	110.4	108.7	40.1	40.2	60.3	60.3	100.9	109.6	40.2	60.3
264	183.5	179.0	172.5	133.8	133.7	130.2	41.8	41.9	58.2	58.4	178.3	132.6	41.9	58.3
267	90.7	90.4	88.9	100.7	102.1	99.3	41.4	41.4	56.7	57.0	90.0	100.7	41.4	56.9
270	187.8	195.8	197.2	122.1	123.6	123.3	40.4	40.5	53.9	54.7	193.6	123.0	40.5	54.3
273	238.2	242.0	240.4	156.1	155.0	154.8	40.9	40.9	58.8	58.8	240.2	155.3	40.9	58.8
276	117.4	117.4	114.4	123.2	123.3	121.7	40.8	40.8	66.2	66.5	116.4	122.7	40.8	66.4
279	140.3	148.2	151.0	119.7	121.7	120.6	40.8	40.9	63.7	63.9	146.5	120.7	40.9	63.8

282	217.6	213.3	205.5	154.3	153.4	150.6	40.8	40.9	66.3	66.4	212.1	152.8	40.9	66.4
285	107.7	107.6	105.1	113.2	115.1	111.7	40.8	40.8	65.9	66.2	106.8	113.3	40.8	66.1
288	245.5	245.1	245.6	160.0	159.9	158.2	40.8	40.8	65.1	65.1	245.4	159.4	40.8	65.1
291	125.7	128.3	123.3	128.6	129.1	126.7	41.0	41.2	71.6	71.1	125.8	128.1	41.1	71.4
294	223.8	218.9	211.2	158.3	158.1	154.2	41.1	41.1	69.5	69.6	218.0	156.9	41.1	69.6
297	112.5	112.1	109.5	117.1	119.5	115.1	40.5	40.6	69.1	69.5	111.4	117.2	40.6	69.3
300	103.1	102.9	100.8	111.8	107.0	108.7	40.5	41.0	65.1	65.5	102.3	109.2	40.8	65.3
303	243.3	245.4	243.7	158.3	158.9	156.4	41.0	41.0	62.2	62.5	244.1	157.9	41.0	62.4
306	111.4	110.9	108.9	117.2	119.3	115.4	41.0	41.0	63.2	62.6	110.4	117.3	41.0	62.9
309	99.8	99.3	97.7	107.3	110.3	105.4	41.0	41.0	63.2	62.6	98.9	107.7	41.0	62.9
312	232.0	236.7	234.7	147.9	149.3	145.7	40.5	40.5	58.7	58.7	234.5	147.6	40.5	58.7
315	249.7	253.4	250.0	164.9	164.7	163.1	41.0	41.0	65.3	65.3	251.0	164.2	41.0	65.3
318	119.8	120.0	116.7	122.3	124.3	120.6	41.5	41.5	69.3	69.6	118.8	122.4	41.5	69.5
321	251.8	255.6	252.4	165.5	163.4	165.8	40.2	40.2	69.0	69.2	253.3	164.9	40.2	69.1
324	238.1	234.2	224.2	167.2	166.7	162.4	39.5	39.6	75.5	75.4	232.2	165.4	39.6	75.5
327	123.4	122.7	120.3	124.7	127.4	122.3	41.0	41.0	75.6	75.6	122.1	124.8	41.0	75.6
330	248.1	253.1	249.7	160.1	161.9	158.1	41.1	41.0	70.6	71.0	250.3	160.0	41.1	70.8
333	263.7	268.4	263.4	174.3	174.6	171.8	41.0	41.0	75.0	75.2	265.2	173.6	41.0	75.1
336	143.7	143.4	139.6	140.5	142.3	137.9	41.0	40.8	81.5	81.6	142.2	140.2	40.9	81.6
339	157.5	165.2	166.7	135.6	135.1	138.6	41.0	40.6	78.4	78.7	163.1	136.4	40.8	78.6
342	264.9	269.8	264.6	175.2	176.3	172.8	41.0	41.0	77.5	77.7	266.4	174.8	41.0	77.6
345	194.1	190.9	183.3	161.4	162.7	157.2	41.0	41.0	84.2	84.0	189.4	160.4	41.0	84.1
348	266.0	270.3	265.2	173.7	175.8	171.1	40.5	40.5	82.9	83.1	267.2	173.5	40.5	83.0
351	279.1	283.4	277.4	187.4	185.9	181.7	41.5	41.5	86.1	86.1	280.0	185.0	41.5	86.1
354	159.6	159.2	155.1	150.2	153.2	147.3	41.0	41.0	90.8	91.3	158.0	150.2	41.0	91.1
357	172.1	180.7	181.3	145.1	149.4	144.4	40.7	40.4	88.2	88.5	178.0	146.3	40.6	88.4
360	276.1	281.2	276.3	182.8	184.6	179.8	40.7	40.8	84.2	84.3	277.9	182.4	40.8	84.3
363	146.2	147.7	142.4	140.6	144.1	137.6	40.8	40.8	87.0	87.1	145.4	140.8	40.8	87.1
366	161.4	170.1	170.9	138.9	143.4	138.3	41.3	41.3	82.4	82.4	167.5	140.2	41.3	82.4
369	259.6	264.1	260.4	169.9	172.2	167.2	40.7	40.8	74.8	75.0	261.4	169.8	40.8	74.9
372	144.0	143.2	139.7	140.3	143.3	137.5	40.5	40.6	79.3	79.6	142.3	140.4	40.6	79.5
375	259.0	263.8	260.1	169.4	171.5	166.3	39.1	39.1	77.5	77.8	261.0	169.1	39.1	77.7
378	130.4	129.8	127.2	129.9	133.6	127.2	39.5	39.5	77.5	77.8	129.1	130.2	39.5	77.7

