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FONTES TÉRMICAS EM CABINES DE VEÍCULOS AUTOMOTIVOS, SUA AVALIAÇÃO E EFEITO NO AMBIENTE INTERIOR

Volume 2

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APÊNDICE A

- Coeficientes experimentais da função I_t.

Polinômios dos coeficientes experimentais do modelo de radiação solar

Os coeficientes experimentais usadas nas equações tanto dos ângulos solares como no cálculo das radiações solares foram tomados de Posata [11]. São polinômios de senos e cossenos e função do dia do ano (dst). Como citado no capítulo 3, os parâmetros B e C são função também do hemisfério. Os polinômios são:

• Parâmetro A (para o cálculo de I_{dn})

$$A = 3{,}1514.[368{,}44 + 24{,}52.\cos(x) + 1{,}14.\cos(2x) - 1{,}09.\cos(3x) - 0{,}58.\text{sen}\,(x) - 0{,}18.\text{sen}\,(2x) + 0{,}28.\text{sen}(3x) \quad \text{(A-1)}$$

• Declinação (δ)

$$\delta = 0{,}302 - 22{,}93.\cos(x) - 0{,}229.\cos(2x) - 0{,}244.\cos(3x) + 3{,}851.\text{sen}(x) + 0{,}002.\text{sen}(2x) - 0{,}055.\text{sen}(3x) \quad \text{(A-2)}$$

• Equação do tempo (ET)

$$ET = -0{,}0002 + 0{,}4197.\cos(x) - 3{,}2265.\cos(2x) - 0{,}0903.\cos(3x) - 7{,}35.\text{sen}(x) - 9{,}3912.\text{sen}(2x) - 0{,}336.\text{sen}(3x) \quad \text{(A-3)}$$

• Parâmetro B (Para o cálculo de I_{dn}) (Não tem o termo em sen(2x))

$$B = 0{,}1717 - 0{,}0344.\cos(x) + 0{,}0032.\cos(2x) + 0{,}0024.\cos(3x) - 0{,}0043.\text{sen}(x) - 0{,}0008.\text{sen}(3x) \quad \text{(A-4)}$$

• Parâmetro C (Para o cálculo de I_d)

$$C = 0{,}0905 - 0{,}041.\cos(x) + 0{,}0073.\cos(2x) + 0{,}0015.\cos(3x) - 0{,}0034.\text{sen}(x) + 0{,}0004.\text{sen}(2x) - 0{,}0006.\text{sen}(3x) \quad \text{(A-5)}$$

onde:

$$x = (2.\pi.dst)/366 \quad \text{(A-6)}$$

sendo dst o dia do ano (de 1 a 366). Para os parâmetros B e C, caso se esteja no hemisfério sul (latitude) então:

$$x = \pi + [(2\pi.dst)/366] \quad \text{(A-7)}$$

APÊNDICE B

- Programa "Simulador de Carga Térmica"

```
{*************************************************************************}
{                          INICIO DO PROGRAMA GERAL                       }
{*************************************************************************}


program geral;
uses crt, printer,Dos;

type

vetor= array[1..10] of real;
matris= array[1..10] of array [1..10] of real;
vetoro= array[0..5] of real;

var
     sairp,saird,sairi: boolean;
     Aux,op5,Op       :char;
     cabine,motor: text;

     Tsiv, Csv, Tse,he, Qcp, Tsip, Tsev, hev, Tsevant, Qcv, compr,anglp,
     arp ,comprv, anglv, Arv, inclv, Alturav,
     F21,Area_comp_ef, Area_comp, Tse_comp,Tsi_comp,Qm,
     absv_direta, trans_direta,
     ct,per                                                  :vetor;


     a1, t1, a, t                                            :vetoro;

     tasf,hi,dire,dst,la,lo,tzn,cl,ro,largura,altura, te, absp, ev, kv, trans
     absv, emsp,emsv, ti,v, d,vz, w ,tlc,
     em_comp,Tmot, he_mot, Emot, Area_mot,tarex,
     tbue,tbui,Hex,Hin,Ure,Uri,Pb,emsvs,
     CTT,N, Qmv,Qto,Pot,Rendimento_motor_ventilacao     : real;

     nomel, nomec, nome, motorN, nomevidrofrontal,

     nomevidrolateral,saida,extensao                    : string[50];

     pessoas,m, numtotsup,Tipo_mot_vent,linhas          : integer;

     e,k,e_comp,k_comp                          : matris;

label

    label_saida;
```

```
{*************************************************************************}
{                    CONTINUACAO DO PROGRAMA GERAL                        }
{*************************************************************************}

BEGIN
{  TELAAP; }
  assign(output,'con');
  rewrite(output);
  sairp:= false;
  DEFOUT;
  while sairP = false do
  begin
    sairD:= false;
    while sairD = false do
    begin
      mostradados;
      menu_principal;
      aux:=readkey;
      case aux of
        'd','D' : begin
                    clrscr;
                    gotoxy(36,13);
                    writeln('Entre com o novo dia');
                    readln(d);
                  end;

        'm','M' : begin
                    clrscr;
                    gotoxy(36,13);
                    writeln('Entre com o novo mes');
                    readln(m);
                  end;
        'L','l' : LOCALIDADE;

        'k','K' : begin
                    clrscr;
                    writeln('Entre com a nova Hora Local com um ponto entre
hora
                                    e minuto,ex:HR.MIN');
                    readln(tlc);
                  end;
        'c','C' : begin
                    clrscr;
                    writeln('Entre com o indice de claridade: ');
                    readln(cl);
                  end;
        't','T' : begin
                    clrscr;
                    writeln('Entre com a temperatura externa');
                    readln(te);
                  end;
```

```
  'i','I' : begin
              clrscr;
              writeln('Entre com a Temp. int.');
              readln(ti);
            end;

  'b','B' : CABINE_PROC;

  'v','V' : begin
              clrscr;
              writeln('entre com a velocidade em Km/h');
              readln(v);
            end;
  'g','G' : begin
              clrscr;
              writeln('Entre com a direcao preferencial em graus -
                       0 p/ norte, sent. horario');
              readln(dire);
              end;
 'h','H'  : begin
              clrscr;
              writeln('Entre com o coef. de conveccao int.(w/m2c)');
              readln( hi );
              end;

 'p','P'  : begin
            clrscr;
            gotoxy(1,12);
            writeln('Entre com o novo numero de passageiros (excluindo  o
                     motorista)');
              readln(pessoas);
             end;

 'e','E'  : LUZES_MOTORES_OUTROS;

'q','Q'   : begin
            clrscr;
            gotoxy(1,12);
            writeln('Entre com a nova vazao massica de ar externo
                     (Kg/s) ');
              readln(Vz);
             end;

 'a','A'  : begin
              clrscr;
              writeln('Entre com a nova Temperatura do solo');
              readln(tasf);
            end;

 'f','F'  : begin
              clrscr;
              writeln('Entre com a nova refletividade do solo');
              readln(ro);
            end;
```

```
    'u','U'    : PSICRO;

      's','S' : goto label_saida ;

      'w','W' : MOTOR_DADOS;
      'x','X' : begin
                  clrscr;
                  writeln('Emissividade do solo : ', emsvs:2:2);
                  writeln('Entre com a nova emissividade');
                  readln(emsvs);
                end;

    'r','R'    : sairD:= true

     end;{ do case aux of}

  end; { do while sairD }
  clrscr;
  gotoxy(1,11);
  writeln('                                        CALCULANDO...');
  CALCULA;
  CALCULA_MOTOR;
  CALCULA_CARGAS_TOTAIS;
  RESULTADOS_GERAIS;
  sairI:= false;
  while sairI= false do
  begin
    {saida:= scr}

    while keypressed do
         op5:= readkey;
    op5:= readkey;

   case op5 of
      'i','I' : IMPRESSAO ;

      'D','d': RESULTADOS;
      'M','m': MOTOR_RESULTADO;
      'g','G': RESULTADOS_GERAIS;
      'R','r' : sairI:= true;
      's', 'S': begin
                  sairP:=true;
                  sairI:= true;
                end;
    end;{ do case op5 }
  end;{ do while sairi }
  end;{do while sairP}
  clrscr;
label_saida:   end.{do programa}
```

```
{*************************************************************************
{                    INICIO DO PROCEDURE DEFOUT                           }
{*************************************************************************}

procedure defout;

var
i,j: integer;

begin
  m:=1;
  d:=21;
  nomeL:= 'Manaus';
  la:= -3.1;
  lo:= 60 ;
  tzn:= 4;
  cl:=1 ;
  te:=32;
  ti:=25;
  hi:=1/0.12;
  nomeC:='HPN Pesado.cab';
  v:= 0;
  dire:= 0;
  tlc:= 12.00;
  pessoas:= 1;
  vz:=0;
  w:=0;
  motorN:= 'HPN Pesado.mot';
  tasf:= 40;
  ro:=0.2;
  tbue:=26;
  ure:=62;
  hex:=81;
  tbui:=19.5;
  uri:=60;
  hin:=55.2;
  pb:=101.325;
  emsvs:=0.8;
  emsv:= 0.95 ;

  n:=1;
  Qmv:=746;
  Pot:=1;
  Rendimento_motor_ventilacao:= 75;
  Tipo_mot_vent:=2;
  w:=240;
  Vz:=0.5;
  Qto:=0;

                                  assign(cabine, 'a:Hpn Pesado.cab');
                                  reset(cabine);
                                  for i:=1 to 5 do begin
                                        for j:=1 to 6 do begin
```

```
                                                readln(cabine, e[i,j],k[i,j])
                                                        end;
                                                end;
                                        for i:=1 to 5 do readln(cabine, arp[i],
                                                compr[i], anglp[i]);
                                        readln(cabine, largura,altura,absp,emsp);
                                        readln(cabine,ev,kv);
                                        for i:=1 to 4 do readln(cabine,arv[i],
                                              comprv[i],inclv[i],alturav[i]);
                                        close(cabine);

Assign(motor, 'a:Hpn pesado.mot');
       reset(motor);
       readln(motor, numtotsup );
       for i:=1 to numtotsup do
       begin
          for j:=1 to 4 do readln(motor, e_comp[i,j],k_comp[i,j] );
          readln(motor, F21[i],Area_comp_ef[i],Area_comp[i] );
       end;
       readln(motor, Em_comp, Tmot,he_mot, Emot, Area_mot);
       readln(motor,tarex);
       close(motor);


     nomevidrofrontal:=' Blindex  5mm  incolor';

    a1[0]:= -0.00042      ;    t1[0]:= -0.00464;
    a1[1]:=  1.39189      ;    t1[1]:=  2.53554;
    a1[2]:= -2.92537      ;    t1[2]:= -3.19423;
    a1[3]:=  3.05010      ;    t1[3]:=  0.55314;
    a1[4]:= -1.65711      ;    t1[4]:=  1.89080;
    a1[5]:=  0.36976      ;    t1[5]:= -1.07666;


     nomevidrolateral:=' Blindex  6mm cinza';

    a[0]:= -0.00311      ;    t[0]:= -0.00366;
    a[1]:=  2.70016      ;    t[1]:=  2.01316;
    a[2]:= -3.27922      ;    t[2]:= -6.52756;
    a[3]:= -0.17579      ;    t[3]:= 10.71373;
    a[4]:=  2.73208      ;    t[4]:= -8.40232;
    a[5]:= -1.35551      ;    t[5]:=  2.53943;


end;{ do procedure}
```

```
{*************************************************************************}
{                        PROCEDURE PULA_LINHAS                            }
{*************************************************************************}

Procedure Pula_linhas;

var
          i: integer;
begin

For i:=1 to linhas do
writeln;

end;{ do Procedure Pula_linhas }


{*************************************************************************
{                  INICIO DO PROCEDURE MOSTRADADOS
{*************************************************************************}


procedure mostradados;
begin
clrscr;

writeln('Mes: ',m:2);
writeln('dia: ',d:2:0);
writeln('Hora Local: ',tlc:2:2);
writeln('Localidade ');
writeln('nome: ',nomeL);
writeln('Latitude: ',la:2:1);
writeln('Longitude: ',lo:2:1);
writeln('Zona Horaria: ', tzn:2:0);
writeln('Indice de Claridade: ',cl:1:2);
writeln('Temperatura exterior: ', te:2:1);
writeln('Coef. de conv. interna: ',Hi:1:1);
writeln('Temperatura interior: ', ti:2:1);
writeln;
writeln('Cabine: ',nomec);
writeln('Motor: ',motorN);
writeln;
writeln('Velocidade:(Km/h)',v:3:0);
writeln('Dir. pref.(0 p/ norte- sentido horario): ',Dire:3:1);
writeln('Numero de ocupantes- excl. o motorista: ', pessoas:2);
writeln('Ar externo(Kg/s): ',vz:3:1);
writeln;
writeln('refletividade do solo : ',RO:1:2);
writeln('Temperatura do solo : ',Tasf:2:1);

end;{do procedure MOSTRADADOS}
```

```
{*************************************************************************}
{                          PROCEDURE MENU_PRINCIPAL                       }
{*************************************************************************}

Procedure Menu_Principal;

begin

gotoxy(48,3);
writeln('Para mudar tecle: ');
gotoxy(54,5);
writeln('m para mes');
gotoxy(54,6);
writeln('d para dia');
gotoxy(54,7);
writeln('k para hora local');
gotoxy(54,8);
writeln('L para localidade');
gotoxy(54,9);
writeln('c para indice de claridade');
gotoxy(54,10);
writeln('t para temperatura ext.');
gotoxy(54,11);
writeln('I para temperatura int.');
gotoxy(54,12);
writeln('b para cabine');
gotoxy(54,13);
writeln('w para motor');
gotoxy(54,14);
writeln('v para a velocidade');
gotoxy(54,15);
writeln('g para direcao.');
gotoxy(54,16);
writeln('h  para coef. de conv. int.');
gotoxy(54,17);
writeln('p para pessoas');
gotoxy(54,18);
writeln( 'e para equipamento');
gotoxy(54,19);
writeln('Q para ventilacao');
gotoxy(54,20);
writeln('f para a refletividade');
gotoxy(54,21);
writeln('a para a Temp. do Asfalto');
gotoxy(54,22);
writeln('u para Tbu/Ur (int/ext)');
gotoxy(54,23);
writeln('r para rodar');
gotoxy(54,24);
writeln('s para sair');
gotoxy(37,11);
end;{ do procedure MENU_PRINCIPAL }
```

```
{*************************************************************************
{                          INICIO DO PROCEDURE LEIA
{*************************************************************************}


 Procedure leia;

  var
    i,j   : integer;
  begin
                                    assign(cabine, 'a:'+nomeC);
                                    reset(cabine);
                                    for i:=1 to 5 do begin
                                            for j:=1 to 6 do begin
                                               readln(cabine, e[i,j],k[i,j])
                                                          end;
                                                end;
                                    for i:=1 to 5 do readln(cabine, arp[i],
                                                compr[i], anglp[i]);
                                    readln(cabine, largura,altura,absp,emsp);
                                    readln(cabine,ev,kv);
                                    for i:=1 to 4 do readln(cabine,arv[i],
                                           comprv[i],inclv[i],alturav[i]);
                                    close(cabine);
                                    end;{do procedure}

{*************************************************************************}
{                     PROCEDURE MOSTRA_MATERIAIS_PAREDES                  }
{*************************************************************************}

Procedure Mostra_Materiais_Paredes;

VAR
 j:integer;

 begin
 clrscr;
 writeln;
 writeln('                                              PAREDES');
 writeln('                                              -------');
 writeln('                 Lateral Direita (1)       Traseira (2)      Lateral
         Esquerda (3)');
 writeln;
 writeln('                 espes.  cond.term      espes.  cond.term      espes.
         cond.term');
 For j:=1 to 6 do
 writeln('isolante ',j,e[1,j]:10:3,k[1,j]:12:4, e[2,j]:11:3, k[2,j]:12:4,
          e[3,j]:11:3,k[3,j]:13:4);
 writeln;
 writeln('                     Teto (4)                          Assoalho (5) ');
 writeln;
 writeln('                 espes.   cond. term        espes.      cond. term');
```

```
For j:=1 to 6 do
writeln('isolante ',j,e[4,j]:10:3, k[4,j]:10:4, e[5,j]:17:3, k[5,j]:13:4);
writeln;
end;{ do procedure Mostra_Materiais_Paredes}


{*************************************************************************}
{                      PROCEDURE MOSTRA_GEOM_PAREDE                       }
{*************************************************************************}

Procedure Mostra_geom_Parede ;

type
          vetor= array[1..5] of string[30];


var
    i:integer;
    p:vetor;

begin
 p[1]:='Parede Lateral Direita   (1)';
 p[2]:='Parede Traseira          (2)';
 p[3]:='Parede Lateral Esquerda  (3)';
 p[4]:='Teto                     (4)';
 p[5]:='Assoalho                 (5)';


 clrscr;
 gotoxy(1,5);
 writeln('                          DADOS  GEOMETRICOS  DA  PAREDE');
 writeln('                          ------------------------------');
 writeln;
 writeln;
 writeln('                                        AREA(m2)          COMPRIMENTO(m)
         ANGULO ');
 writeln;
 for i:=1 to 5 do
 begin
   writeln(P[i],Arp[i]:12:2, compr[i]:19:3, anglp[i]:16:1);
   Writeln;
 end;
 writeln;
 end;{ do procedure Mostra_Geom_Parede }
```

```
{*************************************************************************}
{                    PROCEDURE MOSTRA_GEOM_VIDROS                         }
{*************************************************************************}

Procedure Mostra_Geom_Vidros;

Type

          Vetor= Array [1..5] of string[30];

var
         v:vetor;
         i:integer;

begin

 v[1]:='Vidro Dianteiro          (1)';
 v[2]:='Vidro Lateral Direito    (2)';
 v[3]:='Vidro Traseiro           (3)';
 v[4]:='Vidro Lateral Esquerdo   (4)';

 clrscr;
 gotoxy(1,5);
 writeln('                              DADOS GEOMETRICOS DOS VIDROS');
 writeln('                              ----------------------------');
 writeln;
 writeln;
 writeln('                                    Area(m2)  comprim.(m)  inclinacao
          altura(m)');
 For i:= 1 to 4 do
 begin
  writeln;
  writeln( v[i],Arv[i]:12:2,comprv[i]:12:3,inclv[i]:12:1,alturav[i]:12:3);
 end;
writeln;
writeln;
end;{do procedure Mostra_GEOM_Vidros }


{*************************************************************************}
{                          PROCEDURE MOSTRARQUIVOS                        }
{*************************************************************************}

Procedure Mostrarquivos;

var
     di: Searchrec;
     begin
       writeln;
       writeln;
       writeln('Estes sao os arquivos disponiveis : ');
       FindFirst('a:*.'+Extensao,Archive,di);
       while DosError =0 do
```

```
      Begin
        writeln(di.name);
        FindNext(di);
      end;
    end; {do procedure Mostrarquivos}


{*************************************************************************}
{                    INICIO DO PROCEDURE CABINE                           }
{*************************************************************************}


Procedure cabine_proc;

Var

    Aux1, Aux2, i,j:integer;
   nome: string[50];
   cabine ,novoarq:text;
   op,op1,op2:char;


Procedure grava;

var
    i,j:integer;
   nomcab:text;
    begin
writeln('Entre com o nome que deseja dar a este arquivo (nao coloque a extens
        .cab');
readln(nome);
assign(cabine, 'a:'+nome+'.cab');
rewrite(cabine);
for  i:=1 to 5 do begin
                for j:=1 to 6 do begin
                                writeln(cabine, e[i,j], k[i,j] );
                                end;
                end;
for i:=1 to 5 do writeln(cabine,arp[i], compr[i],' ',anglp[i]);
writeln(cabine,largura, altura, absp, emsp);
writeln(cabine,ev,kv);
for i:=1 to 4 do writeln(cabine, arv[i], comprv[i],' ', inclv[i], alturav[i])
close(cabine);
end;

procedure MOSTRAVIDROS;

begin
  clrscr;
  gotoxy(1,4);
  writeln('                Dados oticos dos vidros: ');
  writeln;
```

```
  writeln;
  writeln('                        Vidro Frontal: ',nomevidrofrontal);
  writeln('                        Vidros Laterais e Traseiro:
          ',nomevidrolateral);
  writeln('                        Emissividade: ',emsv:2:2);
  writeln;
  writeln;
  writeln('                Tecle:');
  writeln;
  writeln('                      [f] para mudar vidro frontal');
  writeln('                      [O] para outros vidros');
  writeln('                      [e] para emissividade');
  writeln('                      [s] para sair');
end;{ do procedure MOSTRAVIDROS }

BEGIN

aux1:= 0;
while aux1<>1 do begin
                  clrscr;
                  writeln;
                  writeln('Entre com L para ler um arquivo');
                  writeln('Entre com E para escrever um arquivo');
                  writeln('Entre com M para modificar um arquivo');
                  writeln('Entre com s para sair');
                  extensao:='cab';
                  mostrarquivos;
                  readln(op);
                  case op of

                    'L', 'l': Begin
                              Mostrarquivos;
                              Writeln('Qual o arquivo que deseja ler?
                             (coloque a extensao .cab)');
                              readln(nomeC);
                              LEIA;
                            end;          { do begin "l"}

                    'E' , 'e':begin
                              for i:=1 to 5 do begin
                                for j:=1 to 6 do begin
                                  writeln('Entre com a espessura e a
                                  condutividade do isolante',j,'da parede '
                                  i);
                                  readln(e[i,j],k[i,j]);
                                                end;
                                           end;

                              for i:= 1 to 5 do begin
                                 writeln('Entre com a area , o compr...
                                         o angulo(0 p/ teto,90 p/ ver...
                                 writeln('e 180 p/ chao) da parede ',i,;
                                 readln(Arp[i],compr[i], anglp[i]);
                                                end;
```

```
                writeln('Entre com a largura do veiculo e
                altura das paredes verticais ,');
                writeln('suas absortividades, e
                emissividades');
                readln(largura, altura, absv, emsp);
                writeln('Entre com a espessura e a
                condutividade dos vidros');
                readln(ev,kv);
                for i:=1 to 4 do begin
                    writeln('Entre com a area , o comprimento
                    (long.), e as inclinacoes(0p/ vertical
                    writeln('- sent. pos. para dentro da
                    cabine) e a altura do vidro ',i);
                    readln(arv[i],comprv[i],inclv[i],
                    Alturav[i]);
                              end;
                writeln('Deseja que estes dados sejam gravado
                em arquivo ? (s/n)');
                readln(op1);
                if( op1='s') or( op1='S') then GRAVA;
                end;{do begin do caso e}

        'M' , 'm':begin
                aux2:= 0 ;
                while aux2 <> 1 do begin
                   writeln('Entre com "p" para mudar os
                   materiais das paredes');
                   writeln('Entre com "g" para mudar a
                   geometria das paredes');
                   writeln('Entre com "d" para mudar dados
                   gerais(Largura do veiculo,');

                   writeln('altura das paredes, absortividade
                   emissividade');
                   writeln('Entre com "v" para mudar o ma
                   do vidro(espessura e condutividade)');
                   writeln('Entre com "o" para mudar a
                   geometria dos vidros(Areas');
                   writeln(',comprimentos e alturas');
                   writeln('Entre com "C" para mudar as carac
                   do vidros(Trans.,abs.,emiss.)');
                   writeln('Entre com " s "  para sair');
                   op2:= readkey;
                   case op2 of
                       'p' , 'P' :
                         begin
                           MOSTRA_MATERIAIS_PAREDES;
                           writeln('Deseja mudar algum d
                           valores acima ? (S/N)');
                           OP2:=readkey;
                           If( op2='s') or (op2='S') then
                           begin
                             writeln('Entre com a parede  e o
                             material a ser mudado');
```

```
        readln(i,j);
        writeln('Espessura do material
        ',j,' da parede ',i,'  :    '
        ,e[i,j]:4:1,'M');
        writeln('Condutividade do materi
       ',j,' da parede ',i,' :
       ',k[i,j]:2:3,' W/m.c');
        writeln('Entre com os novos
        valores nesta ordem');
        readln(e[i,j],k[i,j]);
     end;
   end;

'G' , 'g':
   begin
     MOSTRA_GEOM_PAREDE;
     writeln('Deseja mudar algum dos
     valores acima ? (S/N)');
     op2:=readkey;
     IF (op2='s') or (op2= 'S') then
     begin
       writeln('Entre com o num. da
       parede');
       readln(i);
       writeln('Area: ',Arp[i]:2:2,' m2
     ' Comprimento :',Compr[i]:2:2,' m'
     ' Angul.:',anglp[i]:2:1);
       writeln;
       writeln('Entre com as areas,
       comp., e angulo');
      readln(Arp[i], compr[i], angl
    end;
  end;

'd' , 'D':
  begin
    clrscr;
    gotoxy(1,8);
    writeln( 'Altura: ', Altura:1:2,'m
  ' Largura: ', largura:1:2,' m');
    writeln;
    writeln(' Absortividade da parede:
    absp:2:1);
    writeln(' emissividade da parede:
   ',Emsp:2:1);
    writeln;
    writeln(' Deseja mudar estes dados
   (s/n)');
    op2:=readkey;
    if (op2= 's') or (op2= 'S') then
    begin
      writeln('Entre com os dados na
      ordem descrita acima');
      readln(Altura,largura,absp,emsp);
```

```
                                        end;
                                      end;
                                    'v' , 'V':
                                      begin
                                        clrscr;
                                        gotoxy(1,8);
                                        writeln(' Esp. do vidro :',1000 *
                                        ev:2:1,' mm');
                                        writeln(' Condutividade do vidro: '
                                        kv:1:4,' W/m.C');
                                        writeln;
                                        writeln(' Deseja mudar os dados aci
                                        ? (S/N)');
                                        op2:= readkey;
                                        If (op2= 's') or (op2='S') th
                                        begin
                                          writeln('Entre com os dados
                                          acima');
                                          readln(ev,kv);
                                        end;
                                      end;
                                  'c' , 'C':
                                        begin
                                          aux1:=0;

                                          while aux1 <> 1 do
                                          begin
                                            MOSTRAVIDROS;
                                            readln(op);
                                             case op of

{******* CALC. DOS COEF. OTICOS DO VDR FRONTAL  ******}  'f','F':
   begin
   clrscr;
   gotoxy(1,6);
writeln('      Digite : ');
writeln;
writeln;
writeln('          [1]              para   vidro Blindex    5mm   incolor  ');
writeln('          [2]              para   vidro Blindex    6mm   cinza');
writeln('          [3]              para   vidro blindex    6mm   verde')

aux:= readkey;
case aux of

'1' :
  begin
    nomevidrofrontal:=' Blindex  5mm  incolor';

    a1[0]:= -0.00042      ;    t1[0]:= -0.00464;
    a1[1]:=  1.39189      ;    t1[1]:=  2.53554;
    a1[2]:= -2.92537      ;    t1[2]:= -3.19423;
    a1[3]:=  3.05010      ;    t1[3]:=  0.55314;
    a1[4]:= -1.65711      ;    t1[4]:=  1.89080;
```

```
    a1[5]:=  0.36976       ;     t1[5]:= -1.07666;
 end;

'2':
  begin
    nomevidrofrontal:=' Blindex  6mm cinza';

    a1[0]:= -0.00311       ;     t1[0]:= -0.00366;
    a1[1]:=  2.70016       ;     t1[1]:=  2.01316;
    a1[2]:= -3.27922       ;     t1[2]:= -6.52756;
    a1[3]:= -0.17579       ;     t1[3]:= 10.71373;
    a1[4]:=  2.73208       ;     t1[4]:= -8.40232;
    a1[5]:= -1.35551       ;     t1[5]:=  2.53943;
  end;

'3':
  begin
    nomevidrofrontal:= ' Blindex 6mm verde';

    a1[0]:= -0.00288       ;     t1[0]:= -0.00378;
    a1[1]:=  2.60007       ;     t1[1]:=  2.05101;
    a1[2]:= -3.39185       ;     t1[2]:= -6.10909;
    a1[3]:=  0.39856       ;     t1[3]:=  9.53800;
    a1[4]:=  2.09172       ;     t1[4]:= -7.22829;
    a1[5]:= -1.12097       ;     t1[5]:=  2.12743;
  end;

'4':
  begin
    clrscr;
    writeln('Absortividade atual:', Absv_direta[1]:2:2);
    writeln('Transmissividade atual:',Absv_direta[1]:2:2);
    writeln('Entre com os dois valores em sequencia');
    readln(a1[0], t1[0]);

    a1[1]:= 0              ;     t1[1]:=0  ;
    a1[2]:= 0              ;     t1[2]:=0  ;
    a1[3]:= 0              ;     t1[3]:=0  ;
    a1[4]:= 0              ;     t1[4]:=0  ;
    a1[5]:= 0              ;     t1[5]:=0  ;

    nomevidrofrontal:= 'Vidro com abst. e trasm. constantes';

  end;
end;{ do case aux of (1,2,3,4) }
end;{do begin do caso 'f' }

{ *** CALC. DAS COEF. OTICOS DOS VDRS LATERAIS ***}  'o', 'O' :
   begin
   clrscr;
   gotoxy(1,6);
writeln('      Digite : ');
writeln;
writeln;
```

```
writeln('          [1]              para   vidro Blindex    5mm   incolor  ');
writeln('          [2]              para   vidro Blindex    6mm   cinza');
writeln('          [3]              para   vidro blindex    6mm   verde');

aux:= readkey;
case aux of

'1' :
  begin
    nomevidrolateral:=' Blindex  5mm  incolor';

    a[0]:= -0.00042      ;    t[0]:= -0.00464;
    a[1]:=  1.39189      ;    t[1]:=  2.53554;
    a[2]:= -2.92537      ;    t[2]:= -3.19423;
    a[3]:=  3.05010      ;    t[3]:=  0.55314;
    a[4]:= -1.65711      ;    t[4]:=  1.89080;
    a[5]:=  0.36976      ;    t[5]:= -1.07666;
 end;

'2':
  begin
    nomevidrolateral:=' Blindex  6mm cinza';

    a[0]:= -0.00311      ;    t[0]:= -0.00366;
    a[1]:=  2.70016      ;    t[1]:=  2.01316;
    a[2]:= -3.27922      ;    t[2]:= -6.52756;
    a[3]:= -0.17579      ;    t[3]:= 10.71373;
    a[4]:=  2.73208      ;    t[4]:= -8.40232;
    a[5]:= -1.35551      ;    t[5]:=  2.53943;
  end;

'3':
  begin
    nomevidrolateral:= ' Blindex 6mm verde';

    a[0]:= -0.00288      ;    t[0]:= -0.00378;
    a[1]:=  2.60007      ;    t[1]:=  2.05101;
    a[2]:= -3.39185      ;    t[2]:= -6.10909;
    a[3]:=  0.39856      ;    t[3]:=  9.53800;
    a[4]:=  2.09172      ;    t[4]:= -7.22829;
    a[5]:= -1.12097      ;    t[5]:=  2.12743;
  end;

'4':
  begin
    clrscr;
    writeln('Absortividade atual:', Absv_direta[1]:2:2);
    writeln('Transmissividade atual:',Absv_direta[1]:2:2);
    writeln('Entre com os dois valores em sequencia');
    readln(a[0], t[0]);

    a[1]:= 0             ;    t[1]:=0 ;
    a[2]:= 0             ;    t[2]:=0 ;
    a[3]:= 0             ;    t[3]:=0 ;
```

```
    a[4]:= 0            ;     t[4]:=0 ;
    a[5]:= 0            ;     t[5]:=0 ;

    nomevidrolateral:=' Vidro com abst. e trans. constantes';

  end;
end;{ do case aux of (1,2,3,4) }
end;{ do begin do caso 'o' }
                                        'e','E':
                                        begin
                                          clrscr;
                                          gotoxy(1,11);
                                          writeln('Entre com a emissivida
                                          do vidro');
                                          readln(emsv);
                                        end;

                                        's','S': aux1:= 1;

                                           end;{ do case(f,o,e,s)}
                                      end;    { do while aux1 }
                                    end;      { do begin do caso c }


                                'o', 'O' :
                                   begin
                                     MOSTRA_GEOM_VIDROS;
                                     writeln('Deseja mudar algum dos
                                     valores acima ? (S/N)');
                                     OP2:=READKEY;
                                     If (op2='s') or (op2='S') then
                                     begin
                                       writeln('Entre com o numero
                                       do vidro');
                                       readln(i);
                                       writeln('Area:                  '
                                       Arv[i]:2:2,' m2');
                                       writeln('Comprimento:           '
                                       comprv[i]:2:2,' m');
                                       writeln('inclinacao:
                                       ',inclv[i]:2:1);
                                       writeln('Altura:
                                       ',Alturav[i]:1:3,' m');
                                       writeln('Entre com os dados a...
                                       na sequencia.');
                                       readln(arv[i],comprv[i], inclv[i]
                                       alturav[i]);
                                     end;
                                   end;
                                's' , 'S': Aux2:=1;
                              end;{do case op2}
                            end;{do while aux2}
                            writeln('Deseja que estes dados sejam gravadc
```

```
                                em arquivo ? (s/n)');
                                readln(op1);
                                if(op1= 's' ) or (op1='S') then GRAVA ;


                              end;{do "m" }

                    's','S': aux1:=1


                  end;{do case op }

                end;  {do wwhile aux1}
end;                   {do begin do proc cabine (com ponto e virgula) }


{*************************************************************************
{                  INICIO DO PROCEDURE LOCALIDADE                        }
{*************************************************************************}


procedure localidade;

begin
clrscr;
writeln('Para mudar tecle:');
writeln;
writeln;
writeln;
writeln('s para Sao Paulo');
writeln('r para Ribeirao Preto');
writeln('e para Equador');
writeln('p para Polo Sul ');
writeln('a para Riad (Arabia Saudita)');
writeln('l para definir Localidade');
writeln('n para nenhuma mudanca');
readln( op );
case op of
  's' ,'S': begin
              nomeL:= 'Sao Paulo';
              la:= -23;
              lo:= 46.5;
              tzn:= 3;
            end;
{  'r','R': begin
             nomeL:=
             la
             lo
             tzn:= }
  'l','L': begin
            writeln('Entre com o nome da localidade');
            readln(nomel);
            writeln('Entre com a latitude');
            readln(la);
```

```
            writeln('Entre com a longitude');
            readln(lo);
            writeln('Entre com a Zona Horaria');
            readln(tzn);
           end;

end;{do case}
end; {do begin}

{*************************************************************************}
{                        INICIO DO PROCEDURE CALCDIA                      }
{*************************************************************************}



procedure calcdia;
type
vetor= Array[1..12] of integer;

var
  i,MezT: integer;
  Mez : vetor;
begin
  MezT:=0 ;
  mez[1]:=31 ;
  mez[2]:=28;
  mez[3]:=31;
  mez[4]:=30;
  mez[5]:=31;
  mez[6]:=30;
  mez[7]:=31;
  mez[8]:=31;
  mez[9]:=30;
  mez[10]:=31;
  mez[11]:=30;
  mez[12]:=31;
  case m of
    1: dst:=d;
    2: dst:= d + mez[1];
  else
    begin
      for i:=1 to (m - 1) do  mezT:= mez[i] + mezT;
      dst:= d + mezT;
    end;
  end;{ do case m}
end;{do procedure}
```

```
{*************************************************************************}
{                    INICIO DO PROCEDURE CALCULA                          }
{*************************************************************************}


Procedure calcula;


type
    Vetor= Array[1..10] of real;
var
      Qp, Ite, Re, Tseant, Qv, Rev, Tsevant
     ,Rce, Rc,Rt,Rr,Rcev,Rrv, Fsg,
     Idireti, Idifusi, It_absv, It_trans,
      absv_difusa,trans_difusa    : vetor;

     Sig,Vsi,l, tf, gr, c, m,  Rtv, grc, pt, prec, Pr, ni,G, kar,
     Rci,Rcv,
     cozt,Idireta,Idifusa                                    : real;

    j,i                                                      : integer;

{*********************      FUNCTION     EL     **************************

function el(x,y:real):real;
begin
if (x = 0) then el:= 0

           else begin
                  if x <0 then x:= -1* x ;
                  el:= exp(y * ln(x) );
                end;
end;


{***********************     FUNCTION     IT     ***************************}

function It(s,q:real):real;

var
   x,b1,d,et,a,c,me,hlp,tcll, cozhlp,lat,lon,
   tclp,trc, dif, hsa,h,senb,B , cozh, Divtan , senf, Y, Id,
   Idn, Fss, Ids, Fsg, Idg, f, hora: real;
   I: integer;
Type Vetor = Array[ 1..3] of real;
Var co, si : vetor;
label  label_k,l,label_m,n;

begin;
    hora:= tlc;

    X:= (2*pi*dst)/ 366                                      ;
```

```
    For I := 1 to 3 do
                    begin
                    Co [I] := cos(I*x);
                    si [I] := sin(I*x);
                    end;
 D:= 0.302 - 22.93 * CO[1] - 0.229 * Co[2]
  - 0.243 * Co[3] + 3.851 * Si [1] + 0.002* Si [2] - 0.055 * si[3];

 ET:= -0.0002 + 0.4197*co[1] - 3.2265 * co[2]
  - 0.0903 * co[3] - 7.35* si[1] - 9.3912 * si[2] -0.336*si[3];

 A:= 368.44 + 24.52 * Co[1] - 1.14 * Co[2] - 1.09 * Co [3]
  - 0.58 * si[1] - 0.18 *si [2] + 0.28 * si[3];

 If lat <0 then
              begin
              X:= X + Pi;
              for I:= 1 to 3 do
                             begin
                             Co [I] := cos(I*x);
                             si [I] := sin (I*x);
                             end;
              end;
  B1:= 0.1717 - 0.0344*co[1] + 0.0032* Co[2] + 0.0024 * co[3]
  - 0.0043 *si [1] - 0.0008* si[3];

  C:= 0.0905 - 0.041 * co [1] + 0.0073*co[2] +0.0015 * co[3]
  - 0.0034*si[1] + 0.0004*si[2] - 0.0006 *si[3];

  me:= 0.2618*TZN   ;
  lat:= (la*pi) / 180 ;
  lon := (lo *pi ) / 180 ;
  d:= (d*pi)/180;
  cozhlp:= - (sin(lat) / cos (lat) )* ( sin(d)/ cos(d));
  If cozhlp = 0 then begin
                    hlp:= pi/2;
                    goto label_k;
                    end;
  If Abs(cozhlp) > 1 then begin
                          If cozhlp > 0 then begin
                                             IDN:=0;
                                             goto l;
                                             end
                                        else  begin
                                             hlp:= 1E9;
                                             goto label_m;
                                             end;
                                          end;

Hlp :=Arctan((sqrt(1-sqr(cozhlp)))/ cozhlp);

label_k: if Hlp <0 then Hlp:= - hlp;
```

```
Label_m:

      trc:= Trunc(hora);
      dif:= hora - trc;
      dif:= dif/0.6;
      hora:= trc + dif;
      Hsa:= hora + (et/60) - (lon - me)/0.2618;

  H:= 0.2618*(hsa-12);
  If Abs(H) > Abs (Hlp) then begin
                             Idn:=0;
                             goto 1 ;
                             end;

  senb:=cos(lat) * cos(d) * cos(h) + sin(lat) * sin(d);
     B:= Arctan (senb/sqrt(1- sqr (senb)));
     Cozh := cos(h);
     if lat = 0 then begin
                     divtan:=2;
                     goto n;
                     end;


     divtan:= (sin (d) * cos (lat)) / (cos(d) *sin(lat));
 n:  senf:= cos(d) * sin(h)/ cos(b);
     f:= Arctan (senf/sqrt(1-sqr(senf)));
    If( cozh) >=( divtan) then  f:= pi - f;
    If lat >0 then f:= pi - f;
    S:= S* pi /180 ;
     Q:= (-q + 180) * pi /180 ;
     Y:= F+q ;
     cozT := cos(b) * cos(Y) * sin(s) + sin(b) * cos (S) ;
     Idn:= (A* exp(-b1/sin(b))) *Cl * 3.154 ;
 1:If cozT < 0  then  Id:= 0
                 else  Id:= Idn * cozT;
                  Fss:= (1 + cos(s))/2 ;
     Ids:= C* Idn * FSS;
                 Fsg := ( 1 - cos(s))/2  ;
     Idg:= ( c* Idn + IDn *sin(b) )* ro * fsg ;
     Idireta:= Id;
     Idifusa:= Idg + Ids;
     It:= Idg +Ids +Id ;
     end;{do fuction it}


{************************** PROCEDURE ABSV_TRANS **************************}

Procedure ABSV_TRANS ;

var

 j  :  integer;
```

```
begin

  Trans_direta[i]:= 0;
  trans_difusa[i]:= 0;
  absv_direta[i]:= 0;
  absv_difusa[i]:=0;


  If i = 1 then
  begin

    For j := 0 to 5 do
    begin
      Trans_direta[i] := Trans_direta[i] + t1[j] * el(cozt, j);
      absv_direta[i]:= absv_direta[i] + a1[j] * el(cozT, j);
      Trans_difusa[i]:= Trans_difusa[i] + ( t1[j]/ (j+2) ) ;
      absv_difusa[i]:= absv_difusa[i] + (a1[j]/(j+2) )  ;
    end;

    Trans_difusa[i]:= trans_difusa[i] * 2 ;
    absv_difusa[i]:= absv_difusa[i] * 2 ;

  end
          else
  begin

    For j := 0 to 5 do
    begin
      Trans_direta[i] := Trans_direta[i] + t[j] * el(cozt, j);
      absv_direta[i]:= absv_direta[i] + a[j] * el(cozT, j);
      Trans_difusa[i]:= Trans_difusa[i] + ( t[j]/ (j+2) ) ;
      absv_difusa[i]:= absv_difusa[i] + (a[j]/(j+2) )  ;
    end;

    Trans_difusa[i]:= trans_difusa[i] * 2 ;
    absv_difusa[i]:= absv_difusa[i] * 2 ;

  end;

end; { do procedure ABSV_TRANS  }


{ * * * * * * * *  *  *   *  INICI0 DO PROCEDURE CALCULA   *  *  * * * * * }


begin
sig:= 5.669E-8;
kar:= 0.02624     ;
ni:= 16.84E-6  ;
g:= 9.8        ;
Pr:= 0.708   ;
vsi:= v/3.6 ;
prec:= 0.1;
CALCDIA;
```

```
For I:= 1 to 5 do begin
  Tse[i]:= 300;
  Tseant[i]:= 0  ;
  rc[i]:= 0  ;
  for j:= 1 to 6 do begin
                  Rc[i]:= Rc[i] + e[i,j]/ k[i,j];
                  end;
  Rci:= 1/hi;
  Rt[i]:= Rci + Rc[i];

  If i<= 3 then Qp[i]:= dire + i*90
           else Qp[i]:= dire;
  If Qp[i]>= 360 then Qp[i]:= Qp[i] - 360 ;
  Ite[i]:= It( anglp[i], Qp[i]) ;
  Fsg[i]:= (1-cos(anglp[i]* pi/ 180  ) )/2;

{*********  If Ite[i]= 0 then Ite[i]:= 153.19 *(emsp/absp)*(1- Fsg[i]);***

  Re[i]:= vsi* compr[i]/ ni;


     If re[i] > 0 then begin

         If Re[i] > 500000 then he[i]:= el (pr, 1/3)*(0.037* el (re[i],0.8)
                                    - 850)* kar/compr[i];

         If Re[i]<= 500000 then he[i]:= 0.664* el(Pr,1/3)* sqrt(Re[i])* kar/
                                    compr[i];
                       end;

  While Abs(Tseant[i] - Tse[i]) > prec do begin

     If Re[i]= 0 then  begin

         If i>3 then L:= (compr[i] + Largura)/2
                else L:= Altura;
         Tf:= (Tse[i] + Te + 273)/2 ;
         Gr:= (G/Tf) *abs( TSE[i]- (te+273) ) * el(L,3)/ el(ni,2);
         If i<3 then
                     If (Pr* gr)< 1E9 then   begin
                                                C:= 0.59;
                                                m:= 0.25;
                                              end
                                     else   begin
                                                C:= 0.021;
                                                m:= 0.40;
                                              end
                 else
                    If I= 4 then
                              If( Gr* Pr)< 8E6 then   begin
                                                        C:= 0.54;
                                                        m:= 0.25;
                                                      end
```

```
                                                    else  begin
                                                             C:= 0.15;
                                                             m:= 1/3;
                                                          end;
                        If I= 5 then begin
                                       C:= 0.58;
                                       m:= 0.20;
                                     end;
            he[i]:= C* el(gr*Pr,m)* kar/L  ;
        end;{ end do begin do if re=0...  }
        Rce[i]:= 1/he[i];
        tse[i]:= (Tse[i] + Tseant[i])/2;
        tseant [i]:= Tse[i];

        if i=5 then
        begin
           Rr[5]:= 1/( Emsp*sig * (sqr(tse[i]) + sqr(Tasf+273)) * (tse[i]+tas.
                       273) );

           Tse[5]:= ( (te+273)*Rt[i]*Rr[i] +(ti+273)*Rce[i]*Rr[i]+(tasf+273)*
                                                          Rce[i]*Rt[i]  ) /
                     ( Rt[i]*Rr[i]+ Rce[i]*Rr[i] + Rce[i]*Rt[i] );
        end

              else
        begin
           Rr[i]:= 1/( sig * Emsp * el(Tse[i],3)) ;

           Tse[i]:= ( (te+273)*Rt[i]*Rr[i] +(ti+273)*Rce[i]*Rr[i]+
                    absp* Ite[i]*Rce[i]*Rt[i]*Rr[i]
         + (1- Fsg[i]) *  emsp * 0.82 * sig * el(te+273,4)*Rce[i]*Rt[i]*Rr[i]
       + Fsg[i] * emsp * emsvs * sig * el (tasf + 273,4)*Rce[i]*Rt[i]*Rr[i] ) /
                  ( Rt[i]*Rr[i]+ Rce[i]*Rr[i] + Rce[i]*Rt[i] );
        end;
    end;{ do while abs... }
    Tse[i]:= tse[i] - 273;

    Qcp_por_m2[i]:=(Tse[i]- Ti)/(Rc[i] + 1/hi) ;

    Tsip[i]:= -Qcp_por_m2[i] * Rc[i] + tse[i];

    Qcp[i]:= Qcp_por_m2[i] * Arp[i];
end;                                          {end do For i=1 to 5 do begin ... }
```

```
{ ***************************************************************************
            CALCULO DE CT SOLAR E POR CONDUCAO PELOS VIDROS
***************************************************************************
For i:= 1 to 4 do begin
       Tsev[i]:= 300;
       tsevant[i]:= 0 ;
       Rcv:= ev/kv;
       Rtv:= Rcv + Rci;
       anglv[i]:= inclv[i]+90 ;
       Fsg[i]:= (1- cos(anglv[i]*Pi/180))/2;
       Qv[i]:= dire + (i-1)* 90;
       If Qv[i]>= 360 then Qv[i]:= Qv[i] -360;
       Ite[i]:= It(anglv[i], Qv[i]);

       ABSV_TRANS;

       Idireti[i]:= Idireta;
       Idifusi[i]:= Idifusa;

       It_absv[i]:=   absv_direta[i] * Idireti[i] +
                      Absv_difusa[i] * Idifusi[i];

       It_trans[i]:= Trans_direta[i] * Idireti[i] +
                     Trans_difusa[i] * Idifusi[i];

       Csv[i]:= Arv[i]* It_trans[i];

       Rev[i]:= vsi* comprv[i]/ni;

       If Rev[i] > 0 then

           If Rev[i] <= 500000 then If i=1 then hev[i]:= (kar/comprv[i]) *
((0.83 -
                                                  0.00289* Anglv[1])* el(pr,0.4)
                                                  sqrt(rev[1])) *2

                                        else hev[i]:= (kar/comprv[i])* 0.664*
                                                      el(pr,1/3) * sqrt(rev[i])


                                else  hev[i]:= (kar/comprv[i])* el(Pr,1/3)*(0.037
                                                *el(Rev[i],0.8) - 850);
  While Abs( tsevant[i] - tsev[i]) > prec do begin
           If Rev[i]= 0 then
              If inclv[i] <> 0 then begin

                                 Tf:= (Tsev[i] +Te+ 273)/2  ;
                                 Gr:= ((G/tf)*abs(Tsev[i] - (Te+273))*
                                       el(alturaV[i],3))/
                                        sqr(ni);

                                 If( inclv[i] <= 22) then grc:= 5E9;
                                 If( inclv[i] >= 22) and( inclv[i] <45 )then grc:=
```

```
                                        2E9;
                        if( inclv[i] >= 45) and( inclv[i] <52) then grc:=
                                        1E8;
                        if inclv[i] >= 52                then grc:= 1E6;

                        If Gr< grc then  Pt:=0

                                  else Pt:= 0.14*(el(gr*pr,1/3)-
                                                  el(grc*Pr,1/3));
                        hev[i]:= (kar/alturav[i])*( Pt+0.59* el(gr*pr*
                                 cos(inclv[i]),1/4));
                        end

                   else begin
                        Tf:= (Tsev[i] +TE+ 273)/2 ;
                        gr:= ((g/ tf) *abs(tsev[i]- (Te+
                              273))*el(alturav[i],3))
                              / sqr(ni);
                        If( pr* Gr) < 1E9 then begin
                                               c:= 0.59;
                                               m:= 0.25;
                                               end
                                          else
                                               begin
                                               c:= 0.021;
                                               m:= 0.40;
                                               end;
                        hev[i]:= c* el(gr*pr,m) *kar/ alturav[i] ;

                        end;
          Rcev[i]:= 1/hev[i];
          Tsev[i]:= (Tsev[i] + Tsevant[i])/2;
          Tsevant[i]:= Tsev[i];
          Rrv[i]:= 1 / (sig* emsv* el(tsev[i],3));

          Tsev[i]:= ( (te+273)*Rtv*Rrv[i] +(ti+273)*Rcev[i]*Rrv[i]+
                      It_absv[i]*Rcev[i]*Rtv*Rrv[i]
        +(1- Fsg[i] ) * emsv * sig* el(te+273,4)*0.82 *Rcev[i]* Rtv* Rrv[i]
     +emsv * Fsg[i] * emsvs * sig * el(Tasf+273,4)* Rcev[i]* Rtv* Rrv[i]) /
                ( Rtv*Rrv[i]+ Rcev[i]*Rrv[i] + Rcev[i]*Rtv );
             end;{ do while abs...}
 tsev[i]:= tsev[i] - 273;
 Qcv_por_m2[i]:= (Tsev[i] -ti)/(Rcv + 1/hi) ;

 tsiv[i]:= -Qcv_por_m2[i]*Rcv + Tsev[i];

 Qcv[i]:= Qcv_por_m2[i] * Arv[i];

end;
end; {end do procedure calcula}
```

```
{*************************************************************************
{                        PROCEDURE CALCULA_CARGAS_TOTAIS
{*************************************************************************
procedure Calcula_Cargas_Totais;
  var
       i: integer;

begin

  ct[1]:=0;  ct[2]:=0; ct[3]:=0 ; ct[4]:=0;

  For i:= 1 to 5 do
        ct[1]:= ct[1] + Qcp[i] ; { calc. Cqcp }

  For i:= 1 to 4 do
       ct[2]:= ct[2] + Qcv[i];

  For i:= 1 to 4 do
       ct[3]:= ct[3] + Csv[i];

  For i:= 1 to numtotsup do
       ct[4]:= ct[4] + Qm[i];

  ct[5]:=  375 + pessoas * 117.19  ;

  ct[6]:= (hex - hin) * Vz  * 1000 ;

  ct[7]:= W ;

  ct[8]:=  Qmv;

  ct[9]:=  Qto;


CTT:= 0 ;

For i:= 1  to 9 do
CTT:= CTT + ct[i];

For i:= 1 to 9 do
Per[i]:= ( CT[i]/ CTT ) * 100;

end; { do procedure calcula_cargas_totais  }
```

```
{*************************************************************************}
{                      PROCEDURE RESULTADOS_GERAIS                        }
{*************************************************************************}

Procedure Resultados_Gerais;

type

  vetor= Array[1..9] of string[50];

var

    item: vetor  ;
       i: integer;

begin

item[1]:= ' Conducao atraves das paredes       ';
item[2]:= ' Conducao atraves dos vidros        ';
item[3]:= ' Irradiacao solar pelos vidros      ';
item[4]:= ' Motor                              ';
item[5]:= ' Pessoas                            ';
item[6]:= ' Ar externo                         ';
item[7]:= ' Luzes e equipamento                ';
item[8]:= ' Motores e Ventiladores             ';
item[9]:= ' Outros                             ';

clrscr;
writeln;
writeln('*************************************************************')
writeln('*                        RESULTADOS GLOBAIS                 *')
writeln('*************************************************************')
writeln;
  writeln('   Fontes Termicas              Carga Termica (w)
  Contribuiçao');
writeln;
for i:= 1 to 9 do
begin
writeln(item[i],ct[i]:10:2,per[i]:20:0,' %' );
end;


  writeln('                              ____________                ____________');
  writeln(' CARGA TOTAL                   ',CTT:10:2,'                      100 %');
  writeln;
  writeln(' CARGA TOTAL EM BTU/H                ',3.413* CTT:10:2);
end; {do procedure resultados_gerais}
```

```
{*********************************************************************************}
{                              PROCEDURE RESULTADOS                              }
{*********************************************************************************}

procedure resultados;

type
     vetor= Array[1..5] of string[20];
var
p, v: vetor;
i:integer;

BEGIN
p[1]:= 'Parede Lat. D.  =   ';
p[2]:= 'Parede Tras.    =   ';
p[3]:= 'Parede Lat. E.  =   ';
p[4]:= 'Teto            =   ';
p[5]:= 'Chao            =   ';
v[1]:='Vidro Diant.     =   ';
v[2]:='Vidro Lat. D.    =   ';
v[3]:='Vidro Tras.      =   ';
v[4]:='Vidro Lat. E.    =   ';
clrscr;
writeln;
writeln('*****************************************************************************
writeln('*                          RESULTADOS DISCRETISADOS                          *
writeln('*****************************************************************************
writeln;
writeln;
writeln('                Ganho por        Ganho por        Temp.        Temp.
 Coef. de ');
writeln('                Conducao         Radiacao         Exter.       Inter.
Conv. Ext');
writeln('                 [ W ]            [ W ]            [C]          [C]
 [w/m2.C]');
writeln;
For i:=1 to 5 do

writeln(p[i],Qcp[i]:6:2,'
******',Tse[i]:13:1,Tsip[i]:10:1,he[i]:13:2);
writeln;
For i:=1 to 4 do
writeln(v[i],Qcv[i]:6:2,Csv[i]:14:2,Tsev[i]:13:1,Tsiv[i]:10:1,hev[i]:13:2)
end;{ do procedure resultados }
```

```
{*************************************************************************}
{                          PROCEDURE MOTOR_DADOS                          }
{*************************************************************************}

procedure motor_dados;

var

motor                  :text;
nome                   :string[50];
op,op1,op2             : char;

aux1,aux2,i,j          :integer ;

procedure gravamot ;


var

i,j                  : integer;

begin

 writeln( 'Entre com o nome que deseja dar a este arquivo (nao coloque a
extensao . mot)');
 readln(nome);
 Assign(motor,'a:'+ nome + '.mot');
 rewrite(motor);
 writeln(motor, numtotsup);
 for i:= 1 to numtotsup do
 begin
    For j:= 1 to 4 do  writeln(motor, e_comp[i,j], k_comp[i,j]);
    writeln(motor,F21[i],Area_comp_ef[i], area_comp[i]);
 end;
 writeln(motor,Em_comp,Tmot, he_mot,Emot,Area_mot);
 writeln(motor,tarex);
 close(motor);
end;       {do procedure }

BEGIN

 aux1:=0;
 while aux1 <> 1 do
 begin
    clrscr;
    writeln;
    writeln('Entre com " L " para ler um arquivo');
    writeln('Entre com " e " para escrever um arquivo');
    writeln('Entre com " m " para modificar um arquivo');
    writeln('Entre com " s " para sair ');
    extensao:='mot';
    MOSTRARQUIVOS;
    readln(op);
```

```
case op of
'L', 'l':
begin
   writeln('Qual o arquivo que deseja ler? ( coloque o nome com a extensa
   mot ) ');
   readln(MotorN);
   Assign(motor, 'a:'+ MotorN);
   reset(motor);
   readln(motor, numtotsup );
   for i:=1 to numtotsup do
   begin
      for j:=1 to 4 do readln(motor, e_comp[i,j],k_comp[i,j] );
      readln(motor, F21[i],Area_comp_ef[i],Area_comp[i] );
   end;
   readln(motor, Em_comp, Tmot,he_mot, Emot, Area_mot);
   readln(motor,tarex);
   close(motor);
end;

'E','e':
begin
   writeln('Entre o numero total de superficies do compartimento do
   motor');
   readln(numtotsup);
   for i :=1 to numtotsup do
   begin
      for j:=1 to 4 do
      begin
         writeln('Entre com a espessura e a condutividade do isolante  '
         , j,' da parede ', i);
         readln( e_comp[i,j],   k_comp[i,j] );
      end;{do for j=1...}
      writeln('Entre com o fator de forma do superficie ', i,'para o
      motor,');
      writeln(' sua area efetiva e sua area total');
      readln(F21[i],area_comp_ef[i],area_comp[i]);
   end;{do for i = 1..}
   writeln('Entre com a emissividade das superficies do compartimento do
   motor ');
   writeln(', a temperatura do motor, sua emissividade,sua area ,e o');
   writeln(' coeficiente de conveccao');
   writeln(' das superficies do compart. do motor');
   readln(Em_comp, Tmot,Emot,Area_mot,he_mot);
   writeln('Entre com a temp. do ar no compart. do motor.');
   readln(tarex);
   writeln('Deseja que estes dados sejam gravados em um arquivo ? (s/n)')
   readln(op1);
   if(op1='s') or (op1='S') then gravamot;
end; {do begin e}
'M','m':
begin
   aux2:=0;
   while aux2 <> 1 do
   begin
```

```
writeln('Entre com " p " para mudar os materiais das superf. do
compart. do motor.');
writeln('Entre com " g " para mudar a  geometria das superf. do
compart. do motor.');
writeln('Entre com " c " para mudar dados referentes `a troca de
calor do lado das');
writeln('superficies do compartimento (emissividade das superficies
do comp.');
writeln(',coef. de conveccao na sup. do comp. do motor, e a temp do
ar no compartim.');
writeln('Entre com " m " para mudar os dadas do motor( emissividade
do motor.');
writeln('sua temperatura e sua area.');
readln(op2);
case op2 of
'P', 'p':
begin
   writeln('Entre com a superf. e o material a ser mudado');
   readln (i,j);
   writeln('Espessura e condutividade do material ',j,' da superf.
   ',i,' :   ');
   writeln( e_comp[i,j]:1:4,' m  ', k_comp[i,j]:1:4,' W/m.c ');
   writeln('Entre com os novos valores nesta ordem');
   readln(e_comp[i,j],k_comp[i,j]);
end;

'G','g':
begin
   writeln('Entre com o numero da superf.');
   readln(i);
   writeln('Fator de forma da sup. para o motor , Area efetiva e
   area total:');
   writeln(F21[i],'  ', Area_comp_ef[i]:1:3,' m2  ');
   writeln(area_comp[i]:1:3,' m2');
   writeln('Entre com os novos valores nesta ordem');
   readln(f21[i],Area_comp_ef[i],Area_comp[i]);
end;

'C','c':
begin
   writeln('Emissividade das superficies, coef. de conveccao, ');
   writeln('e a temperatura do ar do comp. do motor');
   writeln(Em_comp:1:2,'  ', he_mot:2:2,' W/m2c   ',tarex:3:1, '
   c');
   writeln('Entre com os novos valores nesta ordem.');
   readln(Em_comp,he_mot,tarex);
end;

'M','m':
begin
   writeln('Temp. do motor, sua area e emissividade');
   writeln(tmot:3:2,' c      ', area_mot:1:2, ' m2
   ',Emot:1:2);
   writeln('Entre com os novos valores nesta ordem.');
```

```
            readln(Tmot,Area_mot,Emot);
          end;
          's','S': Aux2:=1;
          end;{do case op2};
       end;{ do while aux2}
       writeln('Deseja que estes dados sejam gravados em arquivo?(s/n)');
       readln(op1);
       if(op1='s') or (op1='S') then GRAVAMOT;
    end;{ do case "m"}
    's','S': aux1:=1;
    end;{do case op}
 end;{ do while aux1}
end;{ do begin do procedure dados_motor}

{*************************************************************************}
{                          PROCEDIMENTO CALCULA_MOTOR                     }
{*************************************************************************}

procedure Calcula_motor;

Type

vetor= array[1..10] of real;

var

i,j       : integer;

Rt_comp, Rr, Tse_co_ant,  Rmat_comp, Rcv, Rrad: vetor;

Prec,sig : real;

function el(x,y:real):real;
begin
if x= 0 then el:=0
        else el:= exp(y*ln(x));
end;

BEGIN

 sig:= 5.669E-8;
 prec:= 0.01;
 For i:=1 to numtotsup do
 begin
    Rmat_comp[i]:= 0;
    for j:= 1 to 4 do Rmat_comp[i]:= Rmat_comp[i]  + e_comp[i,j]/ k_comp[i,j]
    Rt_comp[i]:= ( Rmat_comp[i] +1/hi )/ area_comp[i];
    Rcv[i]:= 1/ (area_comp[i] * he_mot);
    Rr[i]:= (1- em_comp)/(em_comp* Area_comp_ef[i]) + 1/(F21[i]
    * Area_comp_ef[i]) + (1-emot)/(emot* Area_mot);
    Tse_co_ant[i]:=0;
    tse_comp[i]:= 60 +273;
    while Abs(Tse_comp[i] - Tse_co_ant[i]) >= prec do
    begin
```

```
        Tse_co_ant[i] :=  tse_comp[i];

        Rrad[i] := Rr[i]/( sig*( sqr(tse_comp[i] ) + sqr(Tmot +273) ) *
          (tse_comp[i] + Tmot + 273));

        tse_comp[i] := ( (tarex + 273) * Rrad[i]* Rt_comp[i]
                       +(Tmot+273)* Rcv[i]* Rt_comp[i]
                       +(Ti+273) *Rrad[i]* Rcv[i] )/
          ( Rrad[i]* Rt_comp[i]+ Rt_comp[i]*Rcv[i] +Rcv[i]*Rrad[i]);
      end;{ do while abs...}
      tse_comp[i]:= tse_comp[i] - 273;
      Qm[i]:= (tse_comp[i] - ti)/ Rt_comp[i];
      Tsi_comp[i]:= (- Rmat_comp[i]/ area_comp[i])* Qm[i] + Tse_comp[i];
  end; {do for i=1..}
end; {do procedure}

{************************************************************************}
{                      PROCEDURE RESULTADO_MOTOR                         }
{************************************************************************}

procedure motor_resultado;
var

i             :integer;

begin
clrscr;
writeln;
writeln('             GANHOS DE CALOR E TEMPERATURAS DO COMPARTIMENTO DO
MOTOR');
writeln('             ------------------------------------------------------
');
writeln;
writeln;
writeln('Temp. ext. da superf:');
for i:=1 to numtotsup do
writeln(i, ':',tse_comp[i]:2:2,' c');
gotoxy(24,6);
writeln('temp. int. da superf:');
for i:=1 to numtotsup do
begin
   gotoxy(24,i+6);
   writeln(i,': ',tsi_comp[i]:2:2,' c');
end;
gotoxy(48,6);
writeln('Ganho de calor das superf:');
for i:=1 to numtotsup do
begin
   gotoxy(48,i+6);
   writeln(i,' : ', Qm[i]:3:2,' W');
end;
writeln;
end;{ do proc resultado motor}
```

```
{********************* PROCEDURE TELA_DADOS_PSICRO ************************}

Procedure Tela_dados_psicro;
var

i:    integer ;

begin
clrscr;
writeln;
writeln;
writeln('    Parametros do ar externo:');
writeln('    Temp. de Bulbo seco: ', Te:3:2,' C');
writeln('    Temp. de Bulbo umido: ',Tbue:3:2,' C');
writeln('    Umidade Relativa: ', Ure:3:2,' %');
writeln('    Hentalpia[ Kj/Kg do ar seco]: ',Hex:3:2);
writeln;
writeln('    Parametros do ar externo:');
writeln('    Temp. de Bulbo seco: ', Ti:3:2,' C');
writeln('    Temp. de Bulbo umido: ',Tbui:3:2,' C');
writeln('    Umidade Relativa: ', Uri:3:2,' %');
writeln('    Hentalpia[ Kj/Kg do ar seco]: ',Hin:3:2);
writeln;
writeln('    Pressao Barometrica [KPa]: ', Pb:3:2);
writeln;
writeln('    sair ');
gotoxy(41,3);
writeln('Para mudar Tecle');
for i:=1 to 3 do
begin
  gotoxy(49,i+3);
  writeln('[',i,']');
end;
for i:=1 to 3 do
begin
  gotoxy(49, i+9);
  writeln('[',i+3,']');
end;
gotoxy(49,15);
writeln('[7]');
gotoxy(49,17);
writeln('[s]');
end;{ do procedure Tela_Dados_Psicro}
{************************* PROCEDURE PSICRO ****************************;
Procedure psicro;

Var Tbs,Tbu,Tbu1,T0,T,
    Hlvu,H,Ha,Uau,Hu,Hvu,Hau,Hlu,Hv,
    Ua,Ur,
    Psat,Pv,
    M,R,V,
    Z,Aux                              : Real;
    Op                                 : Char;
```

```
(*************************************************************************)

Procedure Pressao_de_Saturacao;

Var A,B,C,D : Real;

Begin

If T>=0 Then Begin
             A:=24.8584*(1-(T0/Tbu1));
             B:=-5.02808*(Ln(Tbu1/T0)/Ln(10));
             C:=3.4648E-04 * (1-Exp(-19.1044*((Tbu1/T0)-1)));
             D:=9.871901E-04 * (Exp(10.9823*(1-(T0/Tbu1)))-1)-5.1108;
             End
        Else Begin
             A:=-20.9465*((T0/Tbu1)-1);
             B:=3.56654*(Ln(T0/Tbu1)/Ln(10));
             C:=2.0189*(1-(Tbu1/T0))-5.1108;
             D:=0;
             End;
Psat:=Exp(A+B+C+D);
Psat:=Psat*101.325;
End;

(*************************************************************************)

Procedure Tbu_Calculado;

Var Flag  : Boolean;

    Delta : Real;
Begin
Tbu:=Tbs;
Delta:=1;
Flag:=False;
While Delta>=0.05 do
     Begin
     Hau:=1.0057*Tbu;
     Hvu:=2501.6+(1.89*Tbu);
     Tbu1:=Tbu+T0;
     T:=Tbu;
     Pressao_de_Saturacao;
     Uau:=0.622*Psat/(Pb-Psat);
     Hu:=Hau+Uau*Hvu;
     Hlu:=4.19*Tbu;
     If (Hu-Hlu*(Uau-Ua))<H Then Begin
                                 Flag:=True;
                                 Delta:=-Abs(Delta/2);
                                 End
                            Else If Flag Then Delta:=Abs(Delta/2);
     Tbu:=Tbu-Delta;
     End;
End;
```

```
{*************************************************************************}
Procedure Opcao_1;

Begin



     If Tbu>Tbs Then
     begin
       gotoxy(16,12);
       writeln('           Tbu tem que ser menor que Tbs');
       writeln;
       writeln('                          Toque qualquer tecla');
       op:= readkey;
     end;


T0:=273.16;

Tbu1:=T0+Tbu;

T:=Tbu;

Pressao_de_Saturacao;

If (Tbu>=-50) And (Tbu<0) Then Hlvu:=2838.5 Else Hlvu:=2501.65-2.3677*Tbu;
Uau:=(0.622*Psat)/(Pb-Psat);
Hlu:=(4.19*Tbu);
Hv:=2501.6+1.89*Tbs;
Ua:=(Uau*Hlvu+1.0057*(Tbu-Tbs))/(Hv-Hlu);
Pv:=(Pb*Ua)/(0.622+Ua);
Tbu1:=Tbs+T0;
T:=Tbs;
Pressao_de_Saturacao;
Ur:=(100*Pv/Psat);
Ha:=1.0057*Tbs;
H:=Ha+Ua*Hv;
M:=28.97*(1-(Pv/Pb))+18*(Pv/Pb);
R:=8314/M;
V:=R*(Tbs+T0)/(Pb*1000);
If Tbs<0 Then Begin
              Tbu1:=Tbs+T0;
              T:=Tbs;
              Pressao_de_Saturacao;
              Pv:=Psat;
              End;
If Tbs=Tbu Then Ur:=100;

End;
```

```
(*************************************************************************)

Procedure Opcao_2;

Begin


T0:=273.16;
Tbu1:=Tbs+T0;
T:=Tbs;
Pressao_de_Saturacao;
Pv:=Ur*Psat/100;
Ua:=0.622*Pv/(Pb-Pv);
Hv:=2501.6+1.89*Tbs;
Ha:= 1.0057*Tbs;
H:=Ha+Ua*Hv;
M:=28.97*(1-(Pv/Pb))+18*(Pv/Pb);
R:=8314/M;
V:=R*(Tbs+T0)/(Pb*1000);
If Tbs<0 Then Begin
              Tbu1:=Tbs+T0;
              T:=Tbs;
              Pressao_de_Saturacao;
              Pv:=Psat;
              End;
Tbu_Calculado;

Tbu:=Tbu+0.5;

End;

{************************ PROCEDURE  PSICRO ****************************}
begin
aux:=1;
while Aux <> 0 do

begin
  Tela_Dados_psicro;
  op:=readkey;
  case op of
  '1':
  begin
    clrscr;
    writeln('Entre com a temp. de bulbo seco');
    readln(te);
    tbs:= te;
    tbu:= tbue;
    opcao_1;
    ure:=ur ;
    hex:= h;
  end;
  '2':
  begin
```

```
   clrscr;
   writeln('Entre com a nova Temp. de bulbo umido');
   readln(tbue);
   tbu:= tbue;
   tbs:=te;
   Opcao_1;
   ure:=ur;
   Hex:=h ;
 end;
 '3':
 begin
   clrscr;
   writeln('Entre com a nova Umidade Relativa');
   readln(ure);
   ur:= ure;
   Tbs:= te;
   opcao_2;
   Tbue:= tbu;
   Hex:= H ;
 end;

 '4':
 begin
   clrscr;
   writeln('Entre com a temp. de bulbo seco');
   readln(ti);
   tbs:= ti;
   tbu:= tbui;
   opcao_1;
   uri:=ur;
   hin:= h;
 end;
 '5':
 begin
   clrscr;
   writeln('Entre com a nova Temp. de bulbo umido');
   readln(tbui);
   tbu:= tbui;
   tbs:=ti;
   Opcao_1;
   uri:=ur;
   Hin:=h ;
 end;
 '6':
 begin
   clrscr;
   writeln('Entre com a nova Umidade Relativa');
   readln(uri);
   ur:= uri;
   Tbs:= ti;
   opcao_2;
   Tbui:= tbu;
   Hin:= H ;
 end;
```

```
  '7':
  begin
    clrscr;
    writeln;
    writeln;
    writeln;
    writeln;
    writeln;
    writeln;
    writeln('          Digite:');
    writeln(' 1            -          Para mudar a pressao atmosferica');
    writeln;
    writeln(' 2  - Para mudar a pressao caso se conheca somente a altitud-
    local');

     Repeat
          Op:=ReadKey;
     Until (Op>='1') And (Op<='2');
     GoToXY(1,15);
     Case Op of
          '1': Begin
               Write('Entre com a nova pressao barométrica [K Pa] -> ');
               ReadLn(Pb);
               End;
          '2': Begin
               Write('Entre com a altitude [m]           -> ');
               ReadLn(Z);
               Pb:=101.325*Exp(5.2561*(Ln(1-2.25569E-05 * Z)));
               End;
     end;
    Tbs:= te;
    Tbu:=Tbue;
    Opcao_1;
    Ure:= Ur;
    Hex:= H;
    Tbs:= Ti;
    Tbu:=Tbui;
    Opcao_1;
    Uri:= Ur;
    Hin:= H;
  end;{ do item 7}


  's','S': Aux:=0  ;
  end;{do case  op of...}
end;{ do while Aux >< 0...}

end;{do procedure}
```

```
{*************************************************************************}
{                  PROCEDURE LUZES_MOTORES_OUTROS                         }
{*************************************************************************}

Procedure luzes_motores_outros ;

var
   aux:integer;

begin

  aux:=1;
  while aux <> 0 do
  begin
    clrscr;
    gotoxy(1,7);
    writeln('                                                          Par
    mudar tecle:');
    writeln;
    writeln('Potencia eletrica das luzes e equipamento eletrico = ', W:3:2,
    ' W   [1]');
    writeln;
    writeln('Potencia dissipada de motores e ventiladores..... = ', Qmv:3:2,
    ' W   [2]');
    writeln;
    writeln('Cargas Termicas outras.........................= ', Qto:3:2,
    ' W   [3]');
    writeln;
    writeln('SAIR.....................................................
    [s]');
    op:= readkey;
    case op of

    '1':
    begin
      clrscr;
      gotoxy(27,11);
      writeln(' Entre com a potencia de luzes e equip.');
      readln(W);
    end;

    '2':
    begin
      clrscr;
      gotoxy(1,7);
      writeln('Entre com o num. de motores de ventilac., sua potencia (HP) e
      seu rendimt(%)');
      readln(N,pot,Rendimento_motor_ventilacao);
      writeln;
      writeln('    Entre com:');
      writeln;
      writeln('  [1] para motores e  ventiladores dentro do espaco
      condicionado');
```

```
      writeln;
      writeln('  [2] para motor fora e ventilador dentro do espaco
      condicionado');
      writeln;
      writeln('  [3] para somente algum motor dentro da cabine (ex:mot. do
      limp. parabr.)');
      writeln;
      Writeln(' O caso atual e o numero ',tipo_mot_vent);


      op:= readkey;
      case op of

      '1':
      begin
        Qmv:= n* pot* 746* 100/ rendimento_motor_ventilacao;
        tipo_mot_vent:=1;
      end;

      '2':
      begin
        Qmv:= n* Pot* 746;
        tipo_mot_vent:=2;
      end;

      '3':
      begin
        Qmv:= n* Pot * 746*(100- rendimento_motor_ventilacao)/
                                 Rendimento_motor_ventilacao;
        tipo_mot_vent:=3;
      end;


     end;{ docase}
    end;{do caso 2}

    '3':
    begin
      clrscr;
      gotoxy(1,11);
      writeln('Aqui voce pode colocar outras cargas termicas como: valvulas,
      reservatorios');
      writeln('de oleo,fogoes, ganho de calor por particoes, etc... ');
      writeln;
      writeln('Entre com o novo valor de cargas termicas " outras " ');
      readln(Qto);
    end;

    's','S': aux:=0;

    end; {do case op of}
  end; {do while aux ><0 }
end; { do procedure LUZES...}
```

```
{*************************************************************************}
{                        PROCEDURE DADOS_MOTOR_I                          }
{*************************************************************************}

Procedure Dados_Motor_I;

var
       i,j: integer;

begin

 writeln;
 writeln('  Arquivo: ',MotorN);
 writeln;
 Writeln('                    DADOS DAS PAREDES DO COMPARTIMENTO DO MOTOR ');
 writeln('                    ------------------------------------------');
 writeln;
 writeln;
 For i:= 1 to numtotsup do
 begin
   Writeln('                                  DADOS DA PAREDE ',i);
   writeln('                                  ----------------- '  );
   writeln;
     writeln('        CONDUTIVIDADE  TERMICA (W/m.C)
     ESPESSURA(m)');
   writeln;
   For j:= 1 to 4 do
   begin
     writeln('ISOLANTE ',I,K_comp[i,j]:17:4,e_comp[i,j]:37:4);
   end;
   writeln;
   writeln('EMISSIVIDADE DO LADO INTERNO DO COMPARTIMENTO: ',EM_COMP:3:2);
   writeln('FATOR DE FORMA DA SUPERFICIE ',I,' PARA MOTOR: ',F21[I]:4:3);
   writeln('AREA EFETIVA [M2] : ',Area_comp_ef[i]:4:3);
   writeln('AREA         [M2] : ',area_comp[i]:4:3);
   writeln;
 end;
 writeln;
 writeln;
 writeln;
 writeln('                                    DADOS DO MOTOR ');
 writeln('                                    -------------- ');
 WRITELN;
 writeln('Temperatura da superficie do motor (C) : ',Tmot:4:1);
 writeln('Area do motor (M2): ',Area_mot:5:3);
 writeln('Emissividade da superficie do motor: ',Emot:5:2);
 writeln;
 writeln('Temperatura do ar (C): ',tarex:5:1);
 writeln('Coeficiente de convecçao da superficie do comp. (W/m2.C) :
',he_mot:5:2);
 writeln;
end;{ do procedure Dados_motor_I }
```

```
{*************************************************************************}
{                    PROCEDURE DADOS_CABINE_I                             }
{*************************************************************************}

Procedure Dados_cabine_I;

begin
writeln;
writeln('*************************************************************
*******');
writeln('                DADOS GERAIS DE CABINE DO ARQUIVO : ',NOMEC);
writeln('                ---------------------------------- ');
writeln('*************************************************************
*******');
linhas:=3 ;
pula_linhas;

MOSTRA_MATERIAIS_PAREDES;
linhas:=6 ;
pula_linhas;
MOSTRA_GEOM_PAREDE;
linhas:=6;
pula_linhas;
MOSTRA_GEOM_VIDROS;
linhas:=6;
pula_linhas;
writeln( 'Altura: ', Altura:1:2,'m ', ' Largura: ', largura:1:2,' m');
writeln;
writeln(' Absortividade da parede: ', absp:2:1);
writeln(' emissividade da parede: ',Emsp:2:1);
linhas:=6;
pula_linhas;
writeln('Espessura dos vidros (mm): ',1000*ev:5:1);
writeln('Condutividade Termica dos vidros (W/m.C): ',kv:5:3);
linhas:=6;
pula_linhas;

  writeln('                              DADOS OPTICOS DOS VIDROS ');
  writeln('                              ------------------------');

  writeln;
  writeln;
  writeln('                        Vidro Frontal: ',nomevidrofrontal);
  writeln('                        Vidros Laterais e Traseiro:
',nomevidrolateral);
  writeln('                        Emissividade: ',emsv:2:2);
  linhas:=6;
  pula_linhas;
  end;{ do procedure DADOS_CABINE_I }
```

```
{*************************************************************************}
{                          PROCEDURE IMPRESSAO                            }
{*************************************************************************}

Procedure Impressao;

var
       sair_impressao: boolean;

begin
 sair_impressao:= false;



 while sair_impressao= false do
 begin
   clrscr;
   gotoxy(1,7);
   writeln('   Digite para imprimir: ');
   writeln;
   writeln('      [1]          para              Dados gerais.  ');
   writeln('      [2]          para              Dados do motor.');
   writeln('      [3]          para              Dados da Cabine.');
   writeln('      [4]          para              Ganhos de Calor e temperatura
   da Cabine.');
   writeln('      [5]          para              Ganhos de Calor e temp. do
   comp. do motor');
   writeln;
   writeln('      [s]          para              SAIR.');

   assign(output,'prn');
   rewrite(output);


   op:=readkey;

   case op of

  '1' : begin
        linhas:=10;
        pula_linhas;
        writeln;
```

```
writeln('*************************************************************************')
        writeln('*                                                               *')
        writeln('*                      DADOS GLOBAIS                            *')
        writeln('*                      -------------                            *')
        writeln('*                                                               *')
writeln('*************************************************************************')


        linhas:=6;
        pula_linhas;
        MOSTRADADOS;
        linhas:=18;
        pula_linhas;
        end;


  '2' : begin
          linhas:=10;
          pula_linhas;
          DADOS_MOTOR_I;
          linhas:=17;
          pula_linhas;
        end;


  '3' : begin
          DADOS_CABINE_I;
          linhas:=17;
          pula_linhas;
        end;


  '4' : begin
          RESULTADOS_GERAIS;
          linhas:=8;
          pula_linhas;
          RESULTADOS;
          linhas:=17;
          pula_linhas;
        end;


  '5' : begin
         MOTOR_RESULTADO;
         linhas:=17;
         pula_linhas;
        end;
  'S','s':Sair_impressao:= true;
  end;{ do case op of }


  assign(output,'con');
```

```
  rewrite(output);

 end; { do while sair impressao=false}
 RESULTADOS_GERAIS;

end;{do procedure impressao}
```