381	117.6	117.1	115.1	120.2	124.9	117.7	39.9	39.9	73.4	73.4	116.6	120.9	39.9	73.4
384	112.9	112.3	109.9	116.4	120.8	114.0	39.6	39.6	66.8	67.4	111.7	117.1	39.6	67.1
387	105.7	105.4	103.0	110.0	114.1	107.5	39.7	39.7	62.3	62.8	104.7	110.5	39.7	62.6
390	231.7	236.5	235.5	148.7	150.9	146.5	41.0	41.0	59.1	59.2	234.6	148.7	41.0	59.2
393	112.5	112.2	109.9	118.7	123.2	116.7	39.4	39.4	63.1	63.3	111.5	119.5	39.4	63.2
396	104.2	104.1	102.0	109.5	112.6	107.3	40.3	40.4	61.3	61.4	103.4	109.8	40.4	61.4
399	240.3	244.2	241.8	158.9	159.7	156.8	38.8	38.8	61.6	61.8	242.1	158.5	38.8	61.7
402	111.8	111.7	109.6	117.4	120.0	115.3	39.2	39.3	64.9	64.9	111.0	117.6	39.3	64.9
405	101.3	101.0	99.6	108.3	111.3	106.1	38.5	38.5	62.3	62.8	100.6	108.6	38.5	62.6
408	96.9	96.8	94.6	102.7	106.0	100.6	39.9	39.9	58.2	58.7	96.1	103.1	39.9	58.5
411	104.3	104.2	102.0	112.7	115.0	110.9	39.3	39.3	57.9	58.1	103.5	112.9	39.3	58.0
414	223.6	228.4	227.6	144.1	145.6	142.4	39.2	39.2	56.4	56.8	226.5	144.0	39.2	56.6
417	244.8	248.2	246.1	162.6	162.5	160.6	39.3	39.4	63.4	63.4	246.4	161.9	39.4	63.4
420	246.5	249.8	247.6	162.8	163.3	160.9	38.7	38.8	66.9	67.1	248.0	162.3	38.8	67.0

ตาราง แสดงความดันที่ขาเข้าและขาออกของอี โคโนไมเซอร์ขณะเดินเครื่อง

เวลา	ความดัน (mbar)		เวลา	ความดัน (mbar)		เวลา	ความดัน (mbar)	
(วินาที)	เข้า	ออก	(วินาที)	เข้า	ออก	(วินาที)	เข้า	ออก
2	23	8	44	15	4	86	7	-7
4	24	-4	46	18	9	88	24	2
6	18	9	48	24	6	90	19	5
8	28	-4	50	18	8	92	28	8
10	12	6	52	30	8	94	29	2
12	13	-2	54	36	-2	96	18	6
14	18	3	56	12	5	98	23	0
16	12	9	58	2	3	100	26	5
18	17	6	60	16	2	102	11	-5
20	20	3	62	17	1	104	25	8
22	16	5	64	28	2	106	28	-6
24	17	9	66	19	0	108	21	5
26	26	5	68	16	-2	110	7	12
28	18	3	70	10	-4	112	11	-2
30	16	-4	72	29	3	114	20	9
32	11	1	74	17	-8	116	15	8
34	18	3	76	15	-4	118	13	2
36	14	6	78	23	8	120	20	6
38	17	-4	80	9	5	122	27	-3
40	25	6	82	22	1	124	22	-2
42	11	5	84	18	-9	126	9	4

ตาราง แสดงความดันที่ขาเข้าและขาออกของอี โคโนไมเซอร์ขณะหยุดเดินเครื่อง

เวลา	ความดัน (mbar)		เวลา	ความดัน (mbar)		เวลา	ความดัน (mbar)	
(วินาที)	เข้า	ออก	(วินาที)	เข้า	ออก	(วินาที)	เข้า	ออก
2	12	4	44	16	4	86	11	8
4	13	7	46	14	6	88	12	5
6	13	2	48	15	3	90	12	6
8	9	6	50	12	5	92	13	3
10	11	4	52	17	7	94	10	4
12	12	6	54	11	6	96	9	6
14	15	7	56	11	4	98	9	6
16	18	6	58	14	7	100	14	4
18	10	5	60	13	8	102	9	5
20	13	5	62	10	6	104	11	6
22	16	7	64	11	4	106	10	7
24	8	4	66	11	5	108	9	4
26	10	5	68	9	9	110	7	5
28	9	6	70	13	5	112	11	8
30	12	4	72	11	9	114	10	4
32	10	7	74	14	5	116	9	5
34	11	8	76	11	4	118	10	2
36	10	7	78	13	6	120	11	5
38	12	6	80	11	7	122	12	6
40	14	5	82	12	5	124	9	7
42	14	3	84	10	4	126	11	3

ตาราง แสดงอุณหภูมิขาเข้าขณะเดินเครื่องที่สภาวะแปรเปลี่ยน

เวลา (วินาที)	อุณหภูมิ (c)					
0	75.0	92.0	113.0	143.0	166.0	176.0
15	130.0	139.0	155.0	185.0	209.0	216.0
30	181.0	190.0	198.0	236.0	255.0	263.0
45	202.0	212.0	228.0	256.0	276.0	284.0
60	208.0	218.0	235.0	262.0	281.0	289.0
75	212.0	221.0	238.0	264.0	282.0	290.0
90	214.0	223.0	239.0	265.0	284.0	292.0
105	216.0	225.0	242.0	267.0	285.0	294.0
120	217.0	226.0	243.0	269.0	285.0	295.0
135	219.0	229.0	243.0	270.0	287.0	295.0
150	220.0	230.0	246.0	272.0	288.0	297.0
165	222.0	231.0	247.0	271.0	289.0	298.0
180	223.0	233.0	248.0	273.0	290.0	299.0
195	224.0	234.0	249.0	274.0	290.0	298.0
210	226.0	236.0	251.0	275.0	291.0	299.0
225	228.0	236.0	251.0	275.0	294.0	300.0
240	229.0	237.0	253.0	277.0	293.0	299.0
255	229.0	240.0	254.0	277.0	293.0	301.0
270	232.0	241.0	256.0	277.0	296.0	302.0
285	233.0	241.0	256.0	279.0	295.0	301.0
300	234.0	243.0	257.0	279.0	296.0	304.0
315	235.0	243.0	257.0	281.0	298.0	305.0
330	236.0	246.0	258.0	281.0	299.0	305.0
345	238.0	247.0	259.0	282.0	300.0	304.0
360	238.0	246.0	261.0	283.0	298.0	306.0
375	239.0	246.0	263.0	284.0	299.0	306.0
390	241.0	248.0	263.0	285.0	300.0	306.0
405	241.0	250.0	264.0	286.0	300.0	307.0
420	243.0	251.0	263.0	286.0	300.0	309.0

ตาราง แสดงค่าอุณหภูมิเริ่มต้นกับความชัน
ที่อุณหภูมิขาเข้าขณะเดินเครื่องช่วงหนึ่งนาที

อุณหภูมิเริ่มต้น	75	92	113	143	166	176
ความชัน	2.2533	2.1663	2.1133	2.06	1.98	1.96

ตาราง แสดงค่าอุณหภูมิเริ่มต้นกับความชัน
ที่อุณหภูมิขาเข้าขณะเดินเครื่องช่วงหลังจากหนึ่งนาที

อุณหภูมิเริ่มต้น	208	218	235	262	281	289
ความชัน	0.0687	0.0744	0.0737	0.0614	0.0493	0.0449