APÊNDICE C

- C.1 Características dos cabos de extensão
- C.2 Cópia do catálogo do anemômetro
- C.3 Cópia do catálogo do pirômetro
- C.4 Cópia do catálogo do data logger Squirrel
- C.5 Tabela de calibração dos termopares

C.1 Características dos cabos de extensão

C.R,s.a.	**CABLE EXTENSION TERMOPARES** **2 CONDUCTORES (16 AWG)** **APANTALLADO** **THERMOCOUPLE EXTENSION CABLE** **2 CONDUCTORS (16 AWG)** **SHIELDED** **CABO DE EXTENSÃO TERMOPARES** **2 CONDUTORES (16 AWG)** **COM BLINDAGEM**	**ET. 003** **1/1/83**

PANTALLA NO HIGROSCOPICA

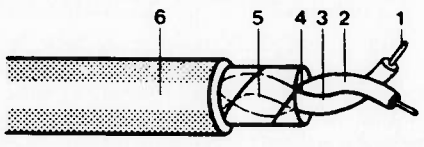
1. **Conductores**: Hilo sólido galga 16 AWG, calibrado segun ISA RP 1.1.7 y ANSI MC 96.1.1975 de acuerdo a la tabla C3
2. **Aislamiento**: a) P.V.C. 105° C, espesor de 0.4 mm.
   b) Polietileno baja densidad (0.92-0.93), espesor de 0.4 mm. Temperatura máxima de ejercicio, 80° C.
3. **Color del par.** Código ISA/ANSI, tabla IV.
4. **Paso del par.** Retorcido entre si, 2" (50 mm.)
5. **Pantalla no higroscópica.** Cinta de Mylar, espesor de 0.023 mm., en hélice solapada, recubriendo el 100 %.
6. **Cubierta final.** P.V.C. 80° C, espesor de 0,6 mm. (color segun ISA/ANSI tabla IV)

NON HYGROSCOPIC SHIELD

1. **Conductors.** Solid wire 16 AWG gauge, gauged according to ISA RP 1.1.7 and ANSI MC 96.1.1975, in accordance with table C3.
2. **Isolation**: a) P.V.C. 105° C, 0.4 mm. thickness.
   b) Low density polyethylene (0.92-0.93), 0.4 mm. thickness. Maximum drill temperature 80° C.
3. **Pair color.** Code ISA/ANSI, table IV.
4. **Pair lay.** Each other twisted 2" (50 mm.)
5. **Non hygroscopic shield.** Mylar tape, 0.023 mm. thickness, in lapped w. apped-up line, overlapping 100 %.
6. **End covering.** P.V.C. 80° C, 0.6 mm. thickness (color according ISA/ANSI, table IV)

BLINDAGEM NÃO HIGROSCÓPICA

1. **Condutores.** Fio nu sólido, bitola 16 AWG, calibrado ISA RP. 1.1.7 e ANSI MC.96.1.1975, de acordo com a tabela C3.
2. **Isolamento**: a) P.V.C. 105° C, espessura de 0,4 mm.
   b) Polietileno baixa densidade (0,92-0,93), espessura de 0,4 mm. Temperatura máxima de exercício, 80° C.
3. **Cor do par.** Código ISA/ANSI, tabela IV.
4. **Passo do par.** Retorcido entre si, 2" (50 mm).
5. **Blindagem não higroscópica.** Fita de Mylar, espessura de 0,023 mm., em helicóide superposta, recobrindo o 100%.
6. **Capa final.** P.V.C. espessura de 0,6 mm (cor segundo ISA/ANSI, tabela IV)



TIPO 1A
(2 conductores) 1 PAR trenzado

1A TYPE
(2 conductors) 1 braided PAIR

TIPO 1A
(2 condutores) 1 PAR torcido

ISA/ANSI	TIPO C.R. - C.R. TYPE - TIPO C.R		MEDIDAS - MEASURES - MEDIDAS			
	*a) P.V.C.	*b) POLIETILENO	MILIMETROS ∅ EXTERIOR	MILIMETROS ∅ RADIO CURVAT.	PESO KG./KM.	METROS POR BOBINA
ISA/ANSI	a) P.V.C.	b) POLYETHYLENE	MILIMETERS ∅ EXTERNAL	MILIMETERS ∅ BENDING RADIUS	WEIGHT KG./KM	METERS PER COIL
ISA ANSI	a) P.V.C.	b) POLIETILENO	MILIMETROS ∅ EXTERNO	MILIMETROS ∅ RAIO CURV.	PESO KG / KM	METROS POR BOBINA
EX JX KX WX TX	1A EXA 1A JXA 1A KXA 1A WXA 1A TXA	1A EXB 1A JXB 1A KXB 1A WXB 1A TXB	5.8	35	61	500

ANSI MC96.1.1975

SIMBOLOS CABLE EXTENSION TERMOPARES TABLA III				TIPOS DE CABLE EXTENSION TERMOPARES TABLA C3		COLORES AISLAMIENTO CABLE EXTENSION TERMOPARES TABLA IV			LIMITE DE ERROR, °C y FUERZA ELECTROMOTRIZ DEL CABLE			
TIPO	SIGLA	POSITIVO	NEGATIVO	TIPO CABLE	ELEMENTO CABLE EXTENSION	POSITIVO AISLAMIENTO	NEGATIVO AISLAMIENTO	CUBIERTA EXTERIOR	TIPO EXTENSION CABLE	CONEXION A 0° C M.V. a 100° C	CAMPO DE TEMPERATURA °C	LIMITE ERROR °C
E	EX	EPX	ENX	Chromel Constanten	EPX (Chromel®, Tophel®, T1®) ENX (Constanten, Advance®, Cupron®)	PURPURA	ROJO	PURPURA	EX	6.317	+17.8 +204	±1.67
J	JX	JPX	JNX	Hierro Constantan	JPX (Hierro) JNX (Constantan, Advance®, Cupron®)	BLANCO	ROJO	NEGRO	JX	5.268	−17.8 +204	±2.22
K	**KX	KPX	KNX	Chromel® Alumel®	KPX (Chromel®, Tophel®, T1®) KNX (Alumel®, Nial®, T2®)	AMARILLO	ROJO	AMARILLO	KX	4.096	−17.8 +204	±2.22
K	WX	WPX	WNX	Hierro Cupronìquel aleado	WPX (Hierro) WNX (Cupronìquel aleado, Cupronel n.° 128)	VERDE	ROJO	BLANCO	WX	4.096	+23.9 +204	±3.33
R6S	SX	SPX	SNX	Cobre Cupronìquel aleado	SPX (Cobre) SNX (Cupronìquel aleado (PCLW) Alloy n.° 11)	NEGRO	ROJO	VERDE	SX	0.646	+23.9 +204	±6.67
T	TX	TPX	TNX	Cobre Constantan	TPX (Cobre) TNX (Constantan, Advance®, Cupron®)	AZUL	ROJO	AZUL	TX	4.277	−59.46 +93	±0.83

**PARA MAXIMA EXACTITUD. *MARCA O NOMBRE REGISTRADO.

CABLES DE EXTENSION PARA TERMOPARES

F E M REFER PLATINO 27

TEMPERATURA		PARA CABLE DE EXTENSION															
°C	°F	HIERRO JPX		CONSTANTAN JNX		COBRE TPX		CONSTANTAN TNX		CROMEL EPX		CONSTANTAN ENX		CROMEL KPX		ALUMEL KNX	
		V	± V	V	± V	V	± V	V	± V	V	± V	V	± V	V	± V	V	± V
−17.8	0	−316	33	+571	33	−98	3	572	25	−445	35	+575	35	−446	35	+236	35
0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37.8	100	+676	48	−1263	48	+260	3	−1267	25	−1007	45	−1263	45	−1007	45	−810	45
93	200	+1665	50	−3241	50	+705	4	−3262	25	+2609	45	−3261	45	−2609	45	−1211	45
100	212	+1780	50	−3487	50	+766	4	−3511	25	+2810	45	−3510	45	+2810	45	−1290	45
149	300	+2592	50	−5351	50	+1252	7	−5395	25	+4316	45	−5392	45	+4316	45	−1773	45
204	400	+3444	50	−7584	50	+1886	9	−7639	25	+6113	45	−7637	45	+6113	45	−2199	45

NOTAS: 1) Para cable de extensión cobre-aleación 11 (Alloy-11), para termopar platino 13 % o 10 % Rhodio-Platino, la f.e.m. del hilo de cobre con referencia al Pt-27 es aquella indicada para cable de extensión Cobre-Constantan, mientras que el hilo en aleación 11 con referencia al Pt-27 debe generar una f.e.m. de 66 microvoltios ± 20 microvoltios a 100° C (112° F).

2) En el cable de extensión para termopar Cromel-Alumel tipo WX (Hierro-Cupronel 128), la f.e.m. del hierro con referencia al Pt-27 es aquélla del cable de extensión Hierro-Constantan, mientras que la f.e.m. con referencia al Pt-17 de la aleación Cupronel 128 es respectivamente a 0° F. +364 V; 32° F. 0 V; 100° F. −842 V; 200° F. −2155 V; 212° F. −232 V; 300° F. −3498 V; 400° F. −4866 V; tolerancia, ± 70 V.

C.2 Cópia do catálogo do anemômetro

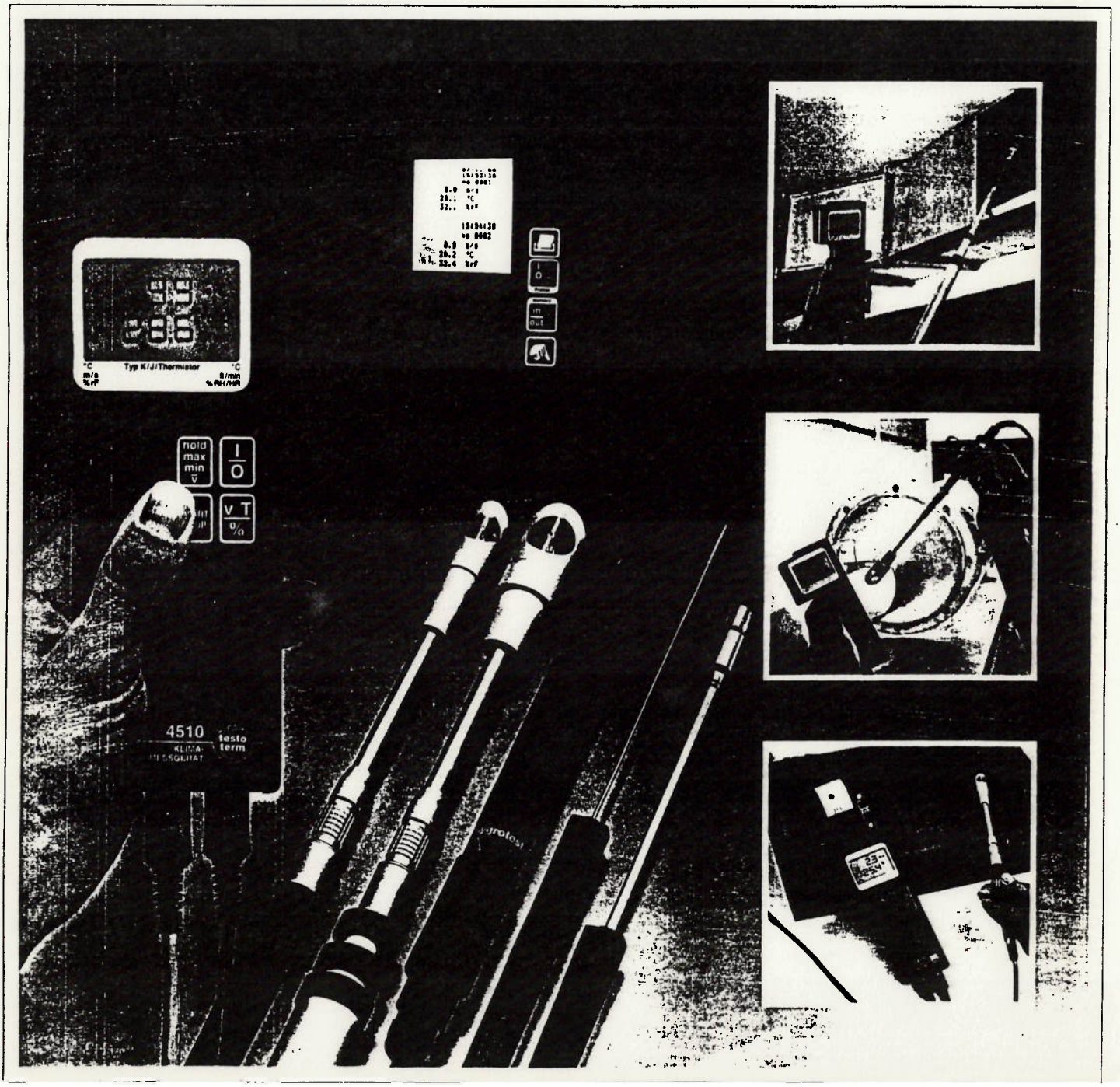
testo term

Instant Action Anemometers of the professional class

testoterm 4500
Precision measuring instrument for
velocity 0.4 to 40 m/s
temperature −120 to +1370°C

testoterm 4510
additional humidity measurement
optional logger/printer module
stores up to 2500 measured values

NEW!



4500/4510

Features

Instant action anemometer for velocity/temperature and humidity measurement

- **microprocessor controlled**
- **large dual indication**
- **very fast and accurate**
- **hand held**
- **with latest design, easy to operate touch-sensitive keyboard**
- **logger connection for storage and printing**
- **wide range of probes**
- **a choice of 2 instruments**

testoterm 4500
...for measurement
- 1 input for connection of a vane probe for velocity and temperature or of a temperature probe type K (NiCr-NiAl) or type J (Fe-CuNi) or NTC
- indication of 2 measured variables
- min./max. store and hold function

testoterm 4510
...for measurement without logging
- 2 measurement inputs
  1st input for vane probe (velocity and temperature) or temperature probe type K (NiCr-NiAl) or type J (Fe-CuNi) or NTC
  2nd input for humidity probe
- simultaneous indication of 2 measured variables
- min./max. value store and hold function
- with timed and multi point mean value measurement
- 2 simultaneous analogue outputs
- connecting socket for mains unit
- logging capability

testoterm 4510 with logger
...for measurement...storage...printing
A complete system for control of the climate is made from the instant action anemometer by plugging-in the logger. The logger stores and prints automaticly up to 2500 measured values according to the programmed measurement parameters or by manual command.

Logger functions:
- simultaneous measurement, storage and printing,
- simultaneous measurement and printing,
- simultaneous measurement and storage.

The measured data can be recalled from the memory at any time and can be indicated and printed out individually, in partial ranges or in total.

Now even a complicated series of measurements can be made at low cost and can be recorded at any time.

Warranty: instruments: 24 months
probes: 12 months
logger: 12 months except for printing mechanism

Standard delivery: Instrument with a 9 V battery and holding device for probe, logger with 4 batteries and paper roll

Rotating vane probes
Measuring range 0.4 to 40.0 m/s (T_{max} + 140°C)
Between 1.0 and 40.0 m/s with high accuracy of ± 1 % of final reading.
The sapphire supported vane is sensed by an inductive sensor. The signals are amplified, linearized and indicated. The temperature probe (NiCr-NiAl) incorporated in the measuring head measures the ambient temperature. This temperature is indicated together with the velocity value. The measuring heads correspond to protection IP 65 and are easy to clean. Connection of the measuring probes to the instrument via the handle or the telescope (see ordering data).

4500
...for measurement

Plug-in logge
for storage and printing
Printing format with date, time an
number of the measured values
Identification of the min./max. value

Paper fee

Printing mechanism on/o

Reading in/out of memor

Keyboard for manual operati
(storage...printing...reading out

Keyboard for automatic operatio
(storage...printing...reading out

Plug-in connector for logge

Batter
compartmen

Plug-in connecto

2-line displa

2 linearized analogue output

Connecting sockets for mains uni
for recharging of the rechargeable
batteries (instrument and logger
and also for mains operatio

On/off ke

Hold the measure
value on the displa
Indicate the max. value
Indicate the min. value

START/STOP mean value measuremen

Switching between velocity
temperature and humidit

1 connecting socket for vane probe
(velocity and temperature)
and temperature probes

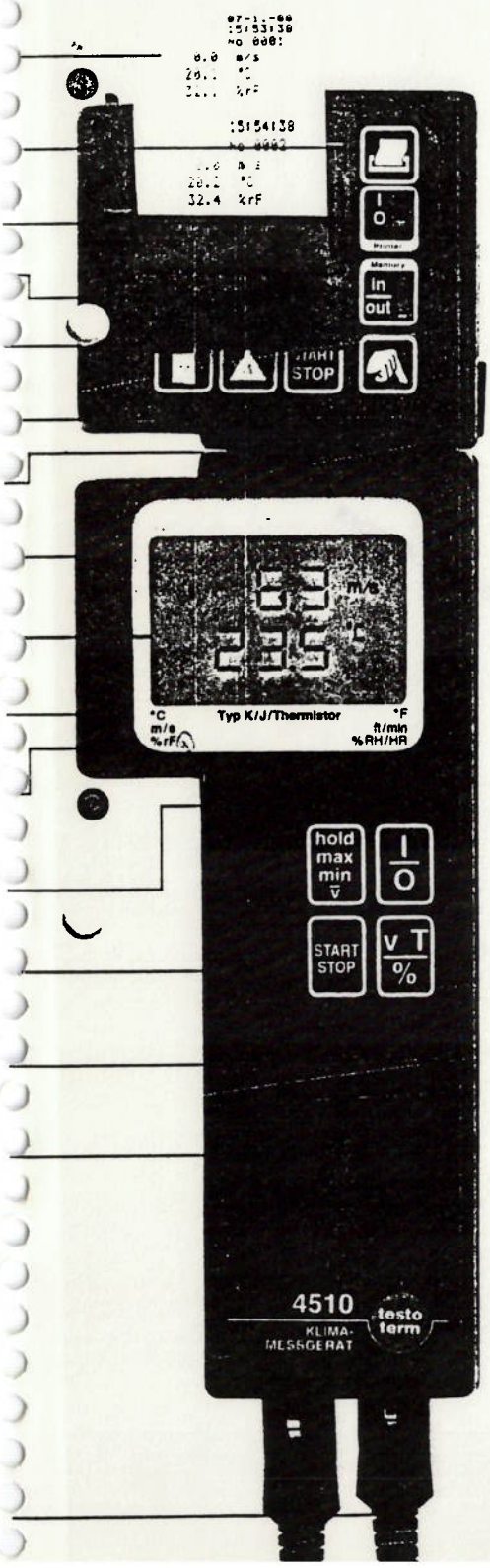
2 connecting sockets for vane probe
(velocity and temperature) an
temperature and humidity prob

testo term

4500/4510

4510

...for measurement...storage... printing



Technical data

Type 4500
1 measurement input for velocity and temperature measurement.

Type 4510
2 measurement inputs for velocity/temperature and humidity measurement

Analogue outputs.	20 mV/m/s, 10 mV/%RH 1 mV/°C
Load:	R > 2 kOhm

Common data types 4500/4510

Measuring range	0.4 to 40 m/s (vane) 2 to 98 % RH (type 4510) – 120.0 to + 1370 °C (NiCr-NiAl) – 120.0 to + 1000 °C (Fe-CuNi) – 40 to + 70 °C (NTC)
Resolution:	0.1 m/s with instantaneous value 0.01 m/s with mean value measurement 0.1 % RH
(K) NiCr-NiAl	0.1 °C (– 120.0 to + 999.9 °C) 1 °C (+ 1000 to + 1370 °C)
(J) Fe-CuNi/NTC	0.1 °C
Accuracy: (± 1 digit)	± 1 % of final reading (m/s) instrument and probe ± 2 % RH (10 to 96 % RH)
(K/J)	± 0.3 °C (– 120.0 to – 50.0 °C) ± 0.2 °C (– 50.0 to + 200 °C) ± 0.1 % of m. v. (above + 200 °C)
NTC	± 0.1 °C (– 20 to + 70 °C) ± 0.2 °C (residual range)
Nominal temperature:	+ 22 °C
Perm. ambient temp.	0 to + 40 °C
Permissible storage and transport temp.	– 30 to + 80 °C
Display.	LCD 2 lines, 9 mm high characters
Case:	Plastic (ABS)
Dimensions:	197 × 55 × 45 (L × W × H)
Weight:	approx. 250 g
Power supply:	Battery 9 V IEC 6F 22 (PP3) or equivalent 9 V rechargeable battery (mains operation type 4510)
Battery life:	10 h continuous measurement or 2000 measurements 20 sec. each
Battery control:	automatic

Logger (for storage and printing)

Storage capacity:	up to 2500 measured values
Printing mechanism:	alphanumeric thermo printing mechanism 16 characters/line
Printing speed:	0.8 sec./line
Power supply:	Battery operation (4 × 1.24 V micro) or mains operation via mains unit with instrument type 4510
Perm. ambient temp.:	0 to + 40 °C
Permissible storage and transport temp.:	– 30 to + 60 °C
Weight.	approx. 250 g

Cycle time storage/printing: free selectable in the range 1 sec. to 1 hour (automatic operation) or manual command.
Special data evaluation via the measured value and the corresponding measurement number.
Printing paper: 3 m long, 38 mm wide for approx. 750 lines

Further measuring instruments in the professional class:

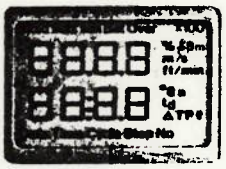
Instant action thermometer types 7000/7010
for temperature measurements – 200 to + 800 °C with Pt100 probes (high accuracy 0.1/0.2 °C)

Instant action thermometer types 9000/9010
for temperature measurements – 120 to + 1370 °C with thermocouple probes type K (NiCr-NiAl), J (Fe-CuNi) and NTC.

Instant action hygrometer types 6000/6010
for measurement of: humidity
temperature
dew point

All measuring instruments xx10 in the professional class can be supplied with a logger.

The practical details

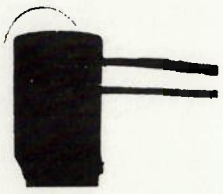


2-line display for indication of 2 measured variables

Brace... to stand up or

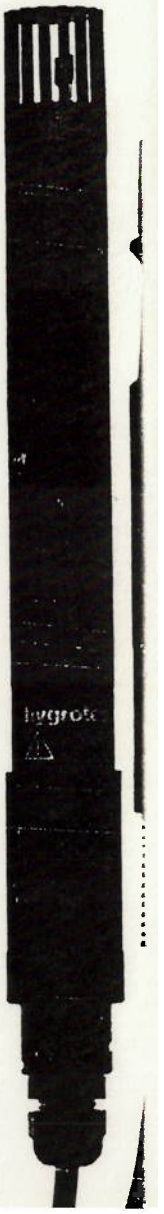
...to hang up the instrument

One-hand operation by fixing the probe to the measuring instrument



Analogue outputs and connecting socket for (type 4510)

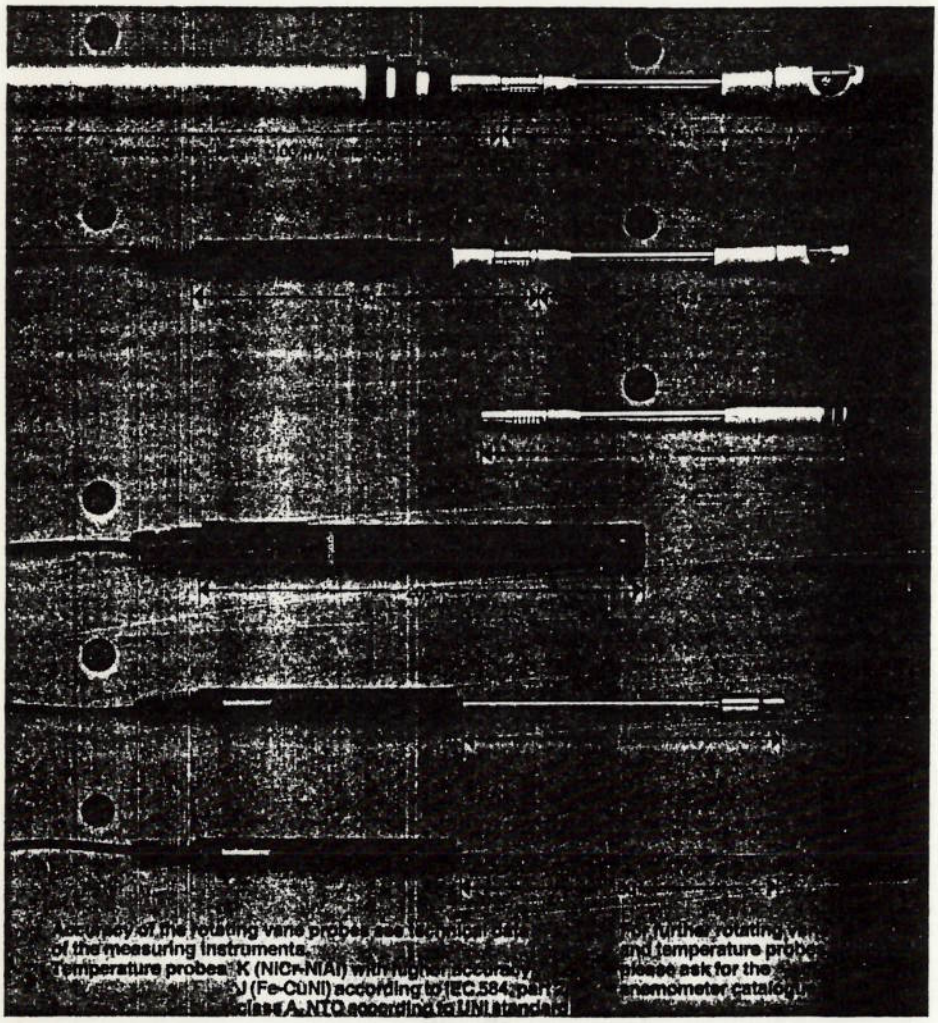
Simple logger to instrument connection (type 4510)