ตาราง แสดงอุณหภูมิขาเข้าขณะหยุดเดินเครื่องที่สภาวะแปรเปลี่ยน

เวลา (วินาที)	อุณหภูมิ (c)					
0	252.0	261.0	274.0	300.0	311.0	327.0
15	183.0	193.0	203.0	222.0	242.0	273.0
30	150.0	158.0	168.0	178.0	199.0	227.0
45	135.0	138.0	149.0	166.0	184.0	204.0
60	126.0	131.0	141.0	161.0	178.0	196.0
75	122.0	127.0	138.0	158.0	175.0	192.0
90	120.0	125.0	135.0	156.0	172.0	188.0
105	119.0	123.0	133.0	153.0	170.0	186.0
120	118.0	122.0	131.0	151.0	168.0	183.0
135	117.0	121.0	129.0	149.0	166.0	181.0
150	117.0	120.0	127.0	147.0	163.0	179.0
165	115.0	119.0	126.0	146.0	162.0	178.0
180	115.0	117.0	125.0	144.0	160.0	176.0
195	114.0	116.0	123.0	142.0	158.0	174.0
210	112.0	115.0	122.0	141.0	157.0	172.0
225	111.0	114.0	121.0	140.0	155.0	170.0
240	110.0	113.0	120.0	138.0	154.0	169.0
255	109.0	112.0	119.0	137.0	152.0	167.0
270	108.0	111.0	118.0	136.0	151.0	165.0
285	107.0	110.0	117.0	135.0	150.0	163.0
300	106.0	109.0	116.0	133.0	149.0	162.0
315	105.0	108.0	115.0	132.0	148.0	161.0
330	104.0	107.0	114.0	131.0	146.0	159.0
345	103.0	106.0	113.0	130.0	145.0	158.0
360	102.0	105.0	112.0	129.0	144.0	157.0
375	101.0	104.0	111.0	128.0	143.0	156.0
390	100.0	103.0	110.0	127.0	141.0	155.0
405	100.0	103.0	110.0	126.0	140.0	153.0
420	99.0	102.0	109.0	125.0	139.0	152.0

ตาราง แสดงค่าอุณหภูมิเริ่มต้นกับความชัน
ที่อุณหภูมิขาเข้าขณะหยุดเดินเครื่องในช่วงหนึ่งนาที

อุณหภูมิเริ่มต้น	252	261	274	300	311	327
ความชัน	-2	-2.1	-2.1333	-2.2267	-2.16	-2.2067

ตาราง แสดงค่าอุณหภูมิเริ่มต้นกับความชัน
ที่อุณหภูมิขาเข้าขณะหยุดเดินเครื่องช่วงหลังจากหนึ่งนาที

อุณหภูมิเริ่มต้น	128	131	141	161	178	196
ความชัน	-0.0755	-0.0708	-0.0767	-0.0934	-0.0959	-0.094

ตาราง แสดงอุณหภูมิขาออกขณะเดินเครื่องที่สภาวะแปรเปลี่ยน

เวลา (วินาที)	อุณหภูมิ (c)					
0	77.0	87.0	105.0	127.0	143.0	152.0
15	99.0	108.0	121.0	143.0	156.0	162.0
30	115.0	125.0	136.0	157.0	167.0	175.0
45	123.0	132.0	143.0	163.0	174.0	180.0
60	127.0	137.0	148.0	167.0	177.0	183.0
75	131.0	139.0	150.0	170.0	179.0	185.0
90	133.0	142.0	153.0	171.0	181.0	187.0
105	136.0	144.0	155.0	172.0	182.0	188.0
120	137.0	145.0	156.0	174.0	182.0	188.0
135	140.0	147.0	158.0	175.0	183.0	189.0
150	141.0	148.0	159.0	176.0	184.0	190.0
165	142.0	149.0	160.0	176.0	185.0	190.0
180	144.0	150.0	161.0	177.0	186.0	191.0
195	145.0	151.0	162.0	178.0	185.0	191.0
210	146.0	153.0	162.0	179.0	186.0	191.0
225	147.0	153.0	163.0	179.0	187.0	192.0
240	149.0	154.0	164.0	180.0	187.0	191.0
255	149.0	155.0	164.0	180.0	187.0	192.0
270	151.0	156.0	165.0	180.0	188.0	193.0
285	151.0	156.0	166.0	181.0	188.0	193.0
300	152.0	157.0	167.0	181.0	189.0	194.0
315	153.0	158.0	167.0	181.0	189.0	194.0
330	153.0	159.0	168.0	182.0	190.0	194.0
345	154.0	159.0	169.0	182.0	190.0	195.0
360	155.0	159.0	169.0	183.0	190.0	195.0
375	155.0	160.0	170.0	183.0	191.0	195.0
390	156.0	161.0	170.0	184.0	191.0	195.0
405	157.0	162.0	171.0	184.0	191.0	196.0
420	158.0	162.0	171.0	184.0	191.0	196.0

ตาราง แสดงค่าอุณหภูมิเริ่มต้นกับความชัน
ที่อุณหภูมิขาออกขณะเดินเครื่องช่วงหนึ่งนาที

อุณหภูมิเริ่มต้น	77	87	105	127	143	152
ความชัน	0.8267	0.8267	O.72	0.6667	0.5733	0.5333

ตาราง แสดงค่าอุณหภูมิเริ่มต้นกับความชัน
ที่อุณหภูมิขาออกขณะเดินเครื่องช่วงหลังจากหนึ่งนาที

อุณหภูมิเริ่มต้น	127	137	148	167	177	183
ความชัน	0.049	0.0543	0.0537	0.0392	0.0306	0.0235

ตาราง แสดงอุณหภูมิขาออกขณะหยุดเดินเครื่องที่สภาวะแปรเปลี่ยน

เวลา (วินาที)	อุณหภูมิ (c)					
0	158.0	164.0	170.0	180.0	191.0	195.0
15	146.0	150.0	159.0	168.0	179.0	183.0
30	137.0	142.0	148.0	158.0	168.0	172.0
45	131.0	134.0	141.0	152.0	161.0	167.0
60	125.0	131.0	137.0	149.0	158.0	164.0
75	123.0	126.0	134.0	147.0	155.0	162.0
90	122.0	125.0	132.0	145.0	154.0	161.0
105	120.0	124.0	130.0	143.0	152.0	159.0
120	118.0	123.0	128.0	142.0	150.0	157.0
135	118.0	122.0	127.0	140.0	149.0	156.0
150	117.0	121.0	125.0	139.0	148.0	155.0
165	116.0	120.0	124.0	138.0	147.0	155.0
180	115.0	120.0	123.0	137.0	146.0	153.0
195	114.0	118.0	122.0	135.0	145.0	152.0
210	113.0	117.0	122.0	134.0	143.0	151.0
225	112.0	116.0	121.0	133.0	142.0	150.0
240	111.0	115.0	120.0	132.0	141.0	149.0
255	111.0	115.0	119.0	132.0	141.0	149.0
270	110.0	114.0	118.0	131.0	140.0	147.0
285	109.0	113.0	117.0	130.0	139.0	147.0
300	108.0	112.0	117.0	129.0	138.0	146.0
315	107.0	111.0	116.0	128.0	138.0	145.0
330	106.0	110.0	116.0	127.0	137.0	144.0
345	105.0	109.0	115.0	126.0	135.0	144.0
360	105.0	109.0	114.0	126.0	135.0	143.0
375	103.0	107.0	114.0	125.0	134.0	142.0
390	102.0	106.0	113.0	124.0	133.0	141.0
405	102.0	106.0	112.0	123.0	133.0	141.0
420	101.0	105.0	111.0	122.0	132.0	140.0

ตาราง แสดงค่าอุณหภูมิเริ่มต้นกับความชัน
ที่อุณหภูมิขาออกขณะหยุดเดินเครื่องช่วงหนึ่งนาที

อุณหภูมิเริ่มต้น	158	164	170	180	191	195
ความชัน	-0.54	-0.5467	-0.56	-0.52	-0.56	-0.52

ตาราง แสดงค่าอุณหภูมิเริ่มต้นกับความชัน
ที่อุณหภูมิขาออกขณะหยุดเดินเครื่องช่วงหลังจากหนึ่งนาที

อุณหภูมิเริ่มต้น	125	131	137	149	158	164
ความชัน	-0.0736	-0.0601	-0.0586	-0.0686	-0.0622	-0.0562

ประวัติผู้เขียน

ชื่อ	นายพลเดช ทองขุนดำ
วัน เดือน ปี สถานที่เกิด	27 มีนาคม 2514 จังหวัดพัทลุง
ประวัติการศึกษา	สำเร็จการศึกษาชั้นมัธยมศึกษาตอนต้น โรงเรียนพัทลุง จังหวัดพัทลุง ปีการศึกษา 2528 สำเร็จการศึกษาชั้นมัธยมศึกษาตอนปลาย โรงเรียนพัทลุง จังหวัดพัทลุง ปีการศึกษา 2531 สำเร็จการศึกษาปริญญาวิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมเครื่องกล มหาวิทยาลัยขอนแก่น ปีการศึกษา 2537
ประวัติการทำงาน	วิศวกรเครื่องกล การประปานครหลวง ปี พ.ศ. 2539 – ปัจจุบัน วิศวกรเครื่องกล บริษัท มีประสงค์อลูมิเนียม จำกัด ปี พ.ศ. 2538 – 2539