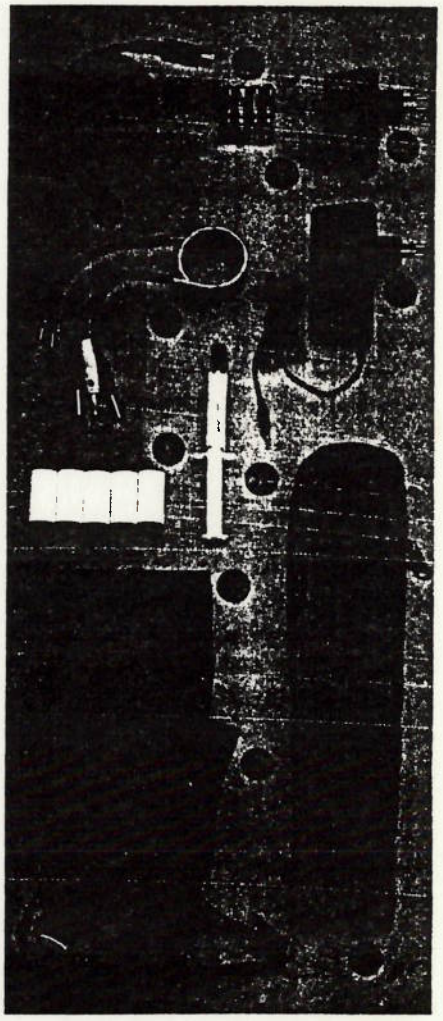
4500/4510 Ordering data

testo term

Measuring probes



Accessories



Ordering data

	Description	Measuring range	t_{90} (sec.)	Part No.	
Indicators	① Meas. instrument type 4500, with 9 V battery and holding device for probe			4500	
	② Meas. instrument type 4510, with 9 V battery and holding device for probe			4510	
	③ Logger for instrument 4510, with 4 × 1.24 V battery and paper roll			0554.0070	
Measuring probes	④ Vane probe for m/sec. and °C	0.4 to 40.0 m/sec.	–	0635.9640	
	⑤ Vane probe for m/sec. and °C	0.4 to 40.0 m/sec.	–	0635.9540	
	⑥ Vane probe for m/sec.	0.6 to 20.0 m/sec.	–	0635.9443	
	⑦ Air probe for humidity measurements (type 4510)	2.0 to 98.0% RH	–	9660	
	⑧ Temperature probe for surface measurements	−200 to +500°C	3	0194	
	⑨ Temperature probe for immersion measurements	−200 to +600°C	1	0493	
	⑩ Handle with 1.5 m long lead for vane probe			0430.3545	
	⑪ Telescope, extendable, for vane probe			0430.0945	
Accessories	⑫ Set of rechargeable batteries for logger 0554.0070 (4 × 1.24 V)			0515.0088	
	⑬ 9 V rechargeable battery for types 4500/4510 (instead of battery)			0515.0025	
	⑭ Recharger for external recharge of the battery 0515.0025 (type 4500)			0554.0026	
	⑮ Mains unit for mains operation and for recharge of the rechargeable battery for instrument type 4510 and logger 0554.0070			0554.0088	
	⑯ Extra long lead for probe (5 m long)			0409.0063	
	⑰ Connecting lead for 1 × analogue output			0409.0084	
	⑱ Silicone paste for better heat transfer (14 g)			0554.0004	
	⑲ 1 pack paper rolls (5 pcs.), for logger			0554.0149	
	⑳ Leather case for 1 to 2 probes			0516.0092	
	㉑ Carrying case (leather) for instruments 4500/4510			0516.0090	
	㉒ Carrying case (leather) for instrument 4510 and logger			0516.0091	
	㉓ Service case for type 4510 and logger (530 × 395 × 107 mm) see fig.			0516.0107	
	Service case for type 4500/4510 without logger (425 × 335 × 85 mm)			0516.0106	

We recommend:

F. ex.: service case for velocity and temperature
without logger
instrument ①
vane probe ④
telescope ⑪

Service case for velocity, temperature and humidity
with logger
instrument ②
logger ③
vane probe ④
telescope ⑪
mains unit ⑮
humidity probe ⑦

Subject to changes without prior notice

C.3 Cópia do catálogo do pirômetro

testo term

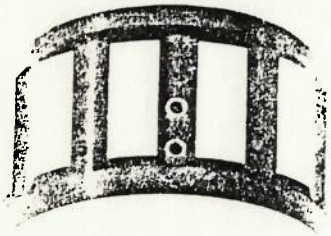
pyroterm

8400/8500

Combined temperature measuring instruments

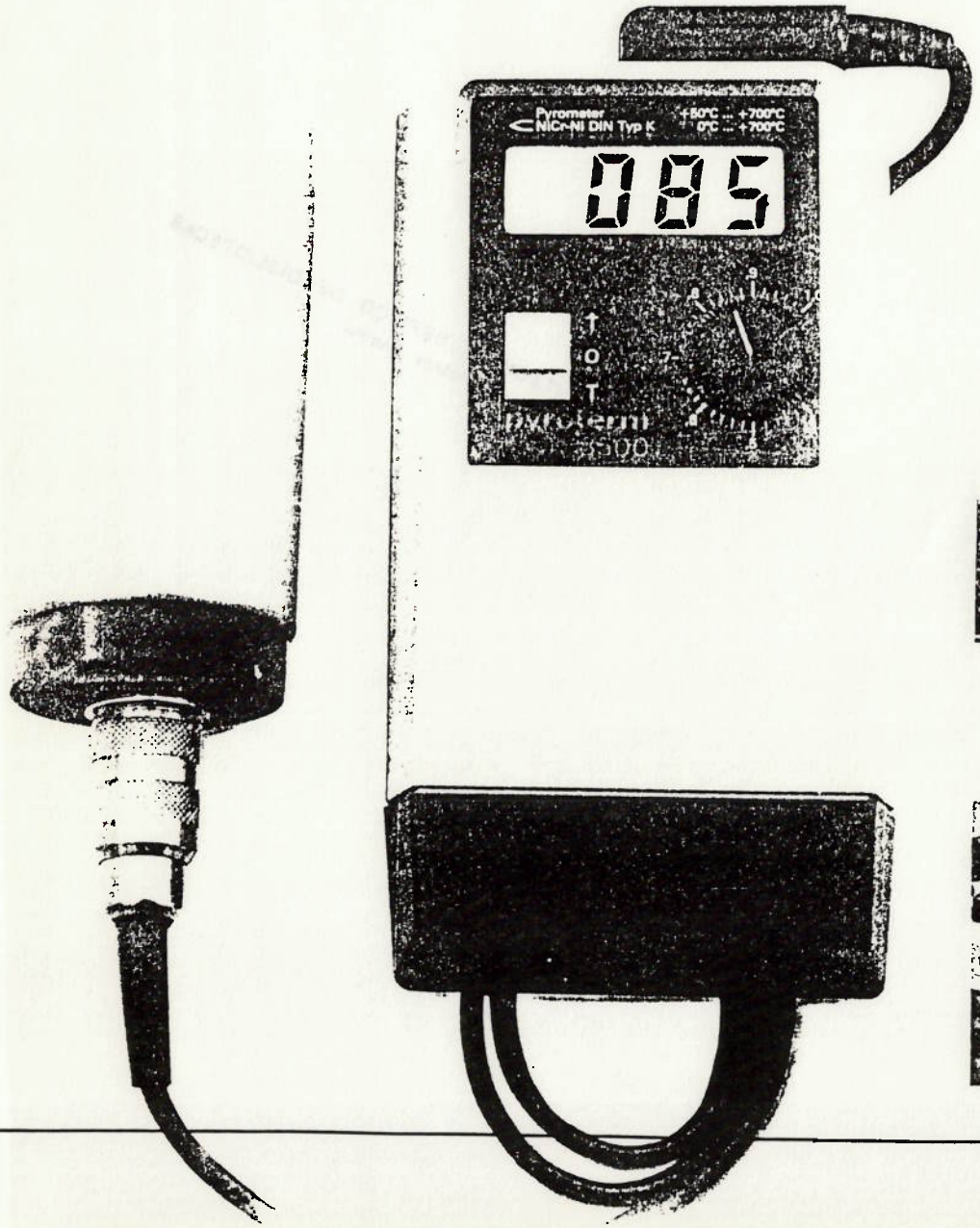
Radiation pyrometer and instant action thermometer in one unit

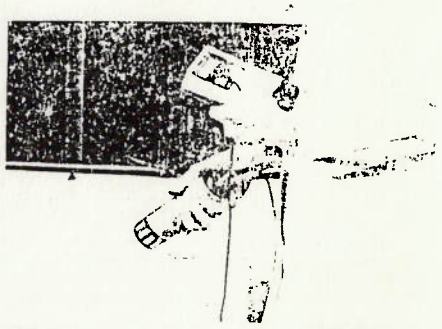
Instant measurement of temperature
Maximum value storing · analogue output
Handy · robust · practical

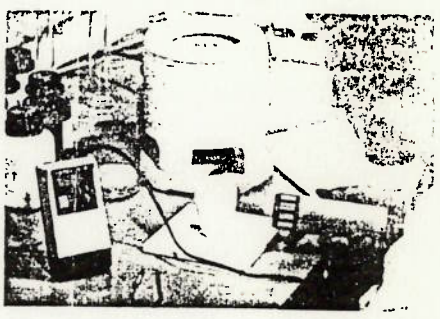


particularly suitable for non-contact temperature measurement on

moving objects
fragile and freshly painted surfaces
live conductors
small parts with little mass
including components
poor heat conductors with
rough surfaces







pyroterm® 8400/8500

Instruments for temperature measurement

Description

pyroterm 8400 and pyroterm 8500 are portable handy instruments for non-contact and contact temperature measurement. Infra-red radiation probes or thermocouple probes K (NiCr-NiAl) can be connected.

pyroterm 8400

is a partial radiation pyrometer for infra-red temperature measurement in the range of − 30 to + 150 °C.

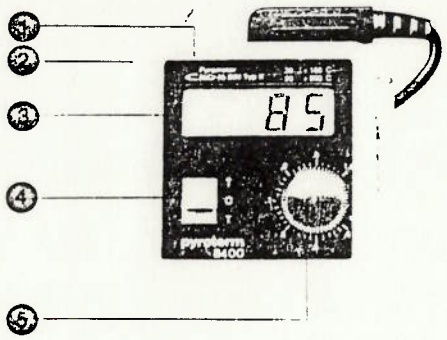
pyroterm 8500

is a total radiation pyrometer for infra-red temperature measurement in the range of + 40 to + 750 °C.

- variable emissivity adjustment
- determination of the emissivity by comparison measurements with thermocouple contact probes
- voltage recorder output (mV)
- maximum value store
- practical accessories

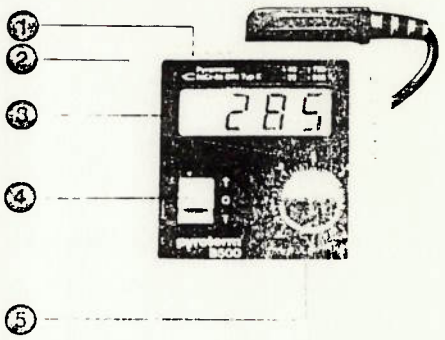
enable many applications and a truly universal measuring system

pyroterm 8400
partial radiation pyrometer



1 Connecting sockets for plug of recharger and output signal
2 Connecting lead for radiation probe
3 Display, characters are 13 mm high
4 Operation switch
T measurement of maximum value
O off
T continuous measurement
5 Adjustment of the emissivity
6 Battery housing – back

pyroterm 8500
total radiation pyrometer



1 Connecting sockets for plug of recharger and output signal
2 Connecting lead for radiation probe
3 Display, characters are 13 mm high
4 Operation switch
T measurement of maximum value
O off
T continuous measurement
5 Adjustment of the emissivity
6 Battery housing – back

We manufacture:

Measuring instruments for physical and chemical values
Temperature
Airflow velocity
Speed
Humidity
Flue gas analysis

We guarantee:

A meticulous and accurate manufacturing by the most modern means, individual testing of all instruments and probes.
Very high quality standards, speedy deliveries usually from stock, highly developped technical specifications.

We offer:

More than 25 years experience in the manufacturing of measuring instruments and sensors
up to 15 years parts availability
24 months warranty for instruments
12 months warranty for sensing heads and probes

Technical data pyroterm 8400

Operation with IR sensing head 6330.8400

Measuring range:	− 30 to + 150 °C
Resolution:	1 °C
Accuracy:	± 2 % of measured value ± 1 digit

Operation with thermocouple probe

Measuring range:	− 20 to + 900 °C
Resolution:	1 °C
Accuracy:	± 1 °C (− 20 to + 100 °C) ± 1 % of measured value (from 100 °C) ± 1 digit

Voltage recorder output:
(only for IR-measurement)
None linear analog output

Output signal:	approx. 1 mV/°C, noline linear
Maximum load:	R ≥ 1 kΩ

Technical data pyroterm 8500

Operation with sensing-head IR 6330.85xx

Measuring range:	+ 40 to + 750 °C (please note the partial measuring ranges of the various sensing heads)
Resolution:	1 °C
Accuracy	± 2 °C (+ 40 to + 130 °C) ± 1.5 % of measured value (from + 130 °C) ± 1 digit

Operation with thermocouple probes

Measuring range:	− 20 to + 900 °C
Resolution	1 °C
Accuracy	± 1 °C (− 20 to + 100 °C) ± 1 % of measured value (from + 100 °C) ± 1 digit

Voltage recorder output: (only for IR measurement)
Linear analog output

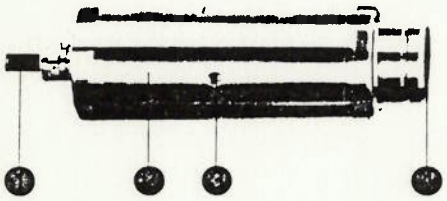
Output signal	1 mV/°C, linear
Maximum load	R ≥ 1 kΩ

Common technical data pyroterm 8400/8500

Measuring rate:	2/sec
Reproducibility:	± 1 %
Nominal temp.:	+ 22 °C
Adjustment of the emissivity:	with potentiometer in the range ε = 0,4 ... 1
Maximum value storing:	storing and display of the max. temperature (switch on position T)
Display	LCD, 13 mm high characters
Operating temp.:	0 to + 40 °C
Storing and transport temperature:	− 20 to + 60 °C
Case:	impact resistance case
Weight:	250 g
Power supply:	Battery 9 V IEC 6F 22 or accu (buffer battery)

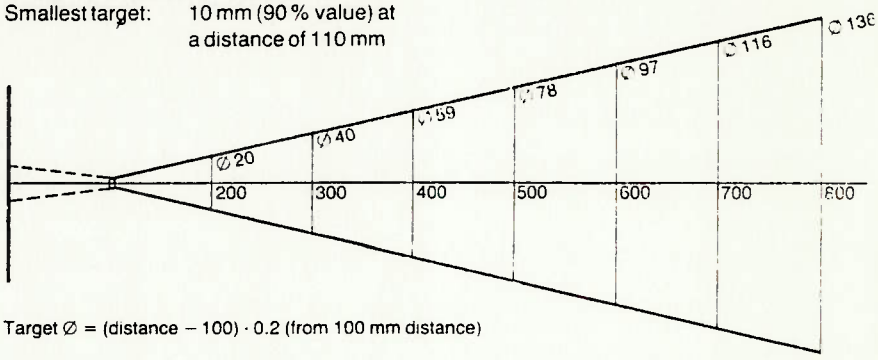
pyroterm® 8400/85
Measuring instrume

IR-sensing head
Infra-red sensing head with concave mirror optics, with PE-foil or solid-state-disc.



- Flexible connecting lead, length: 1.5 m, firmly attached
- Steel case V2A (1.4305)
- Possible connection for strap or support thread socket ¼ inch
- PE-foil or solid-state-disc window, interchangeable

Ray path
Indication of target diameter: 90 % value
Smallest target: 10 mm (90 % value) at a distance of 110 mm



Target Ø = (distance − 100) · 0.2 (from 100 mm distance)

Technical data sensing head

Sensing head for connection to pyroterm 8400

Type 6330.8400

Window:	PE-foil
Measuring range:	− 30 to + 150 °C
Spectral range:	8 to 14 µm

Sensing heads for connection to pyroterm 8500

Type 6330.8500

Window:	PE-foil
Measuring range:	+ 40 to + 750 °C
Spectral range:	0.4 to 30 µm

Type 6330.8501

Window:	solid-state-disc
Measuring range:	+ 40 to + 300 °C
Spectral range:	1.5 to 15 µm

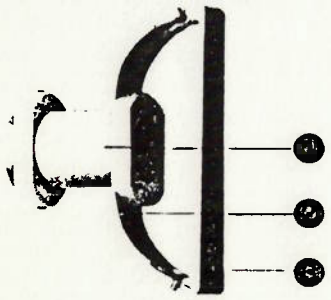
Type 6330.8502

Window:	solid-state-disc
Measuring range:	+ 200 to + 750 °C
Spectral range:	1.5 to 15 µm

Common technical data

Optics:	concave mirror optics smallest target: Ø 10 mm at a distance of 110 mm
Ray path:	see the figure
Perm. operating temperature:	0 to + 50 °C at higher ambient temperatures use cooling jacket
Perm. storage and transport temp.:	− 20 to + 60 °C
Dimensions:	Ø 52 mm, length = 148 mm
Weight:	0.80 kg
Case:	steel case V2A (1.4305)
Connecting lead:	firmly attached, with plug 1.5 m long

Emissivity converter
Plug-in adapter for IR-sensing head for measurement on polished rotating cylinders.



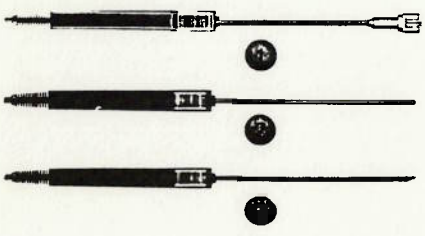
Operation
Connect emissivity converter on sensing head and place it onto the rotating polished cylinder. The teflon tape immediately accepts the surface temperature of the rotating polished cylinder. The IR-sensing head determines the temperature of the teflon tape which has a very good emissivity, in contrast to a polished surface.

- Case material: alumel (with plug-in adapter)
- Support: spring steel
- Teflon tape, ε = 0.94

Technical data emissivity converter

Spare tape:	teflon tape, width: 35 mm, length: 230 mm
Application:	measurements on polished cylinders (max. 250 °C) cylinder diameter: max. 1.5 m, min. 0.05 m perm. peripheral speed: max. 10 m/sec.
Emissivity:	ε = 0.94, to be adjusted on the measuring transducer
Weight:	0.19 kg

Thermocouple probes



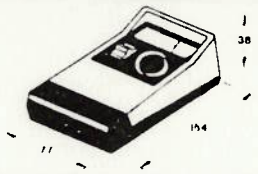
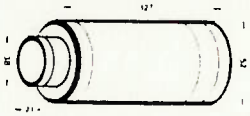
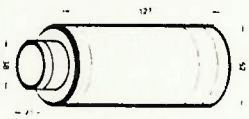
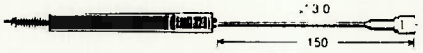
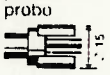
- Very rapid surface probe for temperature measurement to assist with emissivity determination.
- Immersion probe with water proof sheath. The sensing point is in the tip of the probe.
- Very rapid probe for penetration measurements on plastic or semi-solid materials.

Technical data thermocouple probes

Transducer:	thermocouples type K (NiCr-NiAl)
Accuracy:	1/3 DIN (DIN 43710)

Measuring range, response time and design see ordering data.
All the thermocouple probes type K (NiCr-NiAl) from the 9500 range can also be connected.
Please request data sheet 9500.

pyroterm® 8400/8500
Ordering data

	Description	Dimensions in mm		Measuring range	Part. No.	
Indicators	**pyroterm 8400** connection of IR sensing head 6330.8400 or thermocouple probes.			− 30 °C to + 150 °C	**8400**	
	pyroterm 8500 connection of sensing heads 6330 8500, 6330 8501 or 6330 8502 and of thermocouple probes.			+ 40 °C to + 750 °C	**8500**	
Sensing heads	**IR sensing head** for connection to pyroterm 8400		with PE-foil	− 30 to + 150 °C	**6330.8400**	
	IR sensing head for connection to pyroterm 8500 type 8500 with PE-foil type 8501 with solid-state-disc type 8502 with solid-state-disc		with PE-foil	+ 40 to + 750 °C	**6330.8500**	
			with solid-state-disc	+ 40 to + 300 °C	**6330.8501**	
			with solid-state-disc	+ 200 to + 750 °C	**6330.8502**	
Surface probe	Very rapid surface probe for determination of emissivity on surfaces.		point of the probe 	− 200 to + 400 °C	**0095**	
Immersion probe	Immersion probe for temperature measurements in liquids.			− 200 to + 600 °C	**0495**	
Penetration probe	Very rapid penetration probe for plastic and semi-solid materials.			− 200 to + 400 °C	**2695**	
	All temperature probes of our thermometer model 9500 can be connected. Please request data sheet 9500.					

Description	Part. No.	
Cooling jacket for sensing head, for measurements at ambient temperature ≤ 50 °C to approx. + 150 °C depending on connecting cable	**0554.0003**	
Air purge adapter for sensing head, for measurements in dusty atmospheres (operation with compressed air free of oil)	**0554.0014**	
Hand table support for sensing head	**0554.0087**	
Plug-in direction finder, for adjustment of distance of sensing head	**0554.0038**	
Target locator on request	**0554.0037**	
Telescopic support for sensing heads	**0400.9034**	
Emissivity converter for sensing head, for measurement on polished cylinders	**0554.0024**	
PE-foil for sensing head	**0400.0003**	
Solid-state disc for sensing head (silicium). PE-foil can be changed for solid-state-disc in our works	**0137.0005**	
Test radiator for sensing head	**0554.8000**	
Mains supply unit for test radiator	**0554.0033**	
Indicator for test radiator; technoterm 7300	**0560.7300**	
Connecting lead for analog output, 1.5 m length	**0409.0084**	
Rechargeable NiCd-accu, 90 mAh, can be used in place of standard battery	**0515.0025**	
Recharger 220 V with 1.5 m long connection lead and plug	**0554.0080**	
Service case for indicator, 1 sensing head and accessories	**0516.0105**	
Analog recorder for connection to indicator, recording width: 120 mm, mains supply (power supply by battery on request)	**0558.0001**	
Extra long cable 5 m, for connecting indicator to sensing head 6330.8400 Same as above, but to sensing head 6330.85xx	**0409.0098** **0409.0099**	
Extra long cable 5 m, for connecting indicator to probe	**0409.0095**	
Mat black coating to raise the emissivity (e.g. for polished surfaces) $\varepsilon = 0.98 / t_{max} = 150$ °C	**0554.0001**	

Subject to changes without notice.

pyroterm® 8400/8500
Theoretical basis

Theoretical basis for infra-red temperature measurement

Measuring principal
Every body above the absolute zero (0 K = − 273°C) emits electromagnetic radiation. The intensity of the emitted radiation depends on the emissivity E of the material.
The radiation determined by the sensing head consists of the emissivity of the measuring object, the reflection and the transmission of parasitic radiation. The sum is equal to 100 % resp. 1.
The emissivity is calculated according to the formula: $\varepsilon = 1 - (R + T)$.

Emmissivity (ε) is the ability of a material to emit infra-red radiation.

The **reflection factor (R)** depends on the surface condition and on the nature of the material.

The **transmission factor (T)** depends on the thickness and on the nature of the material. It indicates the transmittance of the material for infra-red radiation.

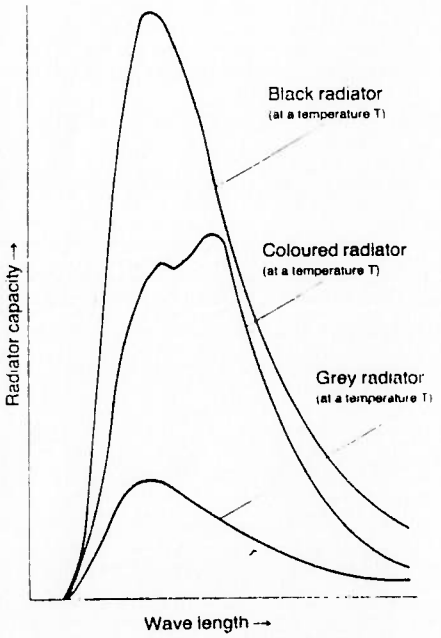
These three quantities can be between 0 and 1.

Coloured radiators
Coloured radiators are materials, the emissivity of which depends on wave length and on temperature. That means that the emissivity of such materials is different at for instance + 200°C and + 600°C.
This is valid for most of the metallic materials. It has to be considered that ε is determined at the probably right measuring temperature.

Examples of coloured radiators

material	T = 200°C	T = 600°C
Nickel	ε = 0.37	ε = 0.48
Cast iron	ε = 0.64	ε = 0.78

Evaluation of the measured signals
For the evaluation of the measured signals the surface under the curve has to be calculated. The "grey radiator" emits like the "black radiator" radiation capacity in the range of 0.4 µm to 30 µm. The smaller surface under the curve due to the flatter curve shows that at the same temperature the intensity of the emitted radiation of the grey radiator is lower. The relation between grey radiation capacity and black radiation capacity must be constant. That means that if ε = 0.8 at for instance 200°C, this is also valid at 600°C.



It is not the same with the "coloured radiator". The curve shown on the figure is an example for any coloured radiator at the temperature T_1. At this temperature the "coloured radiator" shown on the figure has an emissivity (relation between "coloured" and "black" radiation capacity) which is greater than 0.5. At another temperature the "coloured radiator" can have a very different curve line and, especially in contrast to the "grey radiator", a very different emissivity.

Black radiator
If the reflection factor as well as the transmission factor = 0, the measuring object is an ideal one, a so-called "black radiator". The energy radiated by this body can be calculated by means of the "Planck's Radiation Law". The emissivity of such a body is ε = 1. In reality, such ideal conditions do not exist. With the measurement transmission and reflection perfect conditions rarely prevail.

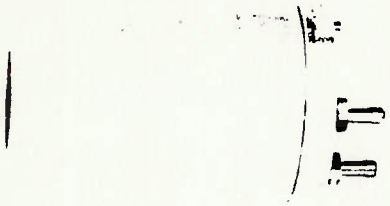
Grey radiator
Most of the bodies to be found in nature are called "grey radiators", i.e. ε < 1. Grey radiators have the same characteristics as black radiators, but the intensity of the emitted radiation is lower. This is corrected by determining the emissivity. The emissivity is equal to the relation between "Grey" and "Black" radiation intensity.

Important emissivities

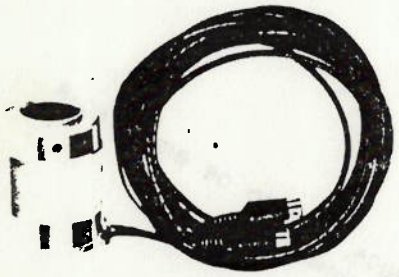
1	Black radiator
0.99	black point
0.95	water, rubber, asbestos slates
0.90	roofing
0.85	brick, fireclay
0.80	paper
0.75	rolled steel
0.70	inconel, rolled
0.65	plastics
0.60	Copper, oxidized
0.55	Aluminium, oxidized
0.50	
0.45	Brass, impure
0.40	Copper, blistered; glazed porcelain

pyroterm® 8400/8500
Applications – Accessories

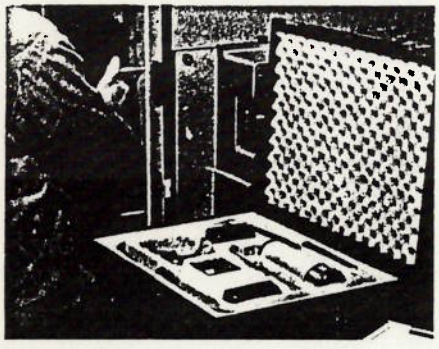
Accessories



Cooling jacket
to be used when operating with sensing head at ambient temperatures between + 50°C to + 150°C. Alumel case.
Cooling: Normal tap water.



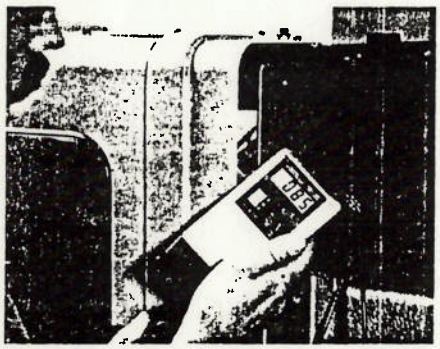
Test radiator
for the calibration and the control of the sensing heads. Test temperature: + 120°C (other values on request).



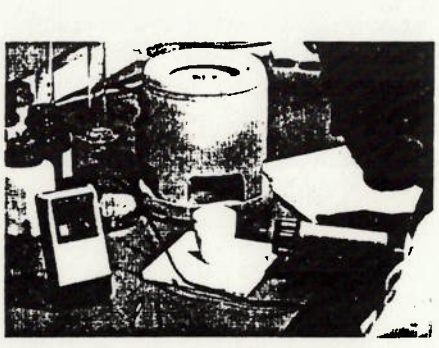
Service case
to hold indicator and accessories.

Applications

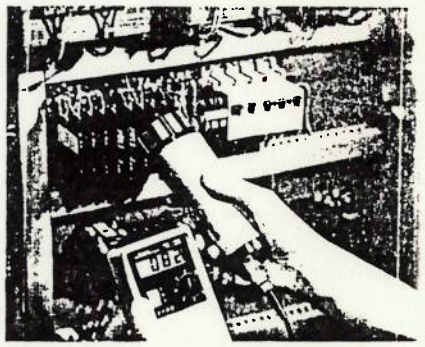
Measurements on small parts.
When operating a contact measurement on parts with little mass (e.g. components) the contact probe absorbs too much heat and thus causes measuring errors. pyroterm 8500 is especially suitable for these operations.



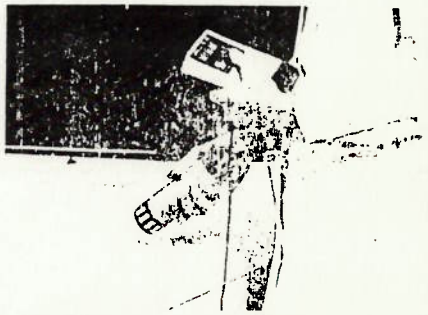
Measurement on moulds.
When opening and closing the mould (e.g. injection mould) the temperature must be determined within 2 sec.



Measurement on poor heat conductor with rough surface.
Measurements on rough and uneven surfaces are always difficult, this is due to the high heat transfer resistance. When measuring with pyroterm 8500 heat transfer resistance is no problem.



Measurement on live conductors.
Temperature measurement on electrical components, contact rails, transformers etc is very dangerous when used with contact thermometer..pyroterm 8500 establishes the temperatures of the live conductors safely



Measurement on fragile and freshly painted surfaces.
How do you measure temperature on freshly painted surfaces without touching them? With pyroterm 8500.

Measurement on moving parts.
Accurate temperature measurement can be established in a milli-second without touching the surface. All the control measure ments required for the fabrication and treament of paper, textiles, rubber, metals and plastic foils etc. can be operated.

C.4 Cópia do catálogo do data logger Squirrel

Grant

DATA SHEET FOR SQUIRREL MEMORY LOGGERS

Types of Squirrel

MIT-EXACTA
Industria e Comércio de Instrumentos e Sistemas de Automação Ltda.
Avenida Azevedo, 471 - Tatuapé - Cep 03308 - Fone: (011) 217-2144 - Cx. P. 2538 - Telx. 1161010 - End. Telegr.: MITEX - São Paulo - Bra

MIT EXACTA REPRESENTANTE EXCLUSIVO GRANT PARA BRASIL

1990

Grant, DATA SHEET FOR SQUIRREL MEMORY LOGGERS

Types of Squirrel

All-analogue Squirrels

Four-channel models have four inputs, either all of the same type and range, or split into two groups of inputs, each group of the same type and range.

16-channel models have 16 inputs, all for type U or type UU thermistors (or all for type S) and all recording in the same range.

Thermistor inputs

Grant manufacture three different types of thermistor probes for use with the Squirrel Memory Logger.

Types U and UU have a resistance of 2000 Ohms at 25°C and use YSI thermistor beads I-18920 and I-18913 respectively (Fenwall UUA32J98 and Dale IC2001-C3 are also suitable).

Type S has a resistance of 20 KOhms at 25°C and uses Betatherm Microclip thermistor beads 20K7MCDX.

Thermocouple inputs

These are for thermocouple probes fitted with thermocouple type K, J or T to American standard ANSI C96. Special

Platinum resistance inputs

These are for platinum resistance probes fitted with Pt 100 sensors (100 Ohms at 0°C) to BS1904 and DIN 43760 1980.

Humidity inputs

Humidity inputs (type L) are for Grant VH-L probes which have a capacitive humidity sensor and a Grant type U temperature sensor inside a protective guard. The temperature sensor is automatically connected to one of the temperature inputs unless a separate temperature sensor is plugged in.

See separate leaflet on temperature and humidity probes for further details.

Event/digital Squirrels

These have an eight-way input which can record either from eight separate event inputs or from a single 8-bit parallel digital input. They can also have four analogue channels, either all of the same type and range, or split into two groups, each of the same type and range.

In the event (state) mode, readings are taken whenever one of the 8 event inputs changes state. Each of the 8 inputs is recorded as 1 or 0, according to whether a contact is open or closed, or a voltage is present or absent. Voltages below 0.5V are recorded as 0, voltages between 5 and 6V as 1. The Squirrel is CMOS and TTL compatible.

Alternatively, readings can be stored at regular intervals from a single 8-bit parallel source. Stored readings will be 8-bit numbers between 0 and 255.

EC6 cable allows easy connection of event inputs by way of a 16 way terminal block.

Pulse-counting Squirrels

These have one channel to record from a pulse input. They can also have one thermistor channel.

All pulses are counted between one recording occasion and the next, on a range of 0 to 1 million. Readings are stored in steps of 1 pulse up to 32,767 and in steps of 32 pulses from 32,768 to 1 million.

A pulse-counting input can count either contact closures or voltage pulses at a maximum frequency of 100Hz.

Contact closures: minimum closure 5ms, minimum interval between closures 5ms.

Voltage pulses: low level must be below 0.5V dc, high level between 4 and 20V dc. Minimum pulse length 5ms, minimum interval between pulses 5ms.

Set-up and Download

For set-up and download the memory logger is connected to an IBM PC or compatible computer either directly or via a telephone and modems. The menu on the computer screen allows the user to start or stop the recording or carry out all other functions, including:

- meter readings on the computer screen
- set real-time and date
- set recording interval between 1 second and 100 minutes
- set scan interval for averaged readings
- on all-analogue models, set delayed start time and date
- on event/digital models, select which event inputs will trigger recording
- select which inputs are to be recorded
- option to continue recording when the memory is full (roll-over memory)
- enter 32 characters of text in the logger's memory
- display battery life in Volts
- transfer stored readings to computer during or after logging.

Recording Modes

Instantaneous readings

The user can set the recording interval between 1 second and 100 minutes, in steps of one second. Instantaneous readings are recorded at the end of each interval.

Averaged readings

The user can set a scanning interval (minimum 1 second) which is shorter than the recording interval. Readings are taken from analogue inputs on each scan, and the average value is stored at the end of each recording interval.

Event-initiated recording

On event/digital Squirrels the user can set any of the eight event inputs to trigger a recording whenever it changes state. The recording consists of:

- time (elapsed time since last recording)
- state (0 or 1) of each event input
- readings from any analogue channels pre-selected by the user.

Modem Operation

The Squirrel can be set up remotely via the telephone system using a computer and modems. The modem at the computer end must be Hayes compatible, the modem at the Squirrel end must be able to auto-answer. The Squirrel cannot communicate with the modem itself, or control it, and only three connections (Receive, Transmit, Ground) exist between the two.

Baud rates can be 300, 600, 1200, 2400, 4800, all full duplex.

300 baud full duplex (V21) is a very common transfer rate, and uses the cheapest modems, but is slow: transfer of 32,000 readings will take 20 minutes. 1200 baud full duplex (V22) and 2400 baud full duplex (V22bis) are more satisfactory, but the modems are more expensive.

Computer Output

Output socket 15-pin D (indoor models)
4-pin waterproof (weatherproof models)

Format RS232C with auto-selected baud rate of 300, 600, 1200, 2400 or 4800 (no hardware handshaking).

Computer connection cables are available for connecting Squirrels to computers.

Data Transfer and Analysis

Transfer to Lotus spreadsheet

The control program for the memory logger includes the facility to transfer data in a Lotus readable format.

Alternatively, the data can be stored and transferred in a format readable by the Grant analysis program for IBM PCs and compatibles (see Memory Logger price list for details of required computer configuration).

Standard analysis program

This program provides printout and analysis of data transferred from both Squirrel meter/loggers and Squirrel memory loggers.

The standard program has a header section giving start time and date, interval, number of readings, and input and range of each channel.

Other information which can be displayed or printed, either for the whole recording run or for a selected period, includes:

- time and value of each reading
- graph, with magnification option
- maximum, minimum and mean values, with standard deviations
- total time for which values were above or below a user-selected threshold.

Portable analysis kits

Portable analysis kits based on IBM PC compatible lap-top computers are available for set up and downloading in the field. See Memory Loggers price list for details.

Inputs and Ranges

Selecting measuring ranges

Users must specify the desired measuring range(s) when ordering a Squirrel. Table 1 shows the highest and lowest values that can be measured by a Squirrel. Users can choose any band within these limits, but must take account of the restrictions on range span laid down in Table 1 (ie shortest/longest possible span).

Ranges are divided into 250 steps, so users should choose ranges which give meaningful divisions. The following are examples of suitable ranges:

0 to 250mV in steps of 1.0mV
0 to 125mV [illegible] mV
−10 to [illegible] °C [illegible] in steps of 0.2°C
10 to 35°C in steps of 0.1°C

Offset

Voltage, current and thermocouple ranges cannot be offset by more than three times the range span. For example:

possible: 75 to 100mV (range span 25mV, offset from zero by 75mV, or 3 × span)
impossible: 100 to 125mV (range span 25mV, offset from zero by 100mV, or 4 × span).

Accuracy

Analogue ranges

Resolution: 1 bit (0.4% span)

Accuracy:
(in Squirrel ambient between 5 and 45°C)
±1 bit (0.4% span) on V, C, L and P ranges
±2 bits (0.8% span) on other ranges

On thermocouple ranges there can also be a cold junction compensation error of up to 0.07°C/°C above or below 20°C Squirrel ambient.

Pulse counting range

Maximum error 1 pulse up to 32,767,
32 pulses up to 1,000,000

Event/digital range

State readings: no error.
Time readings (for event-initiated recording):
1 second plus clock error (non-cumulative).

Input isolation

Voltage, current and thermocouple inputs are isolated from each other. All other inputs are connected to a common ground terminal.

Input impedance

Input impedance of voltage and thermocouple inputs is 1[illegible] Ohms, pulse-counting 100K Ohms, event/digital 22K Ohms.

Impedance of other inputs depends on

Input sockets (for indoor models only)

Voltage (dc) Current (dc) Thermistor (U, UU, S) Pulse count	3.5mm jack socket
K, T, J thermocouple	mini t/c socket
Humidity	6-pin DIN socket
Pt 100	mini 3-pin plug
Event/digital	9-way D

Waterproof models have input cables passing through waterproof glands and connections to terminal blocks inside the logger.

Table 1: Limits for ranges

Input Code	Input type	Limits for ranges: Lowest possible value	Limits for ranges: Highest possible value	Limits for span: Shortest possible span	Limits for span: Longest possible span
V	Voltage (dc)	−25V	+25V	10mV	25V
C	Current (dc)	0	100mA	10mA	100mA
U	Mini-thermistor (U and UU probes)	−60°C (−60°F)	+150°C (+300°F)	25°C (50°F)	125°C (200°F)
S	Micro-thermistor	0°C (32°F)	125°C (250°F)	25°C (50°F)	125°C (200°F)
P	Pt 100 (3 wire)*	−50°C (−60°F)	+600°C (+1100°F)	50°C (100°F)	625°C (1000°F)
K	Chromel-Alumel Thermocouple	−200°C (−330°F)	+1250°C (+2300°F)	100°C† (200°F)	1250°C (2000°F)
T	Copper-Constantan Thermocouple	−200°C (−330°F)	+370°C (+700°F)	100°C† (200°F)	500°C (1000°F)
J	Iron-Constantan Thermocouple	0°C (32°F)	500°C (930°F)	100°C (200°F)	500°C (1000°F)
L	Humidity	0 to 100% rh only, resolution 0.5% rh			
B	Pulse-count	Count range of 0 to 1,000,000 only			
D	Event/digital	No choice of range			

*Two wire Pt 100 probes can also be used, with two pins of the plug connected together
†Shortest span is 125°C (250°F) if low end of range is −150°C or lower

Physical Details

Indoor version: Model MQ

Dimensions and weight (including batteries):
180 × 120 × 40mm/0.5kg — standard case
180 × 120 × 67mm/1.2kg — deep case* for 16-channels.

Material: ABS coated with black textured paint.

*Also available as an option for accommodating extra batteries for averaging.

Weatherproof version: Model MQW

Dimensions and weight (including batteries):
122 × 120 × 55mm/0.5kg — standard case
200 × 120 × 75mm/1.2kg — large case for 16 channel model and certain input combinations.

Material: ABS (protected to IP65 against ingress of dust and liquids).

Power Supply

Standard 9V manganese alkaline (Duracell MN1604 or similar). Recording life up to six months in non-averaging recording mode. An LED flashes every eight seconds to indicate operation.

Low ambient temperatures, frequent downloading by modem, particularly at slow baud rates, and averaging recording can all significantly reduce the recording life of the standard battery, so more power is required.

For models MQ this will be in the form of a deeper case containing six size C cells (Duracell MN1400 or similar). For models MQW the MP9 mains power pack is available.

Clock Accuracy

At 20°C	1 second/day
0 to 40°C	2 seconds/day
−30 to +65°C	5 seconds/day

Memory

MQ8/MQW8	7,840 8 bit bytes
MQ32/MQW32	32,000 8 bit-bytes

Analogue channels (voltage, current, temperature and humidity) use one 8-bit byte per reading, pulse-count channels use two and event-initiated recordings three.

The total memory capacity is shared among those channels actually selected to record.

Stored readings are retained in the memory for over a year when the Squirrel is not in use.

Conditions of Use

Ambient temperature: −30 to +65°C.

Humidity: up to 95% r.h. non-condensing (MQ)
up to 100% r.h. (MQW)

Vibration

Squirrel Meter/Loggers have been successfully tested to BS2011 with 2g acceleration over frequency range 55 to 500Hz and 0.15mm constant amplitude from 20 to 55Hz.

Guarantee

Squirrel Memory Loggers are guaranteed against faulty materials or workmanship for THREE YEARS. Within the United Kingdom we make no charge for labour, materials or carriage when equipment is returned for repair under guarantee.

Computers supplied with TAK kits are covered by their manufacturer's standard guarantee.

Grant Instruments (Cambridge) Ltd
Barrington
Cambridge
CB2 5QZ

Sales Enquiries: 0763 62600
General Enquiries: 0763 60811
Fax: 0763 62410
Telex: 81328

June 1988

mit exacta

Esquilos com evento/digital e canais analógicos só permitem saída RS 232 C.

PRECISÃO DO INSTRUMENTO:

FAIXAS ANALÓGICAS

RESOLUÇÃO: 1 bit (0,4 % da amplitude)
PRECISÃO: ± 1 bit (0,4 % da amplitude) nas faixas V e C.
± 2 bits (0,8 % de amplitude) em outras faixas.

Nas faixas dos termopares pode ter um erro de compensação da junta fria de até 0,07 ° C/°C quando o instrumento estiver sendo utilizado em temperaturas acima ou abaixo de 20° C (ambiente onde se encontra o ESQUILO).

FAIXAS PARA CONTAGEM DE PULSOS:

Modalidade Contagem: erro máximo de 1 pulso até 32.768 e máximo 32 pulsos até 1.000.000.
Modalidade Taxa: erro máximo 1 pulso.

FAIXAS PARA EVENTO/DIGITAL:

Leitura de estado - sem erro
Leitura de tempo - (para armazenamento tipo evento/iniciado) 1 segundo mais o erro do relógio (não acumulativo).

C.5 Tabela de calibração dos termopares

Tabela C.1 Calibração dos termopares

Termômetro de mercúrio (°C)	Termopar sem isolação mineral (°C)	Termopar com isolação mineral (°C)
10,7	11,3	10,9
11,4	10,8	11,1
16,0	16,5	16,5
16,6	17,2	16,8
20,0	20,4	20,4
25,7	25,5	25,5
30,9	30,8	30,8
35,3	35,4	35,4
50,2	50,3	—
50,5	—	50,6
60,0	59,0	60,3

APÊNDICE D

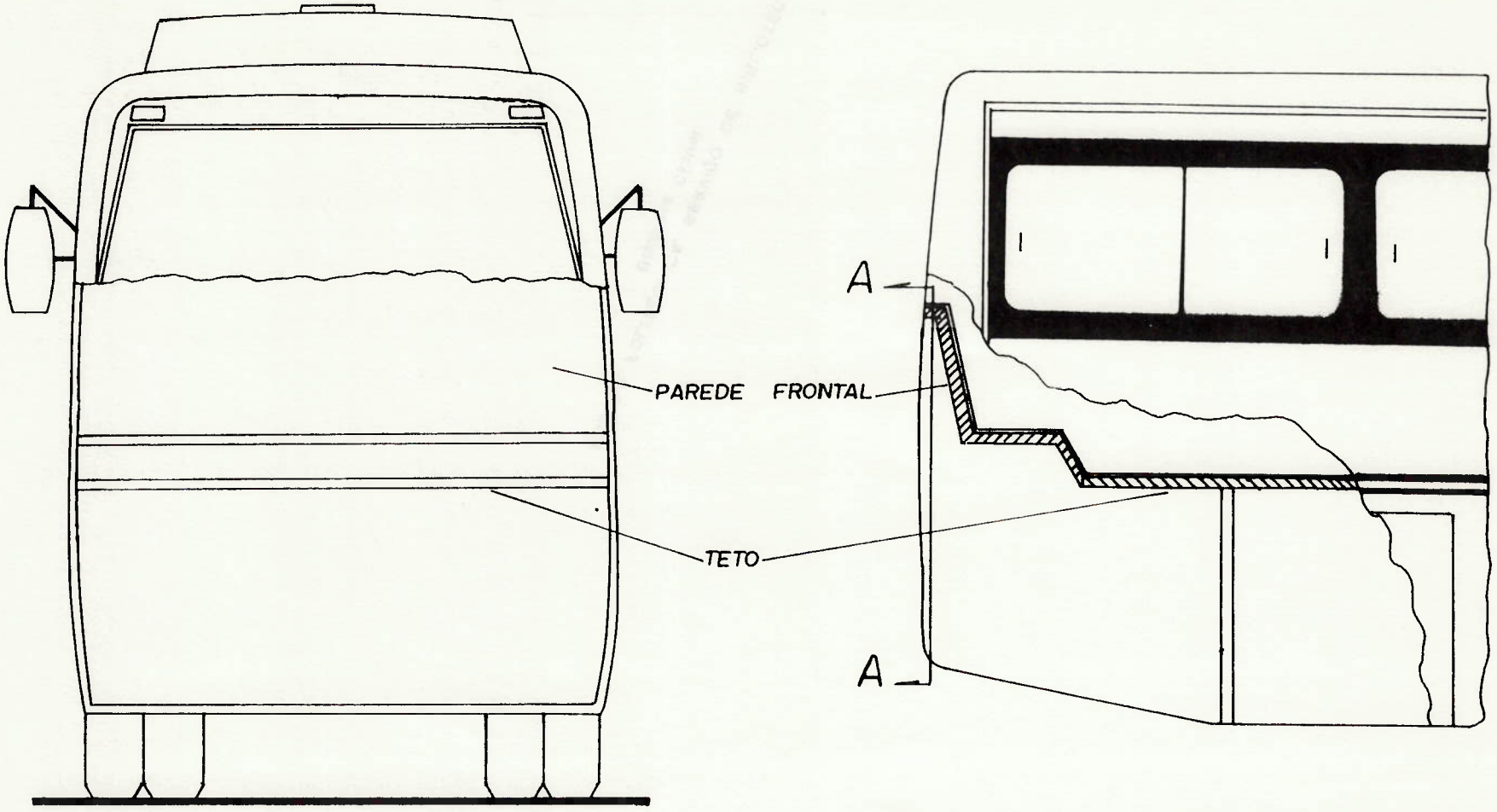


Figura D.1 Superfícies que compõem o compartimento do motor.

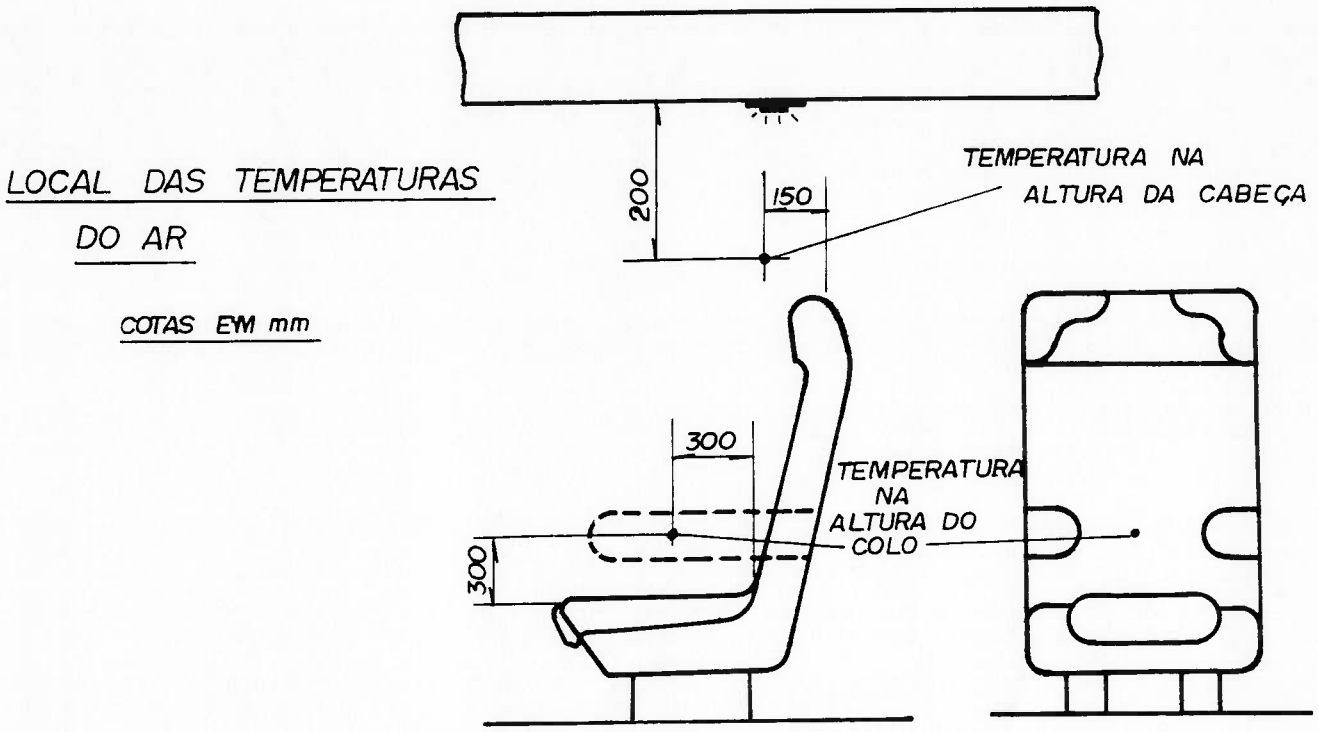


Figura D.2 Posições dos termopares para medida das temperaturas do ar interior.

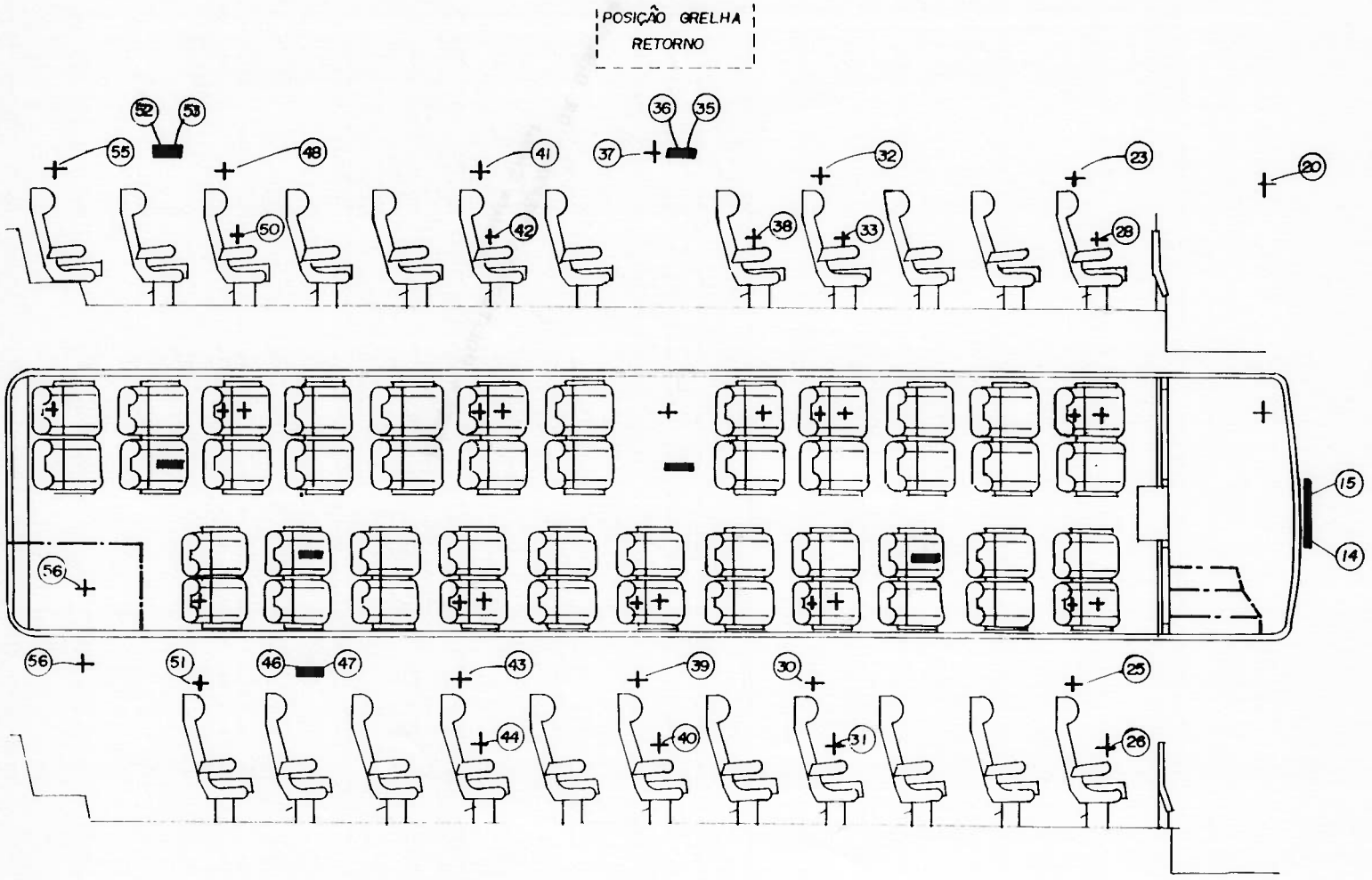


Figura D.3 Localização dos pontos de medição das temperaturas do ar interior e psicômetros.

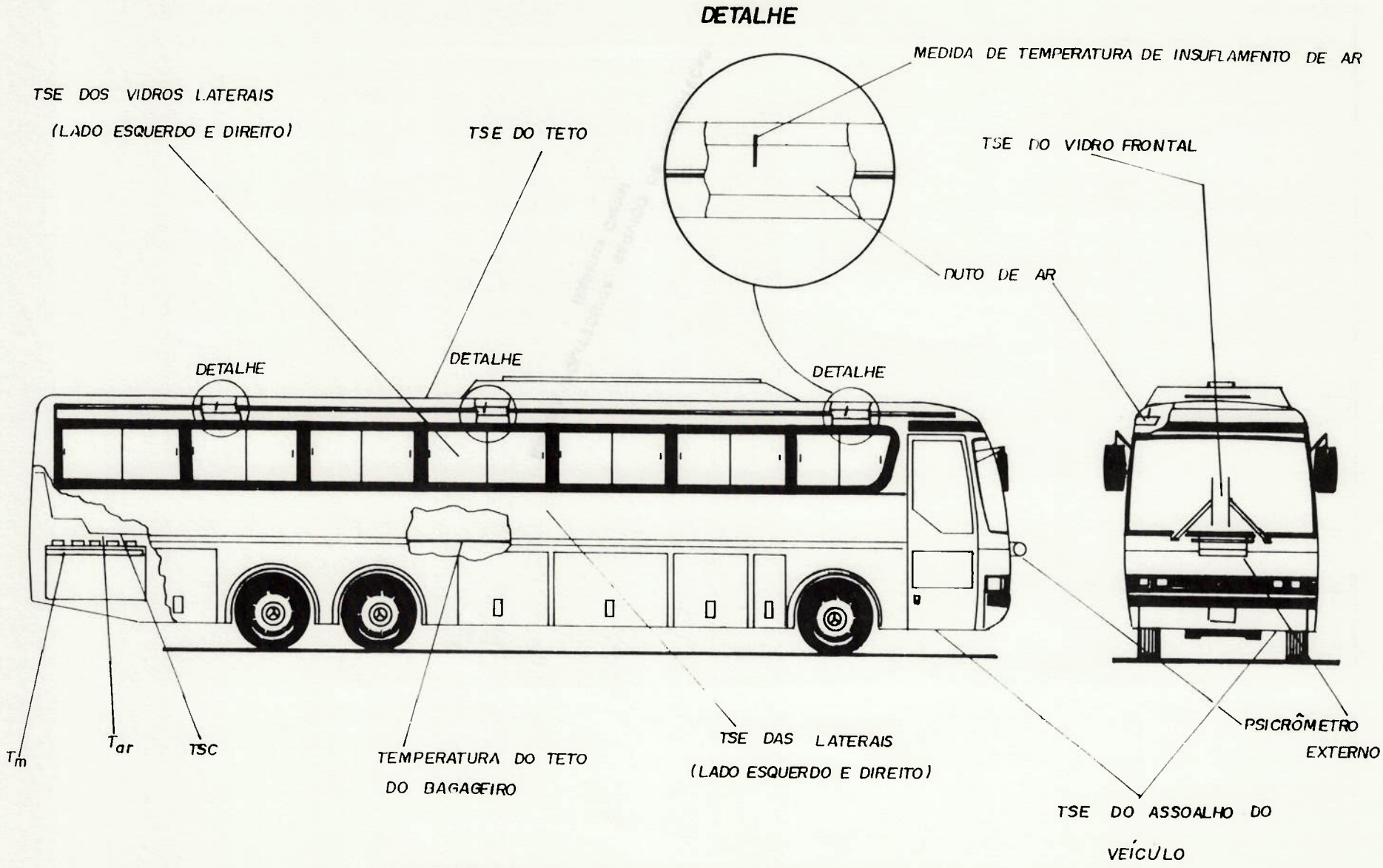


Figura D.4 Localização dos pontos de medição das TSEs e dos dutos de insuflamento..

D.1 Memorial do cálculo de áreas

Áreas de janelas

1 - Janelas laterais

6 janelas (1,467 m x 0,7 m)	6,1614 m^2
1 janela especial (1ª janela)	0,8470 m^2
	7,0084 m^2

2 - Vidro da porta 1,0524 m^2

3 - Vidro esquerdo do motorista 0,6936 m^2

4 - Parabrisa (2,74 m . 1,36) 3,7264 m^2

5 - Lateral direita

Lateral direita = Lateral - e janela da porta - janelas laterais + adendo da parte inferior da porta = = 25,0178 m^2 - 1,0524 m^2 - 7,0084 m^2 + 1,012 m^2 = 17,9690 m2

6 - Lateral esquerda

Lateral esquerda = Lateral - vidros laterai - vidro do motorista = 25,0178 m^2 - 7,008 m^2 - 0,6936 m^2 = 17,3158 m^2

7 - Teto (2,26 m x 12,05 m) 27,23 m^2

8 - Assoalho

Assoalho = Parte horizontal (2,48 m^2 x 11,44 m^2) + parte vertical (degrais + rebaixos) = = 28,37 m^2 + 1,97 m^2 = 30,94 m^2

9 - Frente

Frente = Parte superior (0,35 m x 2,70 m) + parte inferior (0,40 m x 2,50 m) = 0,94 m + 1,0040 m = 1,944 m^2

10 - Parte traseira {2 x (1,18 m x 1,11 m)} 2,61 m^2

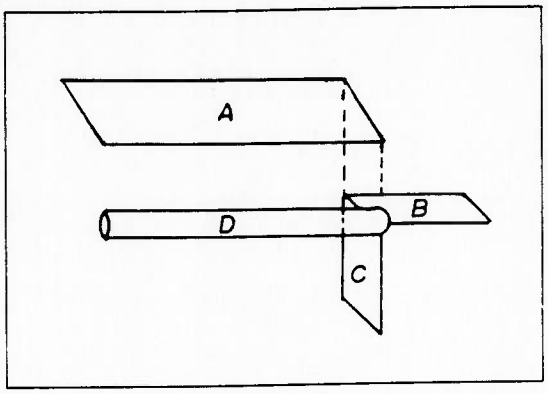
11 - Compartimento do motor

Parede frontal (1,37 m x 2,51 m)	3,45 m^2
Teto do compartimento (0,60 m x 2,51 m)	1,50 m^2

D.2 Cálculos de fatores de forma

Superfície do compartimento do motor - superfícies da tubulação de escape

A disposição das superfícies são conforme desenho abaixo:



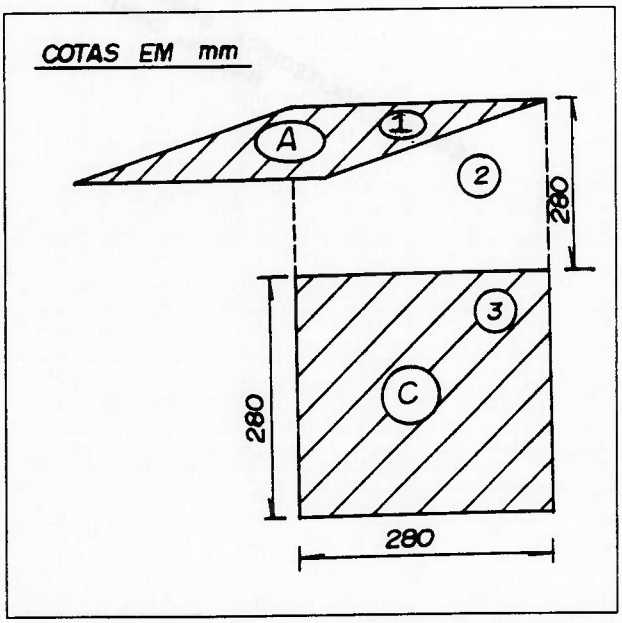
A - superfície escolhida do compartimento do motor;
B, C - superfícies efetivas dos canos de escape;
D - coletor de escape.

Figura D.5 Disposição geométrica das superfícies dos canos de escape e a superfície do compartimento do motor que foi medida a TSC.

Assim:

$$F_{A\text{-}B,C,D} = F_{A\text{-}B} + F_{A\text{-}C} + F_{A\text{-}D} \qquad (I)$$

1) Cálculo de $F_{A\text{-}C}$



$F_{1\text{-}2} + F_{1\text{-}3} + F_{1\text{-}2,3}$

$F_{A\text{-}B} = F_{1\text{-}3} = F_{1\text{-}2,3} - F_{1\text{-}2}$

Calculando pela figura D.10:

$F_{1\text{-}2,3} = 0,18$

$F_{1\text{-}2} = 0,11$

$F_{1\text{-}3} = 0,18 - 0,11 = 0,07$

Figura D.6 Dimensões e posições relativas das superfícies A e C.

2) Cálculo de F_{A-B}

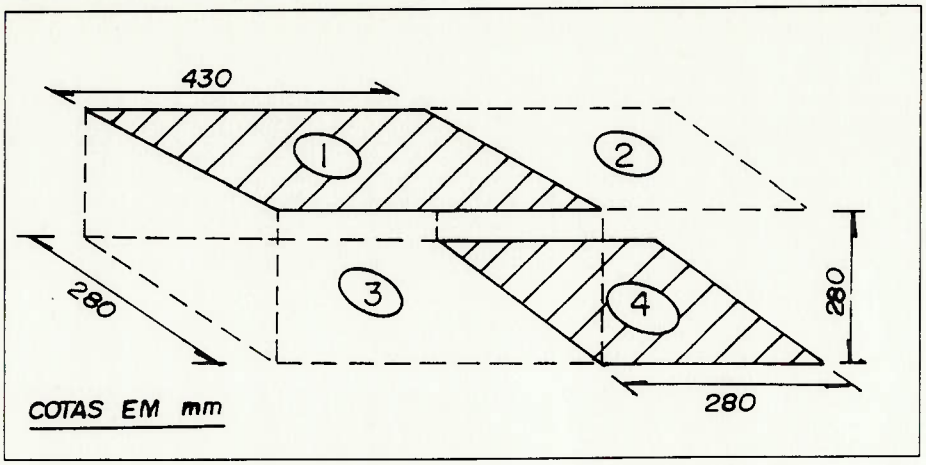


Figura D 7 Posições relativas e dimensões das superfícies 1 e 4.

$$A_{1,2}.F_{1,2\text{-}3,4} = A_1.F_{1\text{-}3,4} + A_2.F_{2\text{-}3,4}$$

$$= A_1.F_{1\text{-}3} + A_1.F_{1\text{-}4} + A_2.F_{2\text{-}3} + A_2.F_{2\text{-}4}$$

$$=.A_1.F_{1\text{-}3} + (A_1 + A_2).F_{1\text{-}4} + A_2.F_{2,4}$$

$$\therefore F_{1,4} = (A_{1,2}.F_{1,2\text{-}3,4} — A_1.F_{1\text{-}3} — A_2.F_{2,4})/A_1 + A_2$$

Da figura D.9 temos:

$F_{1,2\text{-}3,4} = 0{,}4$ $\qquad$ $A_{1,2} = 1.908\ cm^2$

$F_{1\text{-}3} = 0{,}37$ $\qquad$ e $\qquad$ $A_1 = 1.204$

$F_{2\text{-}4} = 0{,}30$ $\qquad$ $A_2 = 704$

$$\therefore F_{A\text{-}D} = F_{1,4} = 0{,}07$$

3) Cálculo de F_{A-D} e $F_{A-B,C,D}$

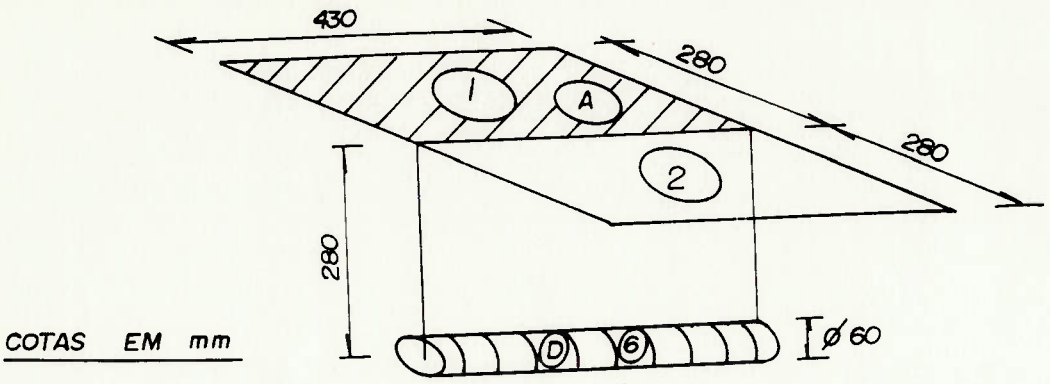


Figura D.8 Dimensões e posições relativas das superfícies A e D.

$$A_{1,2}\, F_{1,2} = A_1F_{1\text{-}6} + A_2F_{2\text{-}6} = 2A_1F_{1\text{-}6}$$

$$F_{1\text{-}6} = (A_{1,2}.F_{1,2\text{-}}6)/2A_1$$

Da figura D.11 temos que $F_{1,2\text{-}6} = 0{,}1$

$$\therefore F_{A\text{-}D} = F_{1\text{-}6} = 0{,}1$$

Portanto da equação I temos:

$$F_{A\text{-}B,C,D} = 0{,}07 + 0{,}07 + 0{,}1 = 0{,}24$$

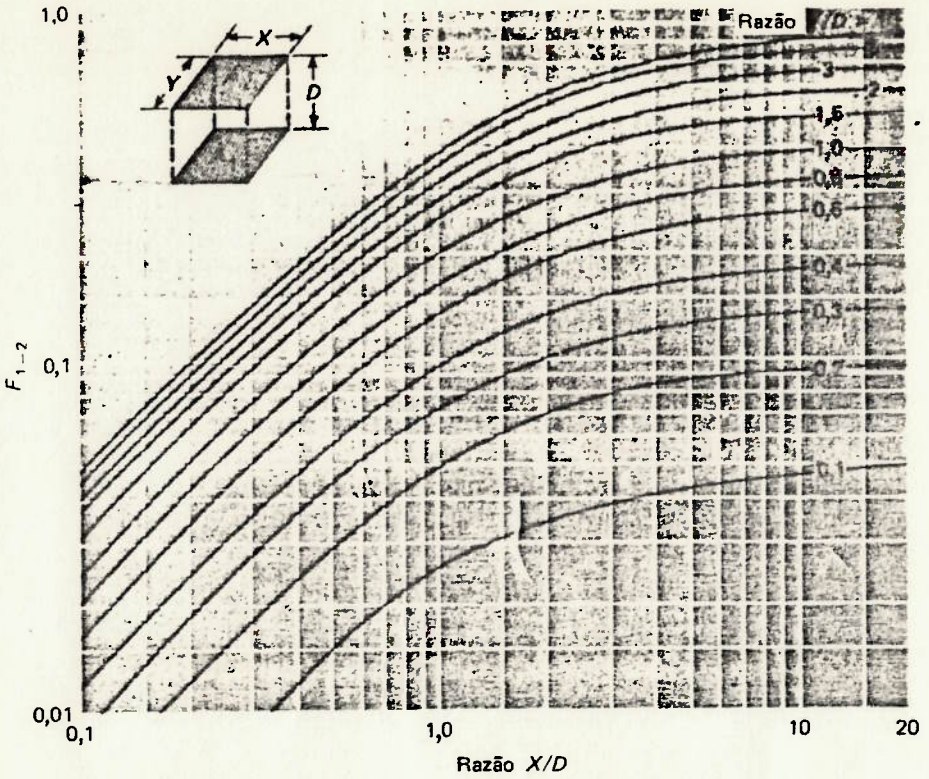


Figura D.9 Fatos de forma de radiação entre retângulos paralelos.

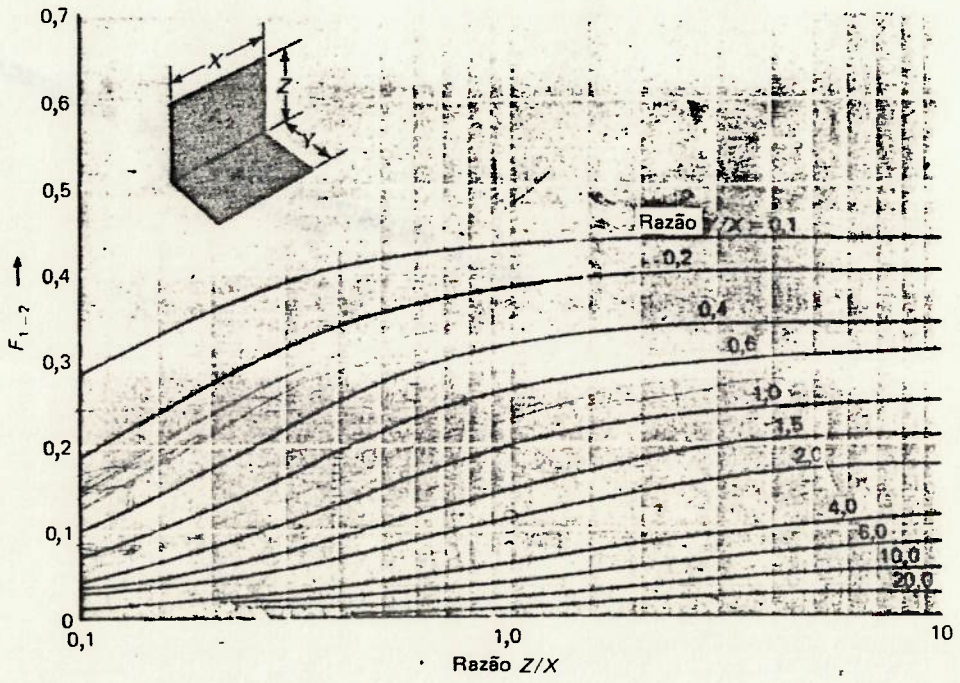
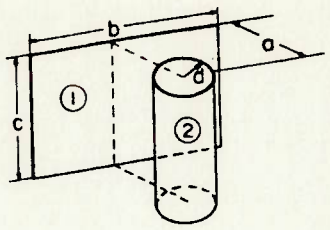


Figura D.10 Fator de forma de radiação entre retângulos perpendiculares com uma aresta comum.



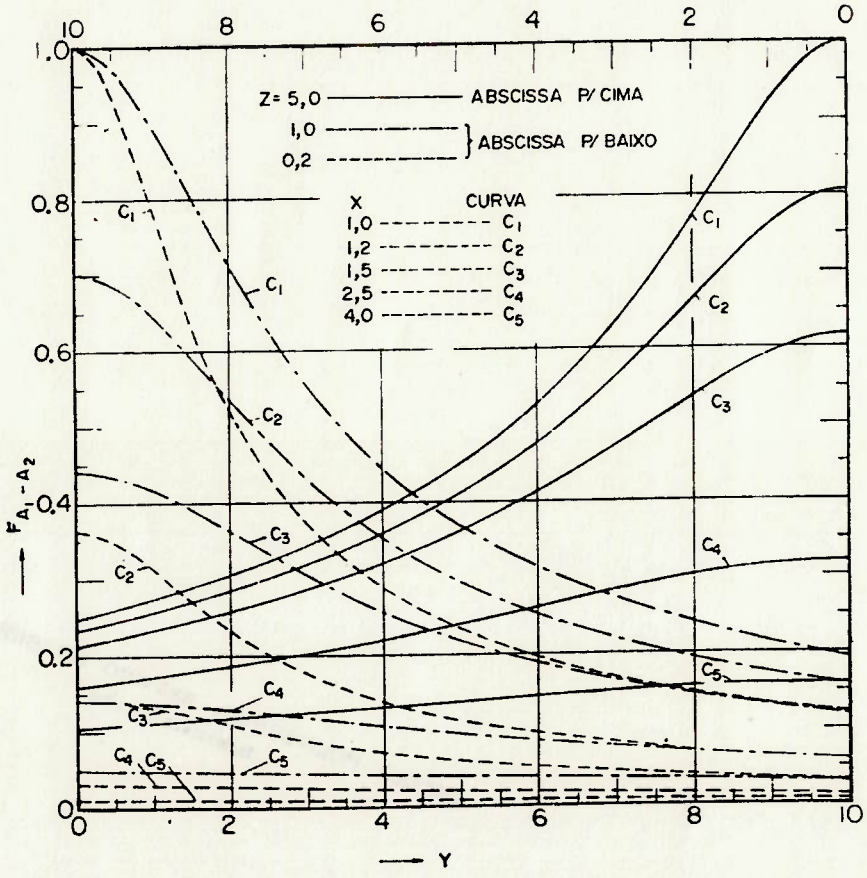


Figura D.11 Fator de forma de radiação entre cilindros e retângulos paralelos.

D.3 Compartimento do motor

Área da parede frontal = 3,45 m^2 (1,40x2,48).

Área do teto do compartimento = 1,48 m^2 (0,60x2,48).

• Composição de isolantes do teto do compartimento do motor

Material	Espessura (mm)	Condutividade Térmica (W/m^2C)[1]	Resistência Térmica ($m^2\,^oC/W$)
Lã de rocha	15	0,0400	0,3750
Poliuretano	25	0,0784	0,3185

• Composição de isolantes da parede frontal

Material	Espessura (mm)	Condutividade Térmica (W/m^2C)[1]	Resistência Térmica ($m^2\,^oC/W$)
Lã de rocha	15	0,0400	0,3750
Poliuretano	50	0,0784	0,3185

1 — O valor das condutividades destes isolantes foram medidas em um condutímetro ANACON/88 segundo norma ASTM C518/76 no Centro Tecnológico da Dow Química.

• Área da superfície do teto do compartimento do motor escolhida para a simulação das TSCs.

Área = 0,28x0,43 = 0,12 m^2 (Figura 6.2)

• Área da superfície dos canos de escape

Área do coletor = $(\pi.D^2.L)/4 = (\pi.0,06^2)/2.0,43$ = 0,007 m^2
Área das duas superfícies retangulares = 2(0,28.0,28) = 0,156 m^2
Área total = 0,162 m^2

D.4 Figuras dos pontos de medição de temperaturas no interior do ônibus 0371-RSD

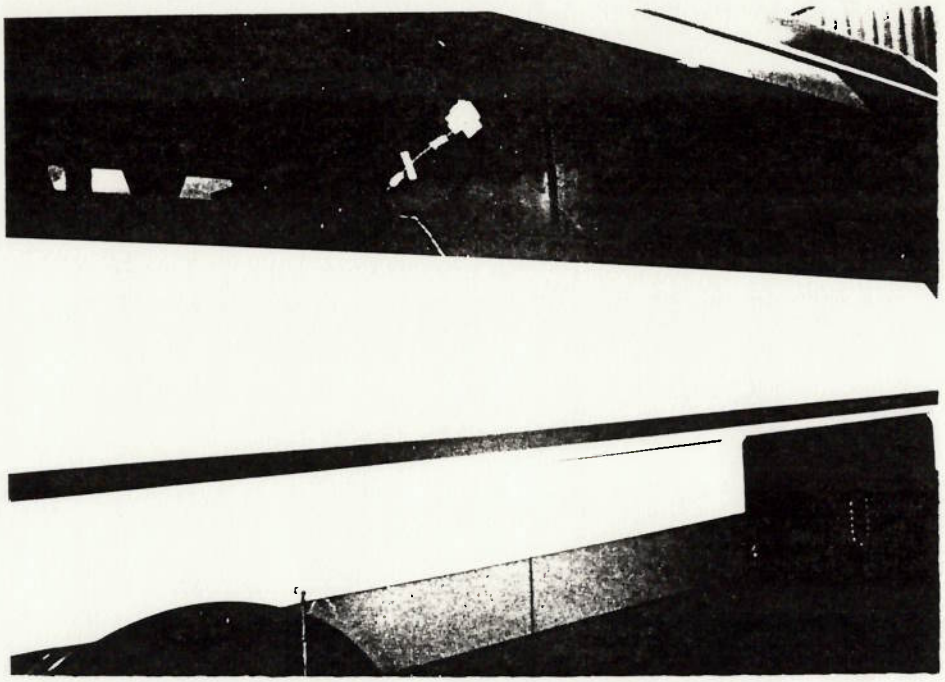


Figura D.12 Termopares instalados para a medida da TSE do vidro da lateral direita.

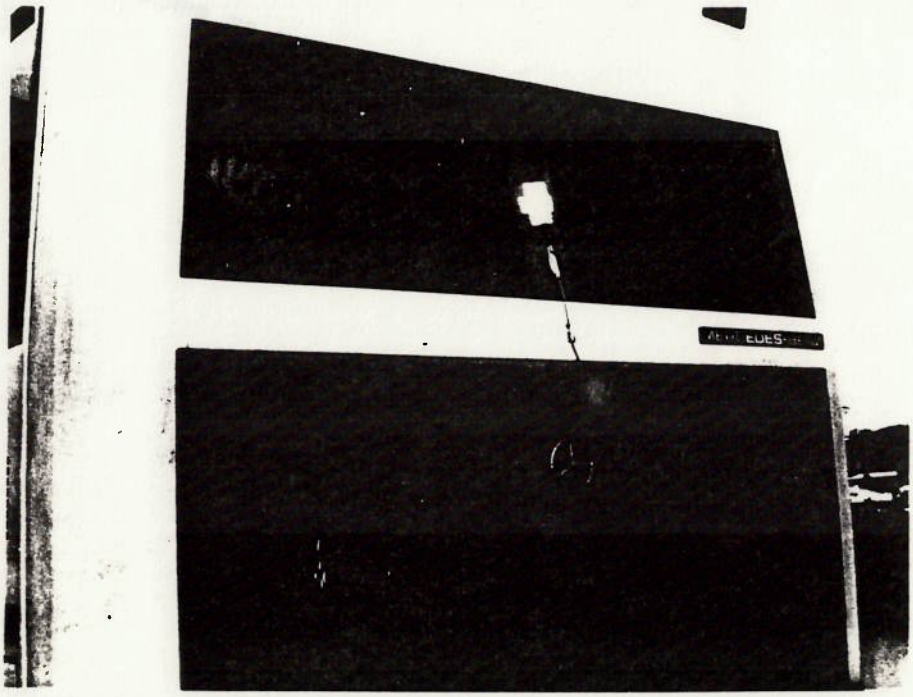


Figura D.13 Termopar instalado para a medida da TSE da parede traseira.

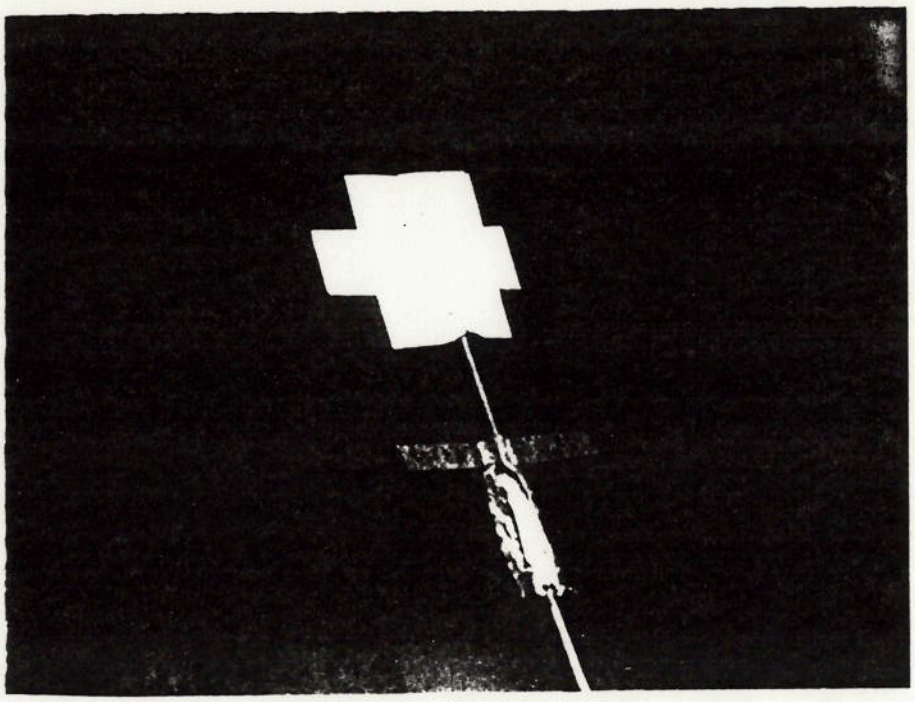


Figura D.14 Detalhe do termopar instalado para a medida da TSE da parede traseira do ônibus.

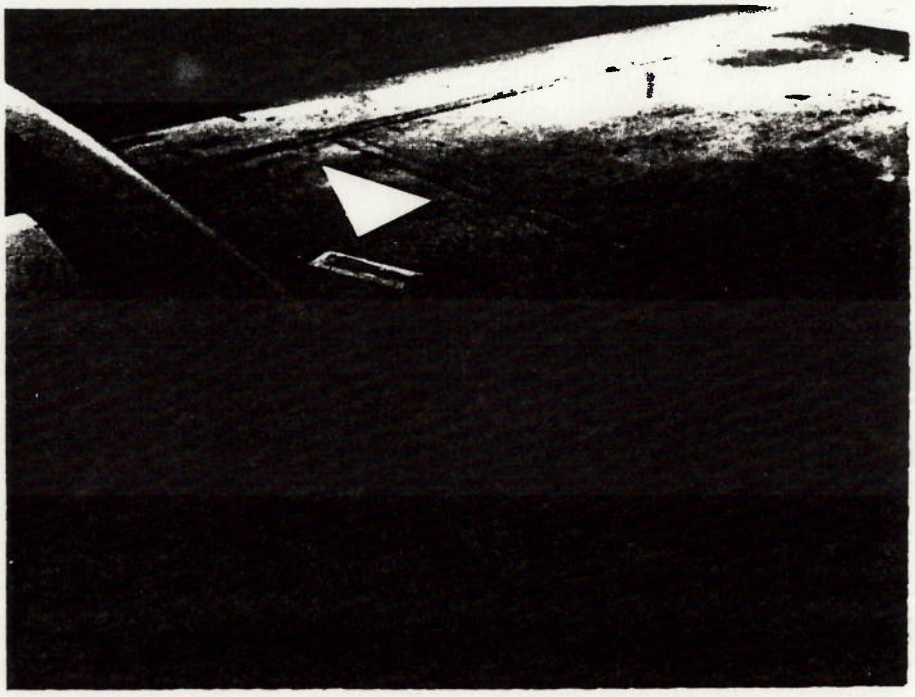


Figura D.15 Termopar instalado para medida da TSE do teto do ônibus.

Figura D.16 Detalhe do termopar instalado para a medida da TSE do teto do ônibus.

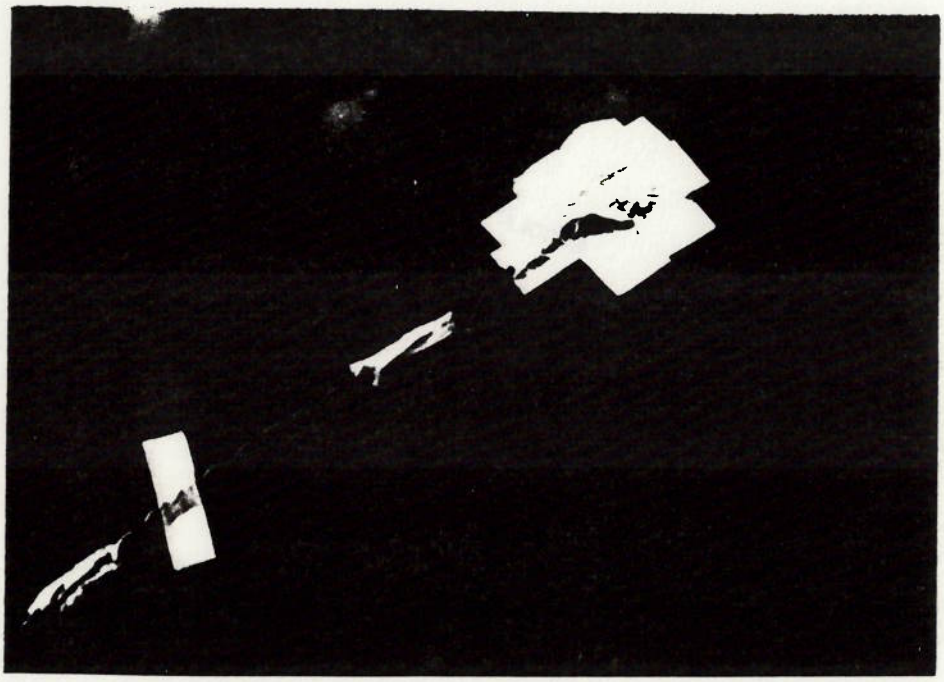


Figura D.17 Detalhe do termopar instalado para medida da TSE do vidro lateral direito.

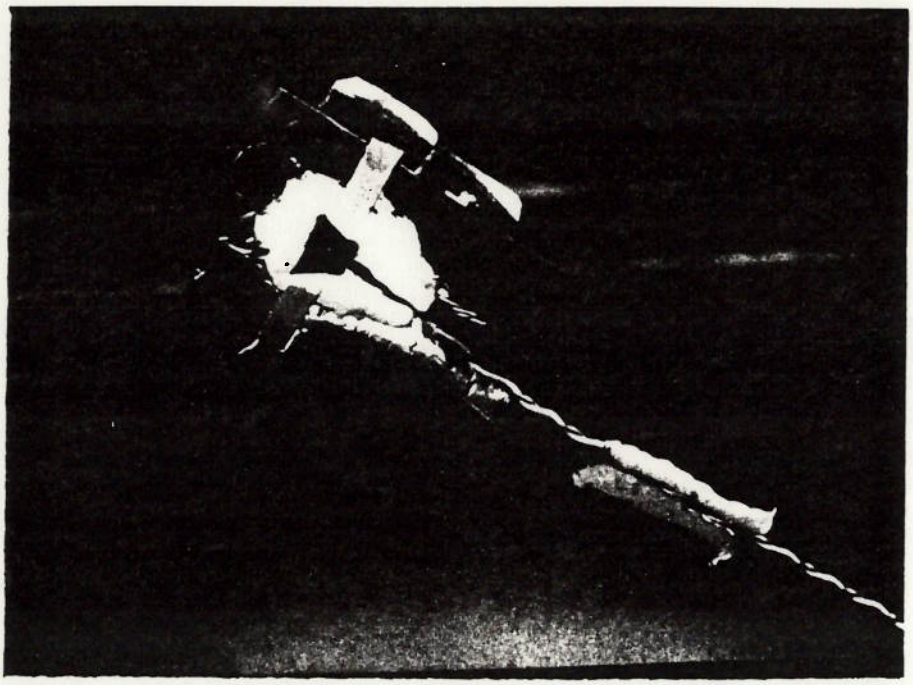


Figura D.18 Detalhe do termopar para medida da TSE do vidro da lateral direita, visto do interior da cabine

Figura D.19 Termopar instalado para a medida da TSE do vidro frontal.

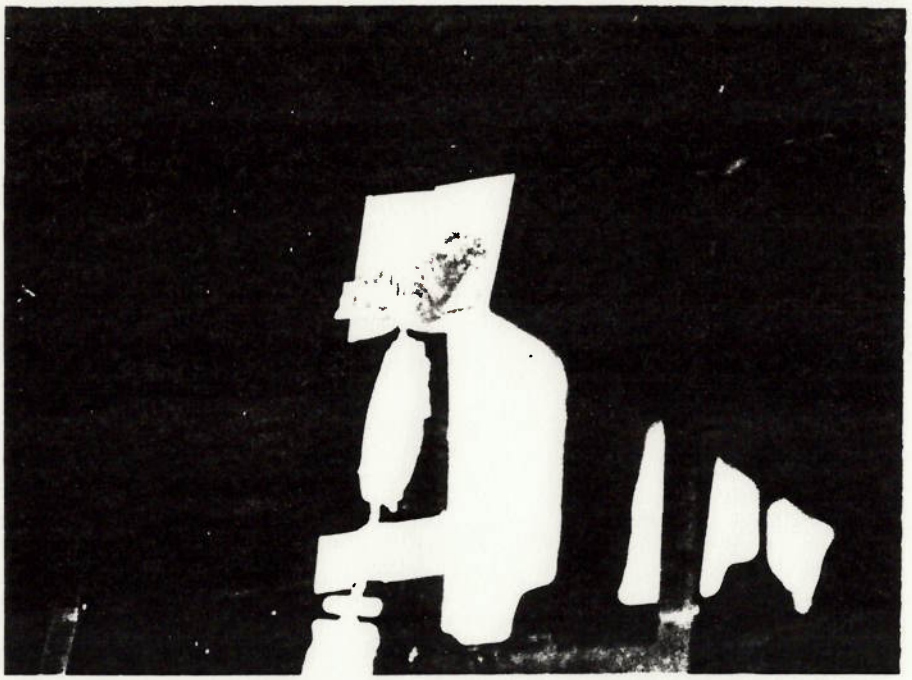


Figura D.20 Detalhe do termopar instalado para a medida da TSE do vidro frontal.

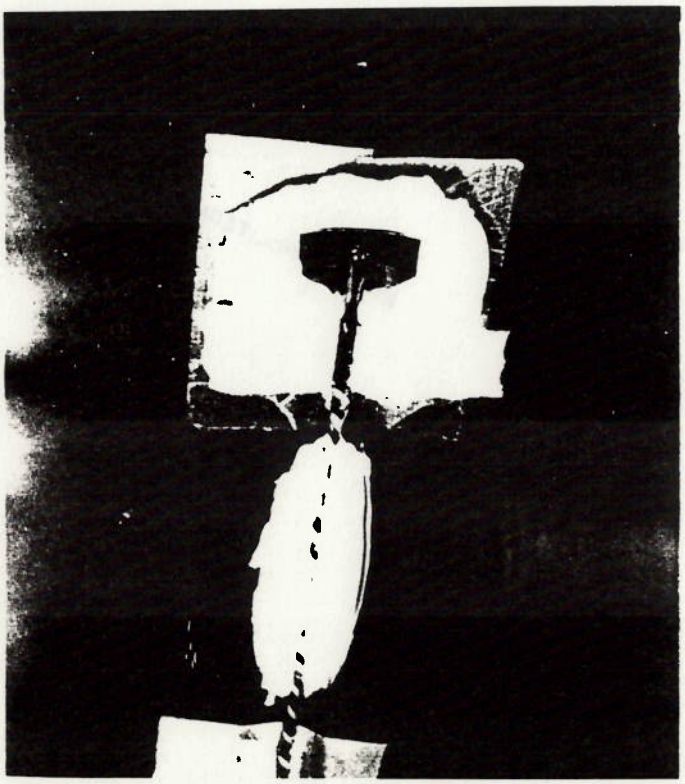


Figura D.21 Detalhe do termopar instalado para a medida da TSE do vidro frontal, visto do lado interno da cabine.

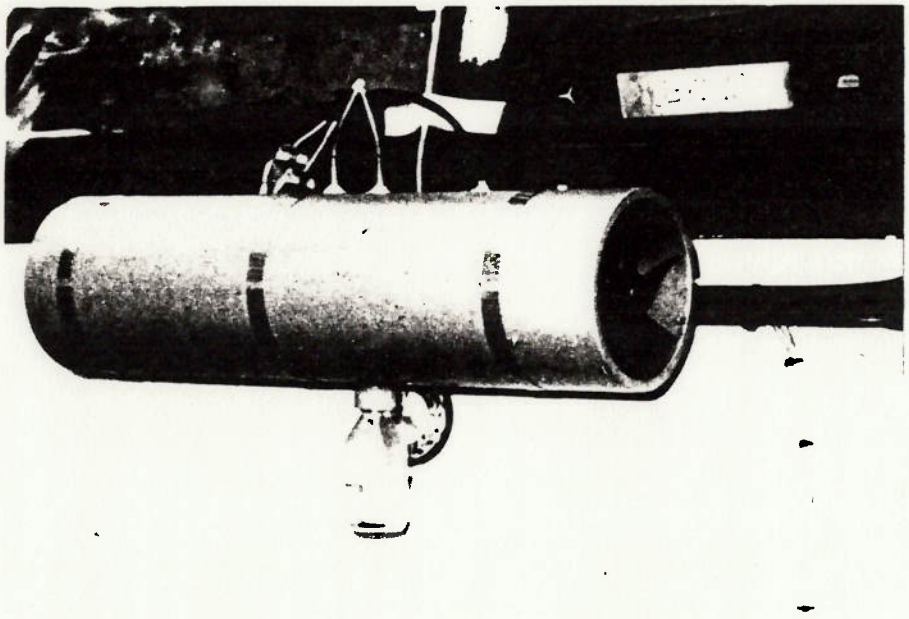


Figura D.22 Psicômetro externo colocado logo abaixo do vidro frontal.

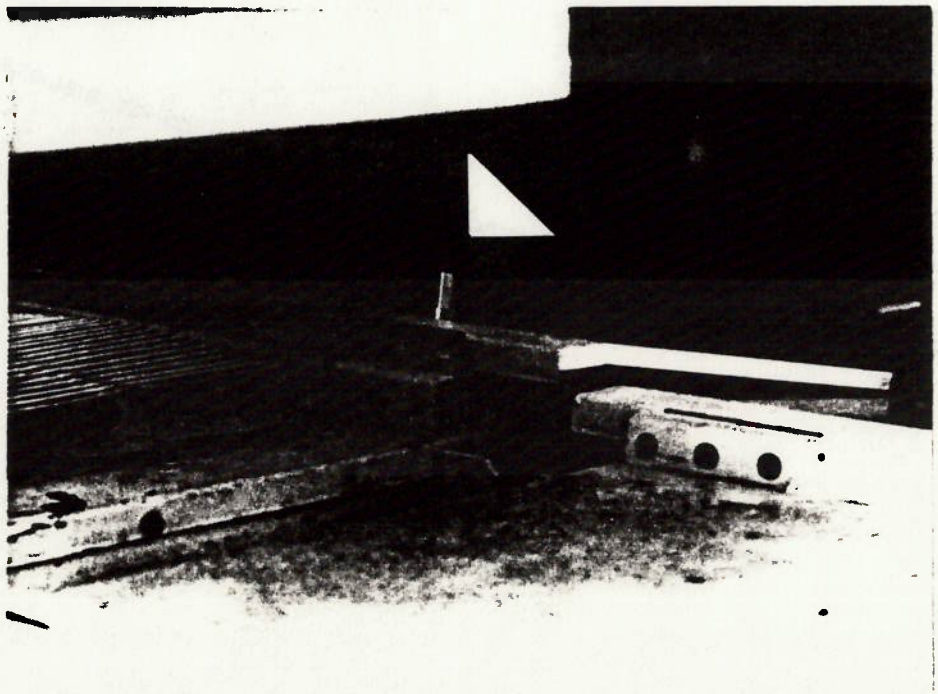


Figura D.23 Radiômetro instalado nas grades dos condensadores, no teto do ônibus.

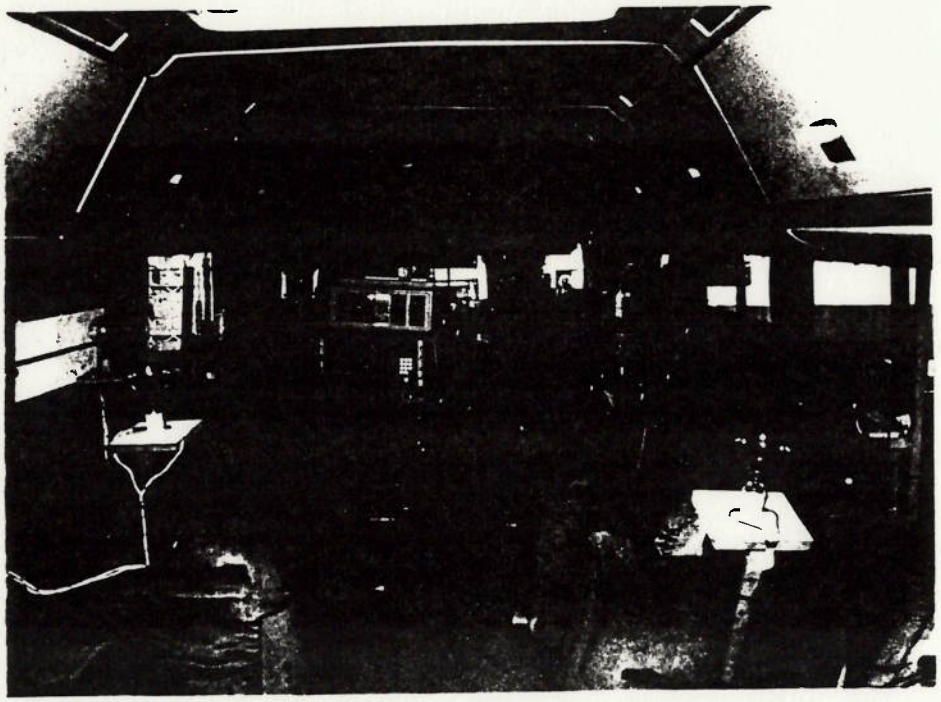


Figura D.24 Interior da cabine do ônibus.

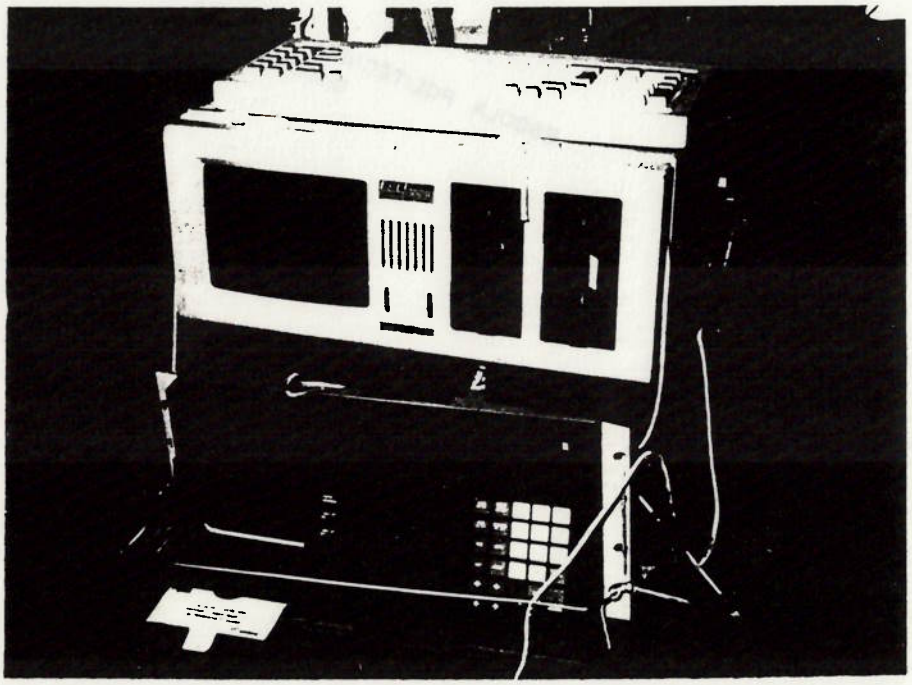


Figura D.25 Data logger Fluke (embaixo) e micro computador PC.

APÊNDICE E

E.1 Tabelas da radiação solar medida, calculada e índice de claridade.

Tabela E.1 Radiação solar medida, calculada e índice de claridade do dia 01/05/91.

DIA 1/5/91

HORARIO	radiacao teorica	radiacao experimental	indice de claridade
08:39 AM	554.03	208.799	0.376
08:40 AM	557.91	514.594	0.922
08:41 AM	561.77	517.422	0.921
08:42 AM	565.62	521.095	0.921
08:43 AM	569.46	526.468	0.924
08:44 AM	573.27	528.617	0.922
08:45 AM	577.07	534.904	0.926
08:46 AM	580.84	537.225	0.925
08:47 AM	584.59	540.260	0.924
08:48 AM	588.32	541.519	0.92
08:49 AM	592.03	538.554	0.909
08:50 AM	595.72	542.221	0.911
08:51 AM	599.39	542.744	0.905
08:52 AM	603.04	545.281	0.904
08:53 AM	606.67	549.849	0.911
08:54 AM	606.97	374.527	0.617
08:55 AM	610.31	375.367	0.615
08:56 AM	613.71	383.758	0.625
08:57 AM	617.05	379.225	0.615
08:58 AM	620.37	381.427	0.615
08:59 AM	623.65	384.223	0.616
09:00 AM	626.97	336.052	0.536
09:01 AM	630.24	345.671	0.548
09:02 AM	633.5	456.192	0.72
09:03 AM	636.74	420.921	0.661
09:04 AM	639.96	455.86	0.712
09:05 AM	643.17	445.076	0.692
09:06 AM	646.35	490.224	0.758
09:07 AM	649.52	550.141	0.847
09:08 AM	652.67	573.515	0.879
09:09 AM	655.81	650.027	0.991
09:10 AM	658.92	630.951	0.957
09:11 AM	662.02	564.434	0.853
09:12 AM	665.1	607.561	0.913
09:13 AM	668.17	574.777	0.86
09:14 AM	671.22	525.025	0.782
09:15 AM	674.24	10.736	0.016
09:16 AM	677.25	592.225	0.874
09:17 AM	680.23	556.467	0.818
09:18 AM	683.22	539.789	0.79
09:19 AM	686.19	597.304	0.87
09:20 AM	689.12	199.676	0.29
09:21 AM	692.04	27.32	0.039
09:22 AM	694.95	24.061	0.035
09:23 AM	697.83	537.487	0.77
09:24 AM	700.7	551.456	0.787
09:25 AM	703.53	576.694	0.82
[illegible]	[illegible]	[illegible]	0.825

cont. tabela E.1

09:27 AM	709.2	626.637	0.884
09:28 AM	711.99	622.227	0.874
09:29 AM	714.77	642.837	0.899
09:30 AM	717.53	633.826	0.883
09:31 AM	720.27	593.270	0.824
09:32 AM	722.99	631.909	0.874
09:33 AM	725.7	599.604	0.826
09:34 AM	728.39	632.484	0.868
09:35 AM	731.05	614.75	0.841
09:36 AM	733.7	630.951	0.86
09:37 AM	736.33	604.877	0.821
09:38 AM	738.95	624.72	0.845
09:39 AM	741.54	610.245	0.823
09:40 AM	744.12	610.628	0.821
09:41 AM	746.67	600.659	0.804
09:42 AM	749.21	595.962	0.795
09:43 AM	751.73	575.064	0.765
09:44 AM	754.24	545.154	0.723
09:45 AM	756.72	657.897	0.869
09:46 AM	759.18	668.815	0.881
09:47 AM	761.63	369.732	0.485
09:48 AM	764.05	600.467	0.786
09:49 AM	766.46	602.427	0.79
09:50 AM	768.85	709.364	0.923
09:51 AM	771.22	395.518	0.513
09:52 AM	773.57	744.161	0.962
09:53 AM	775.91	698.532	0.9
09:54 AM	778.22	692.78	0.89
09:55 AM	780.51	453.801	0.581
09:56 AM	782.79	680.961	0.874
09:57 AM	785.03	738.601	0.941
09:58 AM	787.28	754.035	0.958
09:59 AM	789.5	740.135	0.937
10:00 AM	791.7	696.135	0.879
10:01 AM	793.88	695.944	0.877
10:02 AM	796.04	716.458	0.9
10:03 AM	798.18	691.433	0.866
10:04 AM	800.31	68.348	0.085
10:05 AM	802.41	731.891	0.912
10:06 AM	804.49	753.268	0.936
10:07 AM	806.56	745.675	0.925
10:08 AM	808.6	746.366	0.923
10:09 AM	810.63	675.43	0.833
10:10 AM	812.63	31.634	0.039
10:11 AM	814.62	687.125	0.843
10:12 AM	816.59	676.196	0.828
10:13 AM	818.54	687.796	0.84
10:14 AM	820.46	718.95	0.876
10:15 AM	822.37	753.355	0.916
10:16 AM	824.26	759.595	0.922
10:17 AM	826.13	709.747	0.859
10:18 AM	827.98	766.497	0.926
10:19 AM	829.81	750.009	0.904
10:20 AM	831.62	720.196	0.866
10:21 AM	833.41	721.059	0.865
10:22 AM	835.19	723.933	0.867

cont. tabela E1

10:23 AM	836.94	737.259	0.881
10:24 AM	838.67	730.837	0.871
10:25 AM	840.38	744.449	0.886
10:26 AM	842.07	733.617	0.871
10:27 AM	843.74	748.187	0.887
10:28 AM	845.4	717.896	0.849
10:29 AM	847.03	716.17	0.846
10:30 AM	848.64	735.534	0.867
10:31 AM	850.23	773.678	0.91
10:32 AM	851.81	770.671	0.914
10:33 AM	853.36	701.12	0.822
10:34 AM	854.89	784.039	0.917
10:35 AM	856.4	721.347	0.842
10:36 AM	857.9	748.571	0.873
10:37 AM	859.37	768.797	0.895
10:38 AM	860.82	771.577	0.896
10:39 AM	862.25	748.187	0.868
10:40 AM	863.67	776.658	0.899
10:41 AM	865.06	769.66	0.89
10:42 AM	866.43	779.342	0.899
10:43 AM	867.78	790.27	0.911
10:44 AM	869.11	788.065	0.907
10:45 AM	870.42	777.608	0.894
10:46 AM	871.71	784.027	0.9
10:47 AM	872.98	792.137	0.907
10:48 AM	874.24	791.708	0.906
10:49 AM	875.47	806.183	0.921
10:50 AM	876.67	766.915	0.898
10:51 AM	877.86	790.078	0.9
10:52 AM	879.03	794.967	0.904
10:53 AM	880.18	792.697	0.901
10:54 AM	881.31	790.941	0.897
10:55 AM	882.42	805.032	0.912
10:56 AM	883.51	793.446	0.9
10:57 AM	884.57	41.316	0.047
10:58 AM	885.62	801.869	0.905
10:59 AM	886.65	802.444	0.905
11:00 AM	887.65	798.418	0.899
11:01 AM	888.64	804.17	0.905
11:02 AM	889.6	813.947	0.915
11:03 AM	890.55	815.491	0.916
11:04 AM	891.47	818.261	0.918
11:05 AM	892.37	817.686	0.916
11:06 AM	893.25	816.248	0.914
11:07 AM	894.12	821.328	0.919
11:08 AM	894.96	827.08	0.924
11:09 AM	895.78	827.943	0.924
11:10 AM	896.58	811.071	0.905
11:11 AM	897.36	823.717	0.918
11:12 AM	898.12	788.64	0.878
11:13 AM	898.86	816.344	0.908
11:14 AM	899.58	822.958	0.915
11:15 AM	900.27	609.19	0.677
11:16 AM	900.95	267.162	0.297
11:17 AM	901.6	821.616	0.911
11:18 AM	902.24	839.159	0.93

cont.tabela E1

11:19 AM	902.86	836.379	0.926
11:20 AM	903.45	35.085	0.039
11:21 AM	904.02	831.106	0.919
11:22 AM	904.58	836.666	0.925
11:23 AM	905.11	841.076	0.929
11:24 AM	905.62	841.172	0.929
11:25 AM	906.11	839.83	0.927
11:26 AM	906.58	833.982	0.92
11:27 AM	907.03	831.202	0.916
11:28 AM	907.46	838.006	0.923
11:29 AM	907.86	825.93	0.91
11:30 AM	908.25	814.727	0.899
11:31 AM	908.62	851.333	0.937
11:32 AM	908.96	829.285	0.912
11:33 AM	909.29	830.531	0.913
11:34 AM	909.59	805.607	0.886
11:35 AM	909.88	812.797	0.893
11:36 AM	910.14	827.652	0.909
11:37 AM	910.38	836.954	0.919
11:38 AM	910.6	820.324	0.91
11:39 AM	910.8	822.287	0.903
11:40 AM	910.98	820	0.902
11:41 AM	911.14	827.464	0.908
11:42 AM	911.28	827.109	0.91
11:43 AM	911.4	823.15	0.903
11:44 AM	911.49	806.662	0.885
11:45 AM	911.57	821.904	0.902
11:46 AM	911.63	842.993	0.925
11:47 AM	911.66	830.148	0.911
11:48 AM	911.67	840.692	0.922
11:49 AM	911.67	736.205	0.808
11:50 AM	911.64	836.094	0.917
11:51 AM	911.59	821.424	0.901
11:52 AM	911.52	839.734	0.921
11:53 AM	911.43	819.507	0.899
11:54 AM	911.32	843.28	0.925
11:55 AM	911.19	835.612	0.917
11:56 AM	911.04	847.498	0.93
11:57 AM	910.87	838.392	0.92
11:58 AM	910.68	838.2	0.92
11:59 AM	910.46	850.662	0.934
12:00 PM	910.23	856.762	0.919
12:01 PM	909.97	838.871	0.922
12:02 PM	909.7	834.749	0.918
12:03 PM	909.4	836.954	0.92
12:04 PM	909.09	841.363	0.926
12:05 PM	908.75	834.845	0.919
12:06 PM	908.39	841.843	0.927
12:07 PM	908.01	627.803	0.691
12:08 PM	786.99	780.013	0.991
12:09 PM	624.77	594.302	0.951
12:10 PM	631.4	604.397	0.957
12:11 PM	631.37	611.108	0.968
12:12 PM	631.72	590.977	0.936

cont. tabela E.1

12:13 PM	631.85	602.768	0.954
12:14 PM	631.97	602.288	0.953
12:15 PM	632.07	611.012	0.967
12:16 PM	632.15	605.548	0.958
12:17 PM	632.22	595.193	0.941
12:18 PM	632.27	609.766	0.964
12:19 PM	632.31	607.081	0.96
12:20 PM	632.33	608.134	0.962
12:21 PM	632.33	606.794	0.96
12:22 PM	632.32	606.315	0.959
12:23 PM	632.29	605.835	0.958
12:24 PM	632.24	604.781	0.957
12:25 PM	632.18	607.081	0.96
12:26 PM	632.1	603.055	0.954
12:27 PM	632.01	608.903	0.963
12:28 PM	631.89	600.371	0.95
12:29 PM	631.77	607.081	0.961
12:30 PM	631.62	606.41	0.96
12:31 PM	631.46	604.877	0.958
12:32 PM	631.29	605.068	0.958
12:33 PM	631.1	602.772	0.955
12:34 PM	630.89	604.204	0.958
12:35 PM	630.66	603.62	0.957
12:36 PM	630.42	603.63	0.958
12:37 PM	630.17	603.247	0.957
12:38 PM	629.89	602.672	0.957
12:39 PM	629.6	601.713	0.956
12:40 PM	629.3	601.905	0.956
12:41 PM	628.97	600.563	0.955
12:42 PM	628.64	601.905	0.957
12:43 PM	628.28	600.637	0.956
12:44 PM	627.91	600.946	0.957
12:45 PM	627.52	600.371	0.957
12:46 PM	627.12	600.851	0.958
12:47 PM	626.7	599.892	0.957
12:48 PM	626.26	599.125	0.957
12:49 PM	625.81	598.346	0.956
12:50 PM	625.34	596.824	0.954
12:51 PM	624.86	596.345	0.954
12:52 PM	624.36	595.195	0.953
12:53 PM	623.84	595.099	0.954
12:54 PM	623.31	592.894	0.951
12:55 PM	622.76	590.689	0.949
12:56 PM	622.19	590.018	0.948
12:57 PM	621.61	587.526	0.945
12:58 PM	621.01	587.143	0.945
12:59 PM	620.4	585.034	0.943
01:00 PM	619.77	586.855	0.947
01:01 PM	619.12	583.308	0.942
01:02 PM	618.46	581.295	0.94
01:03 PM	617.78	580.049	0.939
01:04 PM	617.09	580.241	0.94
01:05 PM	616.38	579.857	0.941
01:06 PM	615.65	576.214	0.936
01:07 PM	614.91	561.74	0.914
01:08 PM	614.15	576.31	0.938

cont. tabela E1

01:09 PM	613.37	576.79	0.94
01:10 PM	612.58	576.023	0.94
01:11 PM	611.78	574.777	0.94
01:12 PM	610.95	574.106	0.94
01:13 PM	610.11	573.626	0.94
01:14 PM	609.26	569.792	0.935
01:15 PM	608.39	570.655	0.938
01:16 PM	607.5	571.23	0.94
01:17 PM	606.6	568.238	0.937
01:18 PM	605.68	567.299	0.937
			ERR
01:30 PM	593.42	548.703	0.925
01:31 PM	592.3	547.84	0.925
01:32 PM	591.16	548.319	0.928
01:33 PM	590.01	531.544	0.901
01:34 PM	588.04	541.827	0.92
01:35 PM	587.65	553.304	0.942
01:36 PM	586.43	593.469	1.012
01:37 PM	585.23	614.75	1.05
01:38 PM	584	558.001	0.955
01:39 PM	582.75	559.918	0.961
01:40 PM	581.49	529.771	0.911
01:41 PM	580.21	487.984	0.841
01:42 PM	578.91	541.856	0.935
01:43 PM	577.6	541.897	0.938
01:44 PM	576.28	544.293	0.944
01:45 PM	574.94	548.319	0.954
01:46 PM	573.58	564.136	0.984
01:47 PM	572.21	539.404	0.943
01:48 PM	570.82	515.727	0.903
01:49 PM	569.42	516.206	0.907
01:50 PM	568	543.143	0.956
01:51 PM	566.57	539.173	0.951
01:52 PM	565.12	558.001	0.987
01:53 PM	563.66	575.448	1.021
01:54 PM	562.18	570.367	1.015
01:55 PM	560.69	510.646	0.911
01:56 PM	559.18	506.141	0.905
01:57 PM	557.65	511.317	0.917
01:58 PM	556.12	496.267	0.892
01:59 PM	554.56	498.76	0.899
02:00 PM	552.99	527.482	0.954
02:01 PM	551.41	541.801	0.983
02:02 PM	549.81	550.524	1.001
02:03 PM	548.2	531.16	0.969
02:04 PM	546.57	540.459	0.989
02:05 PM	544.93	537.104	0.986
02:06 PM	543.27	537.07	0.99
02:07 PM	541.6	518.027	0.956
02:08 PM	539.91	492.337	0.912
02:09 PM	538.21	510.838	0.949
02:10 PM	536.49	501.54	0.935
02:11 PM	534.76	516.014	0.965
02:12 PM	533.02	469.043	0.88
02:13 PM	531.26	507.397	0.955
02:14 PM	529.48	462.237	0.873

cont. tabela E.1

02:15 PM	527.69	500.581	0.949
02:16 PM	525.89	475.561	0.904
02:17 PM	524.07	500.869	0.956
02:18 PM	522.24	482.943	0.925
02:19 PM	520.39	518.123	0.996
02:20 PM	518.53	538.542	1.039
02:21 PM	516.65	495.117	0.958
02:22 PM	514.76	506.933	0.984
02:23 PM	512.86	389.192	0.759
02:24 PM	510.94	481.503	0.942
02:25 PM	509.01	145.42	0.286
02:26 PM	507.06	504.799	0.996
02:27 PM	505.1	618.393	1.224
02:28 PM	503.12	501.923	0.998
02:29 PM	501.13	570.75	1.139
02:30 PM	499.13	112.34	0.225
02:31 PM	497.11	454.76	0.915
02:32 PM	495.08	440.381	0.89
02:33 PM	493.04	493.679	1.001
02:34 PM	490.98	481.697	0.981
02:35 PM	488.91	113.211	0.232
02:36 PM	486.82	493.679	1.014
02:37 PM	484.72	653.041	1.347
02:38 PM	482.61	131.52	0.273
02:39 PM	480.48	136.409	0.284
02:40 PM	478.34	192.391	0.402
02:41 PM	476.19	595.578	1.251
02:42 PM	474.02	131.136	0.277
02:43 PM	471.84	439.902	0.932
02:44 PM	469.64	391.013	0.833
02:45 PM	467.44	489.365	1.047
02:46 PM	465.22	480.163	1.032
02:47 PM	462.98	705.088	1.516
02:48 PM	460.73	537.107	1.167
02:49 PM	458.47	444.836	0.97
02:50 PM	456.2	448.433	0.983
02:51 PM	453.91	429.261	0.946
02:52 PM	451.61	414.882	0.919
02:53 PM	449.3	459.307	1.02
02:54 PM	446.97	519.37	1.162
02:55 PM	444.63	518.986	1.167
02:56 PM	442.28	452.939	1.024
02:57 PM	439.92	412.486	0.938
02:58 PM	437.54	388.808	0.889
02:59 PM	435.15	337.044	0.775
03:00 PM	432.74	316.913	0.732
03:01 PM	430.33	335.414	0.779
03:02 PM	427.9	345.096	0.806
03:03 PM	425.46	342.412	0.805
03:04 PM	423	333.38	0.789
03:05 PM	420.54	344.713	0.82
03:06 PM	418.06	354.586	0.848
03:07 PM	415.57	348.93	0.84
03:08 PM	413.07	382.098	0.925
03:09 PM	410.55	15.625	0.038
03:10 PM	408.02	334.456	0.82

Tabela E.2 Radiação solar medida, calculada e índice de claridade do dia 02/05/91.

DIA 2/5/91

HORARIO	Rad.medida	Rad. teorica	indice de clarid
11:24 AM	810.163	866.58	0.94
11:25 AM	816.536	863.53	0.94
11:26 AM	821.904	866.46	0.95
11:27 AM	823.917	865.37	0.95
11:28 AM	813.66	864.25	0.94
11:29 AM	807.429	864.12	0.93
11:30 AM	802.136	865.97	0.93
11:31 AM	804.265	865.79	0.93
11:32 AM	806.738	865.6	0.93
11:33 AM	813.378	861.39	0.94
11:34 AM	810.099	865.13	0.94
11:35 AM	817.111	864.89	0.94
11:36 AM	817.878	864.67	0.95
11:37 AM	814.558	864.32	0.94
11:38 AM	813.327	864.01	0.94
11:39 AM	813.62	863.67	0.94
11:40 AM	808.748	863.31	0.94
11:41 AM	802.436	862.94	0.93
11:42 AM	801.192	862.51	0.93
11:43 AM	796.099	862.12	0.92
11:44 AM	801.581	861.69	0.93
11:45 AM	796.724	862.23	0.92
11:46 AM	794.07	860.73	0.92
11:47 AM	788.928	860.26	0.92
11:48 AM	781.853	859.73	0.91
11:49 AM	788.984	859.2	0.91
11:50 AM	774.243	858.64	0.90
11:51 AM	762.898	858.07	0.89
11:52 AM	775.314	857.48	0.90
11:53 AM	778.727	856.85	0.90
11:54 AM	734.011	856.22	0.86
11:55 AM	784.71	855.56	0.92
11:56 AM	785.107	854.88	0.92
11:57 AM	779.507	854.18	0.91
11:58 AM	781.738	853.47	0.92
11:59 AM	773.878	852.73	0.91
12:00 PM	727.174	851.98	0.85
12:01 PM	752.405	851.2	0.88
12:02 PM	781.067	850.4	0.92
12:03 PM	737.643	849.59	0.87
12:04 PM	779.342	848.75	0.92
12:05 PM	780.656	847.9	0.92
12:06 PM	764.963	847.02	0.90
12:07 PM	799.472	846.13	0.94
12:08 PM	803.49	845.22	0.95
12:09 PM	809.448	844.28	0.96
12:10 PM	804.733	843.33	0.95
12:11 PM	700.161	842.36	0.83
12:12 PM	658.314	841.37	0.78

cont. tabela E.2

12:13 PM	537.775	840.36	0.64
12:14 PM	762.566	839.33	0.91
12:15 PM	782.218	838.28	0.93
12:16 PM	770.619	837.21	0.92
12:17 PM	754.802	836.12	0.90
12:18 PM	767.933	835.01	0.92
12:19 PM	786.052	833.89	0.94
12:20 PM	779.534	832.74	0.94
12:21 PM	769.181	831.58	0.92
12:22 PM	768.51	830.39	0.93
12:23 PM	769.66	829.19	0.93
12:24 PM	767.935	827.97	0.93
12:25 PM	762.47	826.72	0.92
12:26 PM	764.579	825.46	0.93
12:27 PM	756.623	824.18	0.92
12:28 PM	735.63	822.89	0.89
12:29 PM	718.183	821.57	0.87
12:30 PM	726.407	820.23	0.89
12:31 PM	734.096	818.88	0.90
12:32 PM	724.222	817.5	0.89
12:33 PM	727.194	816.11	0.89
12:34 PM	722.305	814.7	0.89
12:35 PM	713.007	813.27	0.88
12:36 PM	710.994	811.82	0.88
12:37 PM	715.02	810.35	0.88
12:38 PM	706.776	808.87	0.87
12:39 PM	707.83	807.36	0.88
12:40 PM	666.227	805.84	0.83
12:41 PM	687.316	804.3	0.85
12:42 PM	674.643	802.74	0.84
12:43 PM	685.111	801.16	0.86
12:44 PM	688.562	799.56	0.86
12:45 PM	685.207	797.95	0.86
12:46 PM	687.987	796.32	0.86
12:47 PM	687.7	794.67	0.87
12:48 PM	690.767	793	0.87
12:49 PM	692.493	791.31	0.88
12:50 PM	696.615	789.6	0.88
12:51 PM	687.891	787.88	0.87
12:52 PM	688.562	786.14	0.88
12:53 PM	680.223	784.38	0.87
12:54 PM	676.58	782.6	0.86
12:55 PM	673.225	780.81	0.86
12:56 PM	673.122	778.99	0.86
12:57 PM	657.312	777.16	0.85
12:58 PM	581.487	775.31	0.75
12:59 PM	540.267	773.45	0.70
01:00 PM	381.91	771.56	0.49
01:01 PM	541.609	769.66	0.70
01:02 PM	665.077	767.74	0.87
01:03 PM	529.396	765.81	0.68
01:04 PM	198.238	763.85	0.26
01:05 PM	201.21	761.88	0.26
01:06 PM	336.083	759.89	0.44
01:07 PM	199.101	757.89	0.26
01:08 PM	215.973	755.87	0.29

cont. tabela E.2

01:09 PM	359.858	753.82	0.48
01:10 PM	343.85	751.77	0.46
01:11 PM	645.809	749.69	0.86
01:12 PM	354.778	747.6	0.47
01:13 PM	473.74	745.49	0.64
01:14 PM	581.103	743.37	0.78
01:15 PM	583.692	741.23	0.79
01:16 PM	615.325	739.07	0.83
01:17 PM	624.432	736.89	0.85
01:18 PM	442.681	734.7	0.60
01:19 PM	607.561	732.49	0.83
01:20 PM	623.857	730.26	0.85
01:21 PM	576.502	728.02	0.79
01:22 PM	595.482	725.76	0.82
01:23 PM	498.76	723.49	0.69
01:24 PM	574.585	721.2	0.80
01:25 PM	540.171	718.89	0.75
01:26 PM	575.543	716.57	0.80
01:27 PM	484.095	714.23	0.68
01:28 PM	225.079	711.87	0.32
01:29 PM	409.322	709.5	0.58
01:30 PM	189.324	707.11	0.27
01:31 PM	163.25	704.7	0.23
01:32 PM	152.226	702.28	0.22
01:33 PM	152.993	699.85	0.22
01:34 PM	160.47	697.4	0.23
01:35 PM	167.755	694.93	0.24
01:36 PM	172.163	692.45	0.25
01:37 PM	182.422	689.95	0.26
01:38 PM	193.629	687.43	0.28
01:39 PM	201.594	684.9	0.29
01:40 PM	209.53	682.36	0.31
01:41 PM	219.232	679.8	0.32
01:42 PM	344.329	677.22	0.51
01:43 PM	229.489	674.63	0.34
01:44 PM	451.301	672.03	0.67
01:45 PM	290.935	669.4	0.43
01:46 PM	380.085	666.77	0.57
01:47 PM	216.739	664.12	0.33
01:48 PM	245.018	661.45	0.37
01:49 PM	516.206	658.77	0.78
01:50 PM	425.331	656.08	0.65
01:51 PM	578.899	653.37	0.89
01:52 PM	564.52	650.64	0.87
01:53 PM	561.452	647.9	0.87
01:54 PM	494.733	645.15	0.77
01:55 PM	400.982	642.38	0.62
01:56 PM	404.242	639.6	0.63
01:57 PM	197.184	636.81	0.31
01:58 PM	184.818	633.99	0.29
01:59 PM	184.147	631.17	0.29
02:00 PM	208.687	628.33	0.33
02:01 PM	135.642	625.48	0.22
02:02 PM	123.084	622.61	0.20
02:03 PM	123.18	619.73	0.20
02:04 PM	134.376	616.84	0.22

cont. tabela E.2

02:05 PM	148.104	613.93	0.24
02:06 PM	159.128	611.01	0.26
02:07 PM	208.208	608.08	0.34
02:08 PM	188.652	605.13	0.31
02:09 PM	157.881	602.17	0.26
02:10 PM	152.226	599.2	0.25
02:11 PM	156.252	596.21	0.26
02:12 PM	170.439	593.21	0.29
02:13 PM	173.986	590.2	0.29
02:14 PM	188.748	587.17	0.32
02:15 PM	186.448	584.13	0.32
02:16 PM	187.023	581.08	0.32
02:17 PM	190.282	578.02	0.33
02:18 PM	204.661	574.94	0.36
02:19 PM	296.687	571.85	0.52
02:20 PM	298.316	568.75	0.52
02:21 PM	327.65	565.64	0.58
02:22 PM	409.322	562.51	0.73
02:23 PM	502.211	559.37	0.90
02:24 PM	543.239	556.22	0.98
02:25 PM	560.973	553.06	1.01
02:26 PM	552.441	549.89	1.00
02:27 PM	549.279	546.7	1.00
02:28 PM	537.197	543.5	0.99
02:29 PM	500.921	540.29	0.94
02:30 PM	499.718	537.07	0.93
02:31 PM	485.243	533.84	0.91
02:32 PM	473.644	530.6	0.89
02:33 PM	467.989	527.34	0.89
02:34 PM	450.254	524.08	0.86
02:35 PM	449.679	520.8	0.86
02:36 PM	439.614	517.52	0.85
02:37 PM	433.950	514.22	0.84
02:38 PM	426.865	510.91	0.84
02:39 PM	415.937	507.59	0.82
02:40 PM	397.64	504.26	0.79
02:41 PM	389.767	500.92	0.78
02:42 PM	384.59	497.57	0.77
02:43 PM	387.945	494.21	0.78
02:44 PM	393.314	490.84	0.80
02:45 PM	389.958	487.46	0.80
02:46 PM	386.028	484.06	0.80
02:47 PM	380.852	480.66	0.79
02:48 PM	383.883	477.25	0.80
02:49 PM	381.139	473.83	0.80
02:50 PM	381.81	470.41	0.81
02:51 PM	378.168	466.97	0.81
02:52 PM	371.17	463.52	0.80
02:53 PM	363.501	460.06	0.79
02:54 PM	349.41	456.6	0.77
02:55 PM	342.987	453.12	0.76
02:56 PM	312.887	449.64	0.70
02:57 PM	281.541	446.15	0.63
02:58 PM	287.484	442.65	0.65
02:59 PM	301.671	439.14	0.69
03:00 PM	311.833	435.62	0.72

cont. tabela E.2

03:01 PM	306.944	432.09	0.71
03:02 PM	304.451	428.56	0.71
03:03 PM	311.928	425.02	0.73
03:04 PM	312.024	421.47	0.74
03:05 PM	307.231	417.91	0.74
03:06 PM	301.671	414.35	0.73
03:07 PM	297.262	410.78	0.72
03:08 PM	301.759	407.2	0.74
03:09 PM	305.63	403.61	0.75
03:10 PM	300.617	400.02	0.75
03:11 PM	296.687	396.42	0.75
03:12 PM	291.894	392.81	0.74
03:13 PM	280.391	389.2	0.72
03:14 PM	274.831	385.58	0.71
03:15 PM	277.898	381.96	0.73
03:16 PM	273.489	378.32	0.72
03:17 PM	264.478	374.69	0.71
03:18 PM	264.957	371.04	0.71
03:19 PM	260.547	367.39	0.71
03:20 PM	259.301	363.74	0.71
03:21 PM	253.741	360.08	0.70
03:22 PM	248.375	356.41	0.70
03:23 PM	246.552	352.74	0.70
03:24 PM	241.28	349.07	0.69
03:25 PM	240.197	345.39	0.70
03:26 PM	241.955	341.7	0.71
03:27 PM	238.979	338.01	0.71
03:28 PM	238.212	334.32	0.71
03:29 PM	233.803	330.62	0.71
03:30 PM	233.036	326.92	0.71
03:31 PM	232.173	323.22	0.72
03:32 PM	224.688	319.51	0.70
03:33 PM	220.286	315.8	0.70
03:34 PM	217.698	312.09	0.70
03:35 PM	214.822	308.37	0.70
03:36 PM	215.11	304.65	0.71
03:37 PM	214.343	300.93	0.71
03:38 PM	212.617	297.2	0.72

Tabela E.3 Radiação solar medida, calculada e índice de claridade do dia 03/05/91.

DIA 3/5/91

	radiacao experimt	radiacao teorico	indice de claridade
11:41 AM	593.565	663.75	0.89426
11:43 AM	594.715	666.11	0.892818
11:44 AM	600.755	667.26	0.900331
11:45 AM	583.404	668.4	0.872837
11:46 AM	590.306	669.52	0.881685
11:47 AM	594.332	670.62	0.886243
11:48 AM	605.452	671.71	0.901359
11:49 AM	595.866	672.78	0.885677
11:50 AM	588.964	673.83	0.874054
11:51 AM	593.853	674.87	0.879952
11:52 AM	614.654	675.89	0.909399
11:53 AM	621.844	676.89	0.918678
11:54 AM	622.131	677.88	0.91776
11:55 AM	607.081	678.85	0.894279
11:56 AM	605.26	679.8	0.89035
11:57 AM	612.545	680.74	0.899822
11:58 AM	614.175	681.66	0.900999
11:59 AM	600.563	682.56	0.879868
12:00 PM	606.602	683.45	0.887559
12:01 PM	621.652	684.32	0.908423
12:02 PM	515.533	685.17	0.752419
12:03 PM	607.944	686	0.886216
12:04 PM	625.966	686.82	0.911397
12:05 PM	628.842	687.62	0.91452
12:06 PM	636.031	688.41	0.923913
12:07 PM	662.68	689.17	0.961562
12:08 PM	674.854	689.92	0.978163
12:09 PM	690.096	690.65	0.999198
12:10 PM	381.235	691.37	0.55142
12:11 PM	590.498	692.07	0.853234
12:12 PM	378.168	692.75	0.545894
12:13 PM	599.029	693.41	0.863889
12:14 PM	639.003	694.06	0.920674
12:15 PM	234.953	694.68	0.338218
12:16 PM	213.001	695.3	0.306344
12:17 PM	208.304	695.89	0.299335
12:18 PM	202.456	696.47	0.290689
12:19 PM	207.824	697.03	0.298156
12:20 PM	282.404	697.57	0.40484

cont. tabela E.3

12:21 PM	228.722	698.09	0.32764
12:22 PM	448.721	698.6	0.642315
12:23 PM	200.347	699.09	0.286503
12:24 PM	201.21	699.56	0.287624
12:25 PM	202.552	700.01	0.289356
12:26 PM	210.317	700.45	0.30026
12:27 PM	229.393	700.87	0.327298
12:28 PM	497.322	701.27	0.709173
12:29 PM	334.551	701.65	0.476806
12:30 PM	241.759	702.02	0.344376
12:31 PM	237.541	702.37	0.338199
12:32 PM	242.047	702.7	0.344453
12:33 PM	246.168	703.01	0.350163
12:34 PM	248.182	703.31	0.352877
12:35 PM	248.661	703.59	0.353417
12:36 PM	544.772	703.85	0.773989
12:37 PM	675.621	704.09	0.959566
12:38 PM	674.375	704.32	0.957484
12:39 PM	589.539	704.52	0.836795
12:40 PM	227.955	704.71	0.323473
12:41 PM	558.001	704.88	0.791626
12:42 PM	212.138	705.04	0.300888
12:43 PM	191.528	705.17	0.271605
12:44 PM	187.023	705.27	0.265172
12:45 PM	186.064	705.39	0.263775
12:46 PM	190.953	705.48	0.270671
12:47 PM	193.254	705.54	0.273909
12:48 PM	202.456	705.59	0.286932
12:49 PM	213.001	705.62	0.301864
12:50 PM	230.735	705.63	0.326991
12:51 PM	420.059	705.62	0.595305
12:52 PM	253.637	705.59	0.359751
12:53 PM	252.399	705.55	0.357734
12:54 PM	279.911	705.49	0.396761
12:55 PM	670.732	705.41	0.95084
12:56 PM	657.6	705.32	0.932343
12:57 PM	641.399	705.2	0.909528
12:58 PM	626.637	705.07	0.888739
12:59 PM	634.401	704.92	0.899962
01:00 PM	635.935	704.75	0.902355
01:01 PM	634.977	704.56	0.901239
01:02 PM	631.813	704.36	0.897003
01:03 PM	646.001	704.14	0.917433
01:04 PM	653.382	703.9	0.928231

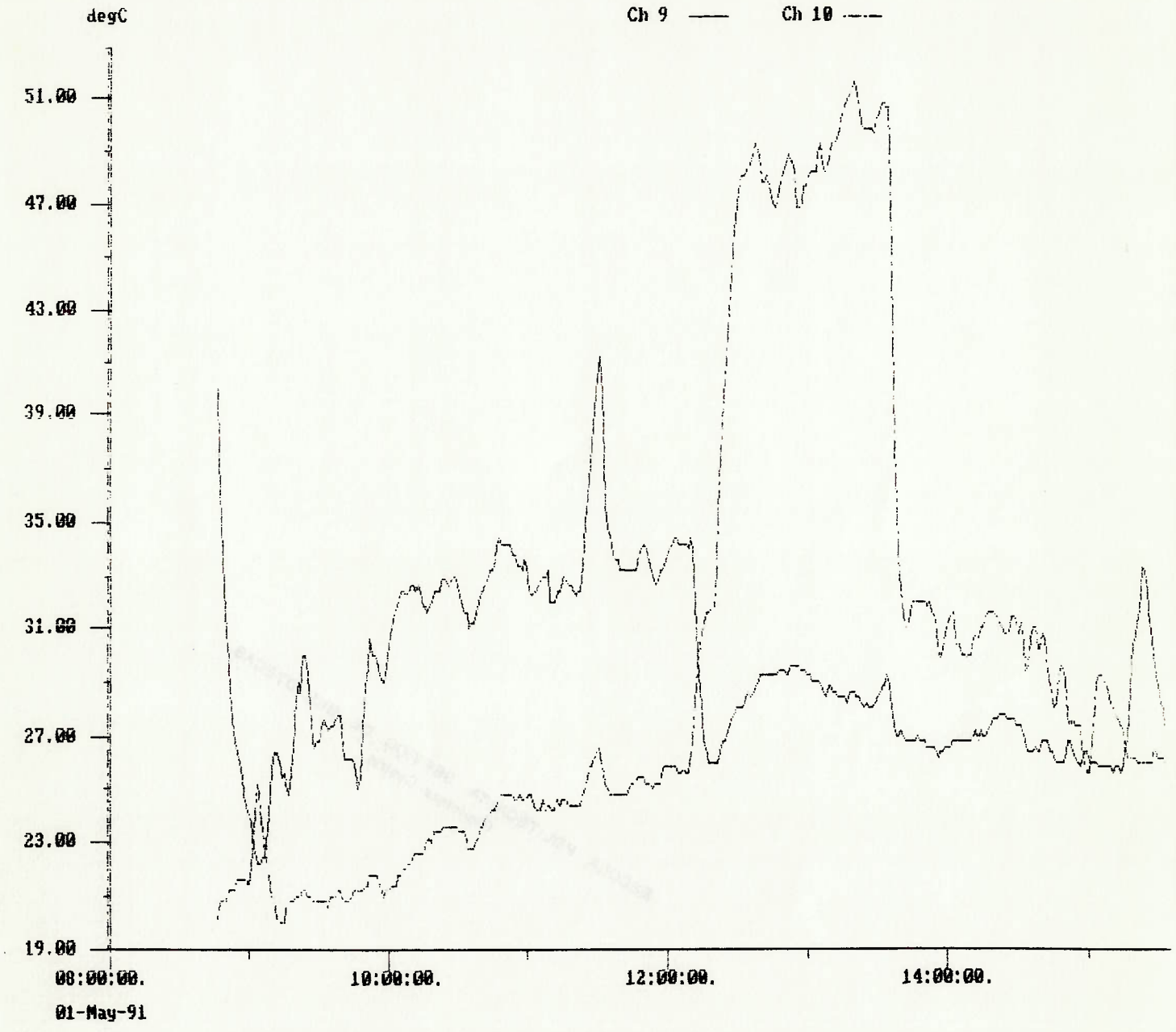


Figura E.2 TSEs da lateral direita (9) e da lateral esquerda (10).

Tabela E.4 TSEs do teto (B), lateral direita (9) e esquerda (10).

Rdg no	Time	Ch 8 degC	Ch 9 degC	Ch 10 degC
0	01-May-91 08:46:26.	30.000	40.000	20.200
1	01-May-91 08:47:26.	30.200	37.400	20.600
2	01-May-91 08:48:26.	30.400	35.000	20.800
3	01-May-91 08:49:26.	30.400	32.400	20.800
4	01-May-91 08:50:26.	30.200	30.800	20.800
5	01-May-91 08:51:26.	30.400	29.800	21.200
6	01-May-91 08:52:26.	30.600	28.600	21.200
7	01-May-91 08:53:26.	30.800	27.600	21.200
8	01-May-91 08:54:26.	31.000	26.800	21.200
9	01-May-91 08:55:26.	31.200	26.400	21.600
10	01-May-91 08:56:26.	31.200	26.000	21.600
11	01-May-91 08:57:26.	31.600	25.400	21.600
12	01-May-91 08:58:26.	31.800	24.800	21.600
13	01-May-91 08:59:26.	31.600	24.400	21.600
14	01-May-91 09:00:26.	31.600	24.000	21.400
15	01-May-91 09:01:26.	31.200	23.800	22.000
16	01-May-91 09:02:26.	29.400	22.800	23.400
17	01-May-91 09:03:26.	27.800	22.400	24.800
18	01-May-91 09:04:26.	27.600	22.200	25.200
19	01-May-91 09:05:26.	26.800	22.200	24.200
20	01-May-91 09:06:26.	26.800	22.400	23.400
21	01-May-91 09:07:26.	26.800	22.400	22.600
22	01-May-91 09:08:26.	27.000	23.400	22.000
23	01-May-91 09:09:26.	26.800	24.800	21.400
24	01-May-91 09:10:26.	26.200	25.800	21.000
25	01-May-91 09:11:26.	25.800	26.400	20.800
26	01-May-91 09:12:26.	25.000	26.400	20.200
27	01-May-91 09:13:26.	24.400	26.000	20.000
28	01-May-91 09:14:26.	23.400	25.400	20.000
29	01-May-91 09:15:26.	23.400	25.600	20.000
30	01-May-91 09:16:26.	23.600	25.200	20.600
31	01-May-91 09:17:26.	24.000	24.800	20.600
32	01-May-91 09:18:26.	24.200	25.600	20.800
33	01-May-91 09:19:26.	24.800	26.600	20.800
34	01-May-91 09:20:26.	25.600	28.400	21.000
35	01-May-91 09:21:26.	26.400	29.000	21.000
36	01-May-91 09:22:26.	26.200	28.600	21.000
37	01-May-91 09:23:26.	26.800	30.000	21.200
38	01-May-91 09:24:26.	26.800	30.000	21.200
39	01-May-91 09:25:26.	26.200	29.200	21.000
40	01-May-91 09:26:26.	25.600	28.200	21.000
41	01-May-91 09:27:26.	24.600	26.800	20.800
42	01-May-91 09:28:26.	24.200	26.600	20.800
43	01-May-91 09:29:26.	24.200	26.800	20.800
44	01-May-91 09:30:26.	24.600	26.800	20.800
45	01-May-91 09:31:26.	24.800	27.400	20.800
46	01-May-91 09:32:26.	24.800	27.600	20.800
47	01-May-91 09:33:26.	24.600	27.400	20.800
48	01-May-91 09:34:26.	24.800	27.200	20.600

Continuação da tabela E.4

49	01-May-91 09:35:26.	25.000	27.400	21.000
50	01-May-91 09:36:26.	25.400	27.400	21.000
51	01-May-91 09:37:26.	25.600	27.600	21.000
52	01-May-91 09:38:26.	25.800	27.800	21.200
53	01-May-91 09:39:26.	26.000	27.800	21.200
54	01-May-91 09:40:26.	26.000	27.200	21.000
55	01-May-91 09:41:26.	25.400	26.200	20.800
56	01-May-91 09:42:26.	25.200	26.200	20.800
57	01-May-91 09:43:26.	25.600	26.200	20.800
58	01-May-91 09:44:26.	26.000	26.200	21.000
59	01-May-91 09:45:26.	26.000	26.000	21.200
60	01-May-91 09:46:26.	26.400	25.600	21.200
61	01-May-91 09:47:26.	26.400	25.000	21.200
62	01-May-91 09:48:26.	26.800	25.400	21.200
63	01-May-91 09:49:26.	28.400	27.200	21.200
64	01-May-91 09:50:26.	29.600	28.800	21.400
65	01-May-91 09:51:26.	30.400	29.600	21.400
66	01-May-91 09:52:26.	31.800	30.600	21.800
67	01-May-91 09:53:26.	31.600	30.000	21.800
68	01-May-91 09:54:26.	31.200	30.000	21.800
69	01-May-91 09:55:26.	30.800	29.800	21.800
70	01-May-91 09:56:26.	30.200	29.200	21.400
71	01-May-91 09:57:26.	29.200	29.000	21.200
72	01-May-91 09:58:26.	28.800	29.000	21.000
73	01-May-91 09:59:26.	28.800	29.600	21.200
74	01-May-91 10:00:26.	29.000	30.400	21.200
75	01-May-91 10:01:26.	29.200	31.000	21.400
76	01-May-91 10:02:26.	29.200	31.600	21.400
77	01-May-91 10:03:26.	29.200	31.800	21.400
78	01-May-91 10:04:26.	29.600	32.000	21.800
79	01-May-91 10:05:26.	29.800	32.400	21.800
80	01-May-91 10:06:26.	30.000	32.400	22.000
81	01-May-91 10:07:26.	29.600	32.200	22.000
82	01-May-91 10:08:26.	30.000	32.400	22.200
83	01-May-91 10:09:26.	30.200	32.600	22.200
84	01-May-91 10:10:26.	30.200	32.600	22.400
85	01-May-91 10:11:26.	30.000	32.400	22.600
86	01-May-91 10:12:26.	30.000	32.600	22.600
87	01-May-91 10:13:26.	30.000	32.400	22.600
88	01-May-91 10:14:26.	30.200	31.800	22.600
89	01-May-91 10:15:26.	30.800	31.800	22.800
90	01-May-91 10:16:26.	31.000	31.600	23.000
91	01-May-91 10:17:26.	31.400	31.800	23.200
92	01-May-91 10:18:26.	31.400	32.000	23.000
93	01-May-91 10:19:26.	31.400	32.400	23.400
94	01-May-91 10:20:26.	31.200	32.400	23.400
95	01-May-91 10:21:26.	31.200	32.400	23.400
96	01-May-91 10:22:26.	31.400	32.800	23.400
97	01-May-91 10:23:26.	31.600	33.000	23.600
98	01-May-91 10:24:26.	31.800	32.800	23.600
99	01-May-91 10:25:26.	31.800	32.600	23.600
100	01-May-91 10:26:26.	32.200	32.800	23.600
101	01-May-91 10:27:26.	32.400	33.000	23.600
102	01-May-91 10:28:26.	32.400	33.000	23.600
103	01-May-91 10:29:26.	32.400	32.600	23.600
104	01-May-91 10:30:26.	32.000	32.200	23.400
105	01-May-91 10:31:26.	32.200	31.800	23.400

Continuação da tabela E.4

106	01-Mau-91 10:32:26.	32.400	31.600	22.400
107	01-Mau-91 10:33:26.	32.600	31.600	23.200
108	01-Mau-91 10:34:26.	31.600	31.000	22.800
109	01-Mau-91 10:35:26.	31.400	31.200	22.800
110	01-Mau-91 10:36:26.	31.200	31.200	22.800
111	01-Mau-91 10:37:26.	31.200	31.600	23.000
112	01-Mau-91 10:38:26.	31.200	32.000	23.200
113	01-Mau-91 10:39:26.	31.600	32.400	23.600
114	01-Mau-91 10:40:26.	31.600	32.400	23.600
115	01-Mau-91 10:41:26.	32.000	32.600	23.800
116	01-Mau-91 10:42:26.	32.400	32.800	24.000
117	01-Mau-91 10:43:26.	32.400	33.200	24.000
118	01-Mau-91 10:44:26.	32.600	33.200	24.200
119	01-Mau-91 10:45:26.	33.000	33.600	24.200
120	01-Mau-91 10:46:26.	33.200	34.200	24.400
121	01-Mau-91 10:47:26.	33.200	34.400	24.600
122	01-Mau-91 10:48:26.	33.000	34.200	24.800
123	01-Mau-91 10:49:26.	33.000	34.200	24.800
124	01-Mau-91 10:50:26.	33.200	34.200	24.800
125	01-Mau-91 10:51:26.	33.000	34.200	24.800
126	01-Mau-91 10:52:26.	33.000	34.200	24.800
127	01-Mau-91 10:53:26.	33.000	33.800	24.800
128	01-Mau-91 10:54:26.	33.000	33.800	24.600
129	01-Mau-91 10:55:26.	33.000	33.400	24.600
130	01-Mau-91 10:56:26.	33.000	33.400	24.800
131	01-Mau-91 10:57:26.	32.800	33.200	24.600
132	01-Mau-91 10:58:26.	33.200	33.600	24.600
133	01-Mau-91 10:59:26.	33.000	33.400	24.600
134	01-Mau-91 11:00:26.	31.800	32.400	24.800
135	01-Mau-91 11:01:26.	32.000	32.200	24.800
136	01-Mau-91 11:02:26.	32.000	32.400	24.400
137	01-Mau-91 11:03:26.	32.200	32.400	24.200
138	01-Mau-91 11:04:26.	32.200	32.600	24.200
139	01-Mau-91 11:05:26.	32.200	32.800	24.200
140	01-Mau-91 11:06:26.	32.400	33.000	24.600
141	01-Mau-91 11:07:26.	32.400	33.000	24.200
142	01-Mau-91 11:08:26.	32.800	33.200	24.400
143	01-Mau-91 11:09:26.	31.800	32.000	24.400
144	01-Mau-91 11:10:26.	31.600	32.000	24.200
145	01-Mau-91 11:11:26.	31.600	32.000	24.200
146	01-Mau-91 11:12:26.	31.800	32.400	24.600
147	01-Mau-91 11:13:26.	31.800	32.400	24.400
148	01-Mau-91 11:14:26.	32.200	32.800	24.600
149	01-Mau-91 11:15:26.	32.400	33.000	24.600
150	01-Mau-91 11:16:26.	32.400	32.800	24.600
151	01-Mau-91 11:17:26.	32.600	32.600	24.400
152	01-Mau-91 11:18:26.	32.600	32.600	24.400
153	01-Mau-91 11:19:26.	32.400	32.400	24.400
154	01-Mau-91 11:20:26.	32.400	32.200	24.400
155	01-Mau-91 11:21:26.	32.600	32.400	24.400
156	01-Mau-91 11:22:26.	32.400	32.400	24.400
157	01-Mau-91 11:23:26.	33.400	33.400	24.800
158	01-Mau-91 11:24:26.	35.000	35.000	25.000
159	01-Mau-91 11:25:26.	36.200	36.000	25.400
160	01-Mau-91 11:26:26.	37.600	37.200	25.800

Continuação da tabela E.4

161	01-Mau-91 11:27:26.	38.600	38.000	25.800
162	01-Mau-91 11:28:26.	39.600	39.200	26.200
163	01-Mau-91 11:29:26.	40.800	40.400	26.400
164	01-Mau-91 11:30:26.	42.000	41.200	26.600
165	01-Mau-91 11:31:26.	41.000	39.800	26.000
166	01-Mau-91 11:32:26.	38.600	37.400	25.600
167	01-Mau-91 11:33:26.	36.600	35.600	25.200
168	01-Mau-91 11:34:26.	35.600	34.800	25.000
169	01-Mau-91 11:35:26.	35.000	34.400	24.800
170	01-Mau-91 11:36:26.	34.200	33.800	24.800
171	01-Mau-91 11:37:26.	33.800	33.600	24.800
172	01-Mau-91 11:38:26.	33.800	33.600	24.800
173	01-Mau-91 11:39:26.	33.600	33.200	24.800
174	01-Mau-91 11:40:26.	33.600	33.200	24.800
175	01-Mau-91 11:41:26.	33.600	33.200	24.800
176	01-Mau-91 11:42:26.	33.600	33.200	24.800
177	01-Mau-91 11:43:26.	33.600	33.200	25.000
178	01-Mau-91 11:44:26.	33.800	33.200	25.200
179	01-Mau-91 11:45:26.	33.800	33.200	25.200
180	01-Mau-91 11:46:26.	33.800	33.200	25.200
181	01-Mau-91 11:47:26.	33.800	33.800	25.400
182	01-Mau-91 11:48:26.	33.800	34.000	25.400
183	01-Mau-91 11:49:26.	34.000	34.200	25.400
184	01-Mau-91 11:50:26.	34.200	34.000	25.200
185	01-Mau-91 11:51:26.	34.200	33.800	25.200
186	01-Mau-91 11:52:26.	33.800	33.400	25.200
187	01-Mau-91 11:53:26.	33.600	33.000	25.000
188	01-Mau-91 11:54:26.	33.400	32.600	25.200
189	01-Mau-91 11:55:26.	33.400	33.800	25.200
190	01-Mau-91 11:56:26.	33.600	33.200	25.200
191	01-Mau-91 11:57:26.	33.600	33.200	25.600
192	01-Mau-91 11:58:26.	33.800	33.400	25.800
193	01-Mau-91 11:59:26.	34.200	33.800	25.800
194	01-Mau-91 12:00:26.	34.400	34.000	25.800
195	01-Mau-91 12:01:26.	34.400	34.200	25.800
196	01-Mau-91 12:02:26.	34.600	34.400	25.800
197	01-Mau-91 12:03:26.	34.400	34.400	25.800
198	01-Mau-91 12:04:26.	34.400	34.200	25.600
199	01-Mau-91 12:05:26.	34.400	34.200	25.600
200	01-Mau-91 12:06:26.	34.400	34.200	25.800
201	01-Mau-91 12:07:26.	34.400	34.200	25.600
202	01-Mau-91 12:08:26.	34.200	34.000	25.600
203	01-Mau-91 12:09:26.	34.600	34.400	26.000
204	01-Mau-91 12:10:26.	35.600	34.000	26.800
205	01-Mau-91 12:11:26.	35.200	32.000	28.200
206	01-Mau-91 12:12:26.	34.400	30.000	29.600
207	01-Mau-91 12:13:26.	33.600	28.600	30.400
208	01-Mau-91 12:14:26.	33.200	27.600	31.000
209	01-Mau-91 12:15:26.	32.800	26.800	31.200
210	01-Mau-91 12:16:26.	32.600	26.600	31.600
211	01-Mau-91 12:17:26.	32.400	26.000	31.600
212	01-Mau-91 12:18:26.	32.600	26.000	31.800
213	01-Mau-91 12:19:26.	32.600	26.000	31.800
214	01-Mau-91 12:20:26.	33.600	26.000	33.200
215	01-Mau-91 12:21:26.	35.600	26.000	35.400

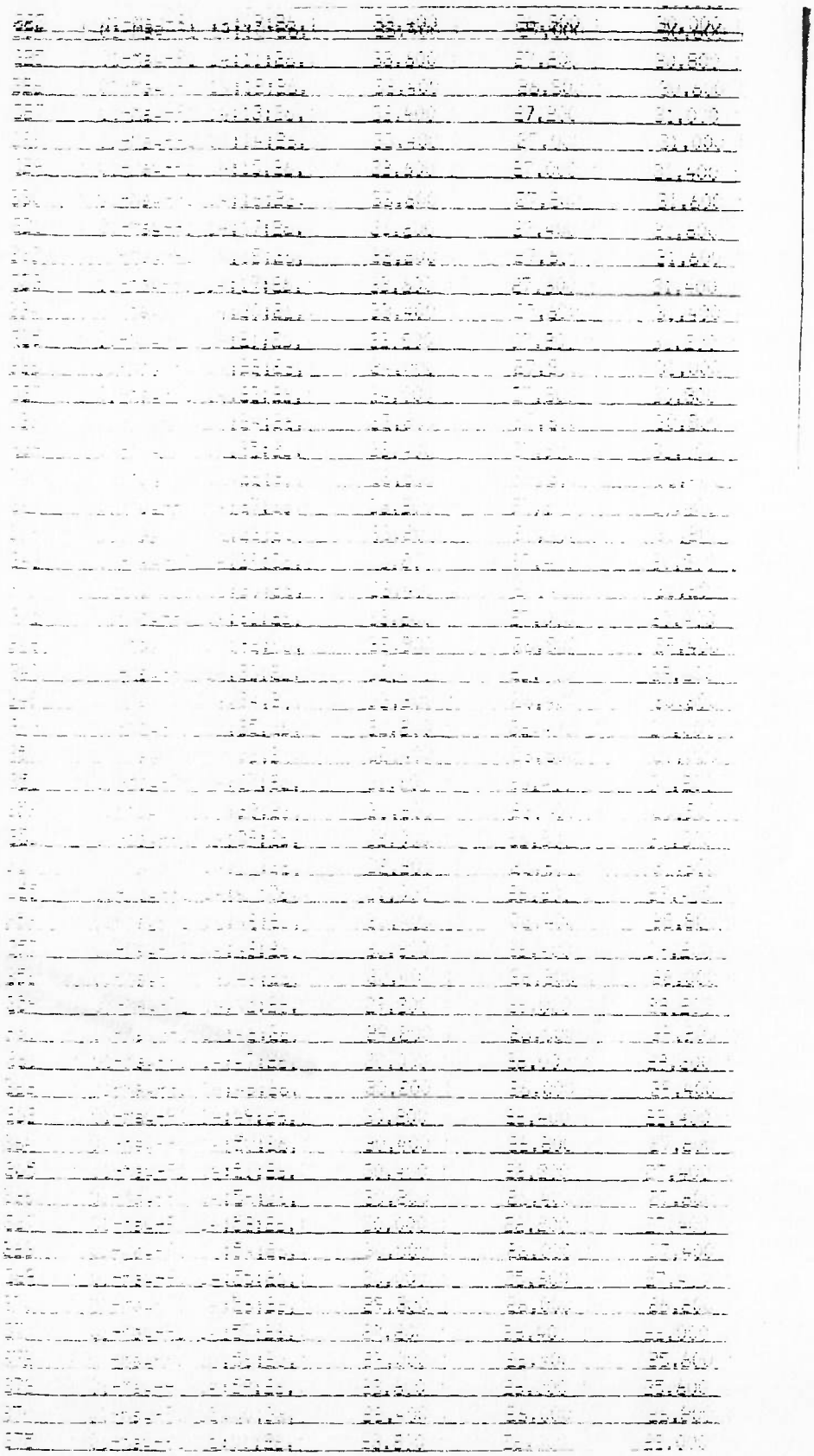
Continuação da tabela E.4

216	01-Mau-91 12:22:26.	37.600	26.400	37.600
217	01-Mau-91 12:23:26.	39.400	26.800	39.600
218	01-Mau-91 12:24:26.	41.000	26.800	41.200
219	01-Mau-91 12:25:26.	42.200	27.200	43.000
220	01-Mau-91 12:26:26.	43.200	27.400	44.400
221	01-Mau-91 12:27:26.	44.400	27.600	45.400
222	01-Mau-91 12:28:26.	45.400	27.800	46.400
223	01-Mau-91 12:29:26.	46.200	28.000	47.400
224	01-Mau-91 12:30:26.	46.800	28.000	48.000
225	01-Mau-91 12:31:26.	46.800	28.000	48.000
226	01-Mau-91 12:32:26.	46.800	28.200	48.200
227	01-Mau-91 12:33:26.	46.800	28.400	48.400
228	01-Mau-91 12:34:26.	47.200	28.600	48.400
229	01-Mau-91 12:35:26.	47.600	28.400	48.800
230	01-Mau-91 12:36:26.	48.000	28.600	49.200
231	01-Mau-91 12:37:26.	48.000	28.800	49.000
232	01-Mau-91 12:38:26.	47.600	29.000	48.400
233	01-Mau-91 12:39:26.	47.400	28.200	47.800
234	01-Mau-91 12:40:26.	47.400	28.200	47.800
235	01-Mau-91 12:41:26.	47.400	28.200	48.000
236	01-Mau-91 12:42:26.	47.200	28.200	47.600
237	01-Mau-91 12:43:26.	46.800	28.200	47.200
238	01-Mau-91 12:44:26.	46.400	28.200	46.800
239	01-Mau-91 12:45:26.	46.400	28.200	46.800
240	01-Mau-91 12:46:26.	46.600	28.200	47.200
241	01-Mau-91 12:47:26.	46.800	29.400	47.800
242	01-Mau-91 12:48:26.	47.600	29.400	48.200
243	01-Mau-91 12:49:26.	47.800	29.400	48.400
244	01-Mau-91 12:50:26.	48.400	29.200	48.800
245	01-Mau-91 12:51:26.	48.200	29.200	48.400
246	01-Mau-91 12:52:26.	48.000	29.600	48.800
247	01-Mau-91 12:53:26.	47.400	29.600	48.200
248	01-Mau-91 12:54:26.	46.800	29.600	48.800
249	01-Mau-91 12:55:26.	46.400	29.600	46.800
250	01-Mau-91 12:56:26.	46.800	29.400	47.000
251	01-Mau-91 12:57:26.	47.000	29.400	47.600
252	01-Mau-91 12:58:26.	47.400	29.400	47.600
253	01-Mau-91 12:59:26.	48.000	29.200	48.000
254	01-Mau-91 13:00:26.	48.200	29.200	48.800
255	01-Mau-91 13:01:26.	47.800	29.000	48.200
256	01-Mau-91 13:02:26.	47.800	29.000	48.200
257	01-Mau-91 13:03:26.	48.400	29.000	48.800
258	01-Mau-91 13:04:26.	49.200	29.000	49.200
259	01-Mau-91 13:05:26.	48.800	28.800	48.400
260	01-Mau-91 13:06:26.	48.400	28.600	48.200
261	01-Mau-91 13:07:26.	48.400	28.400	48.400
262	01-Mau-91 13:08:26.	48.800	28.800	49.000
263	01-Mau-91 13:09:26.	49.000	28.800	49.200
264	01-Mau-91 13:10:26.	49.200	28.600	49.200
265	01-Mau-91 13:11:26.	49.400	28.600	49.400
266	01-Mau-91 13:12:26.	49.800	28.400	49.800
267	01-Mau-91 13:13:26.	50.400	28.400	50.400
268	01-Mau-91 13:14:26.	50.600	28.400	50.600
269	01-Mau-91 13:15:26.	50.600	28.400	50.800
270	01-Mau-91 13:16:26.	50.800	28.200	51.000

Continuação da tabela E.4

271	01-Mau-91 13:17:26.	50,800	28,600	51,200
272	01-Mau-91 13:18:26.	51,400	29,600	51,600
273	01-Mau-91 13:19:26.	51,200	29,600	51,400
274	01-Mau-91 13:20:26.	50,600	29,400	51,000
275	01-Mau-91 13:21:26.	50,200	28,400	50,400
276	01-Mau-91 13:22:26.	49,200	28,200	49,800
277	01-Mau-91 13:23:26.	49,200	28,000	49,800
278	01-Mau-91 13:24:26.	49,200	28,200	49,800
279	01-Mau-91 13:25:26.	49,000	28,000	49,800
280	01-Mau-91 13:26:26.	49,000	28,000	49,800
281	01-Mau-91 13:27:26.	48,800	28,000	49,600
282	01-Mau-91 13:28:26.	48,800	28,200	50,200
283	01-Mau-91 13:29:26.	49,600	28,400	50,400
284	01-Mau-91 13:30:26.	50,200	28,600	50,800
285	01-Mau-91 13:31:26.	50,600	28,800	50,200
286	01-Mau-91 13:32:26.	50,600	28,800	50,600
287	01-Mau-91 13:33:26.	50,800	29,200	50,600
288	01-Mau-91 13:34:26.	48,400	28,800	47,400
289	01-Mau-91 13:35:26.	44,000	28,000	42,000
290	01-Mau-91 13:36:26.	40,400	27,400	38,000
291	01-Mau-91 13:37:26.	38,000	27,000	35,600
292	01-Mau-91 13:38:26.	37,000	27,000	33,800
293	01-Mau-91 13:39:26.	36,800	27,200	32,600
294	01-Mau-91 13:40:26.	35,600	27,000	31,400
295	01-Mau-91 13:41:26.	35,400	26,800	31,000
296	01-Mau-91 13:42:26.	35,000	26,800	31,200
297	01-Mau-91 13:43:26.	34,800	26,800	31,600
298	01-Mau-91 13:44:26.	34,600	26,800	32,000
299	01-Mau-91 13:45:26.	34,600	26,800	32,000
300	01-Mau-91 13:46:26.	34,600	27,000	32,000
301	01-Mau-91 13:47:26.	34,400	26,800	32,000

Continuação da tabela E.4



Continuação da tabela B.4

376	01-May-91	15:02:26	28,600	26,000
377	01-May-91	15:03:26	28,400	25,800
378	01-May-91	15:04:26	28,600	25,800
379	01-May-91	15:05:26	28,400	25,800
380	01-May-91	15:06:26	28,200	25,800
381	01-May-91	15:07:26	28,400	25,800
382	01-May-91	15:08:26	28,400	25,800
383	01-May-91	15:09:26	28,200	25,800

E.2.2 Gráficos das TSEs dos vidros.

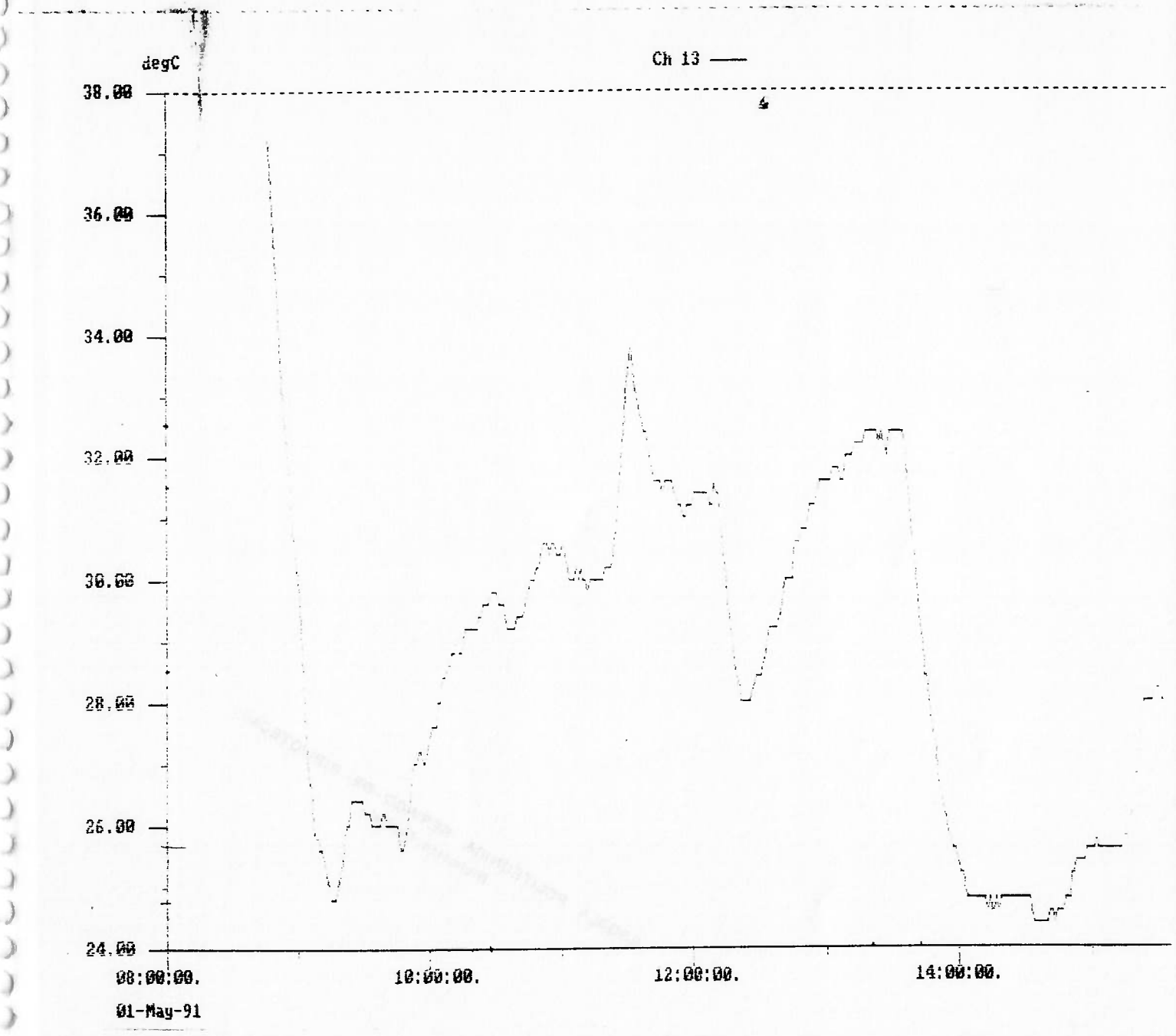


Figura E.3 TSE do vidro da lateral direita.

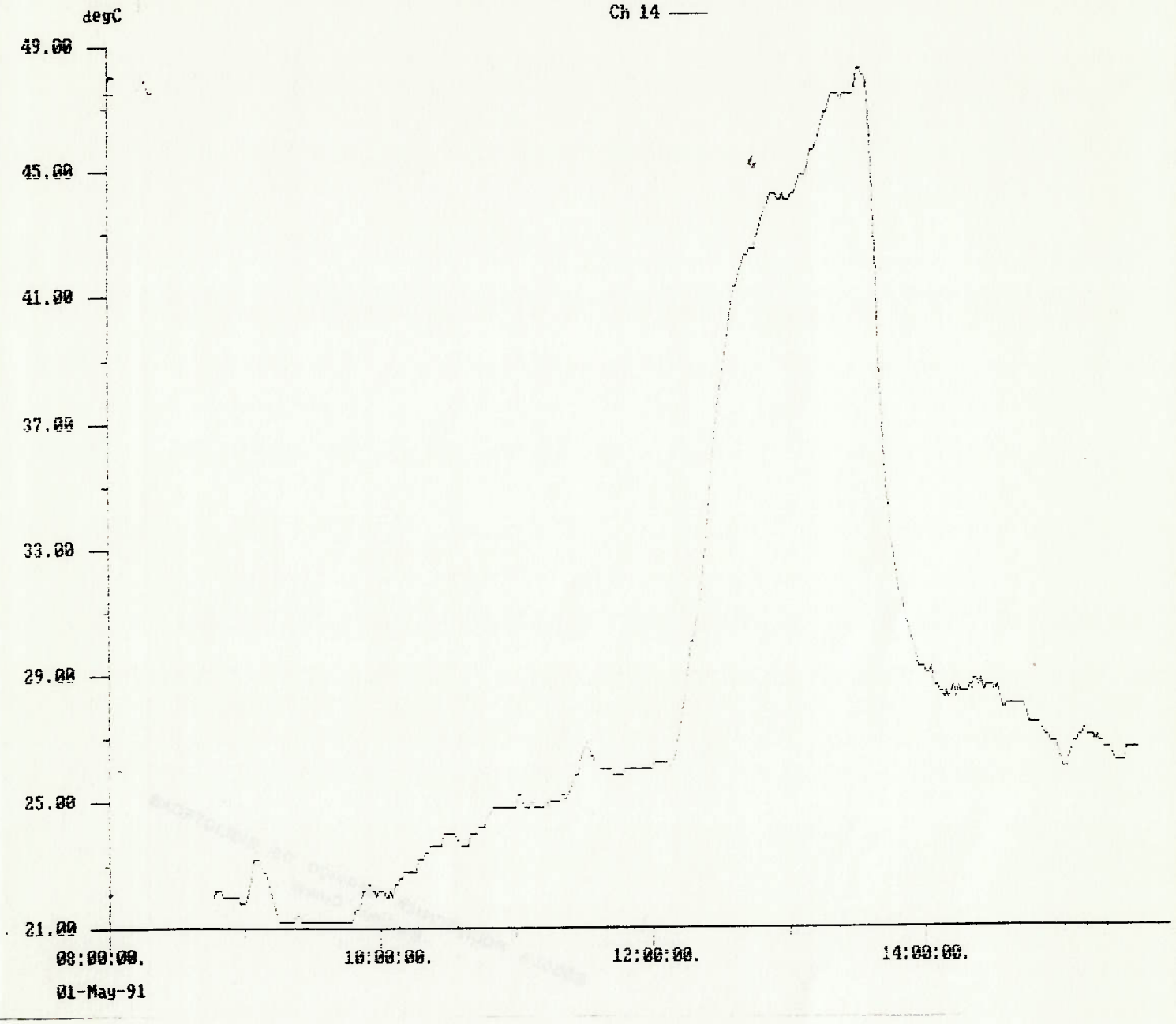


Figura E.4 TSE do vidro da lateral esquerda.

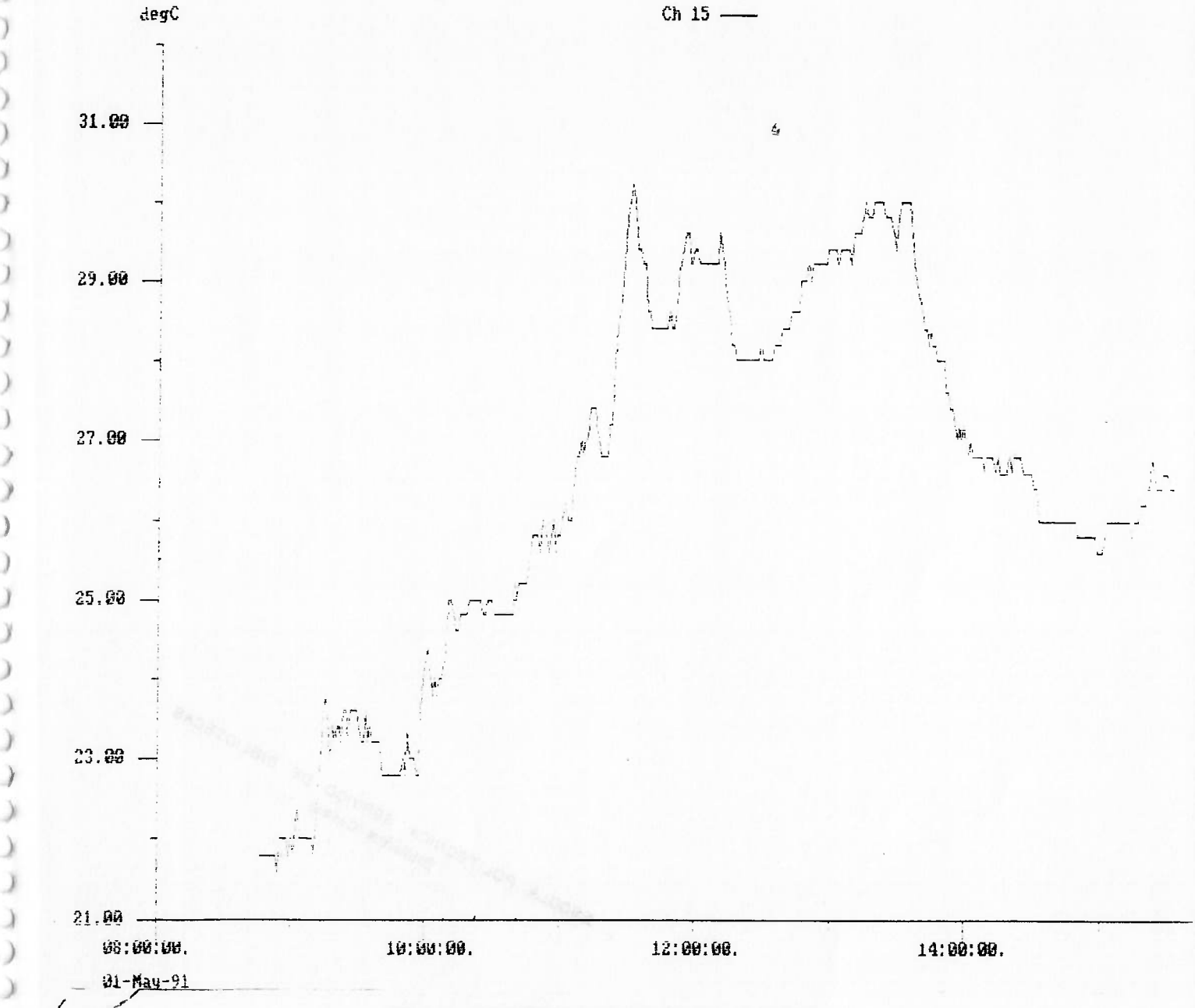


Figura E.5 TSE do vidro frontal (parabrisa).

E.2.3 Gráficos e tabelas das TSEs das paredes opacas em medição noturna.

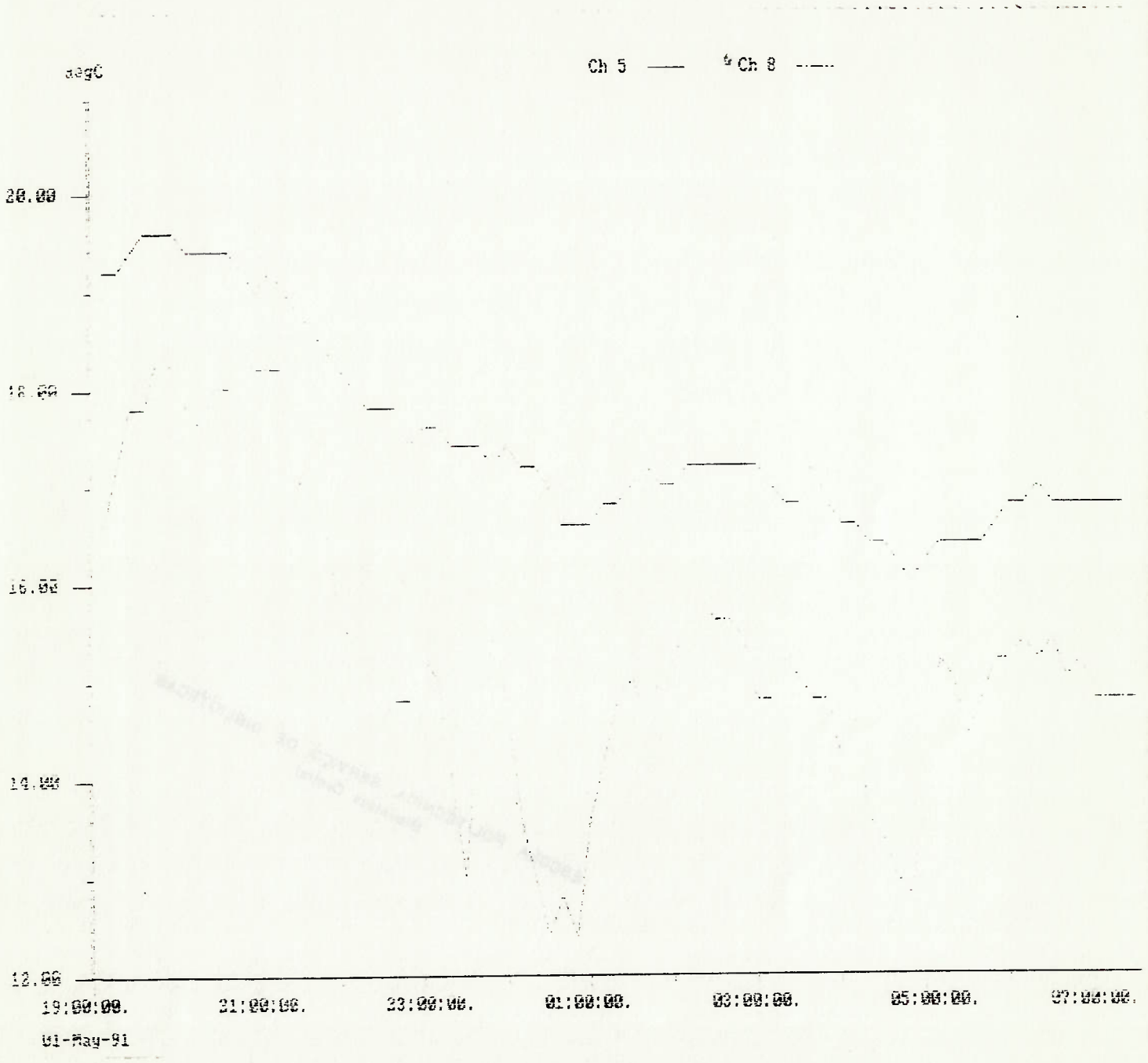


Figura E.6 Temperatura do ar externo (5) e do teto(8).

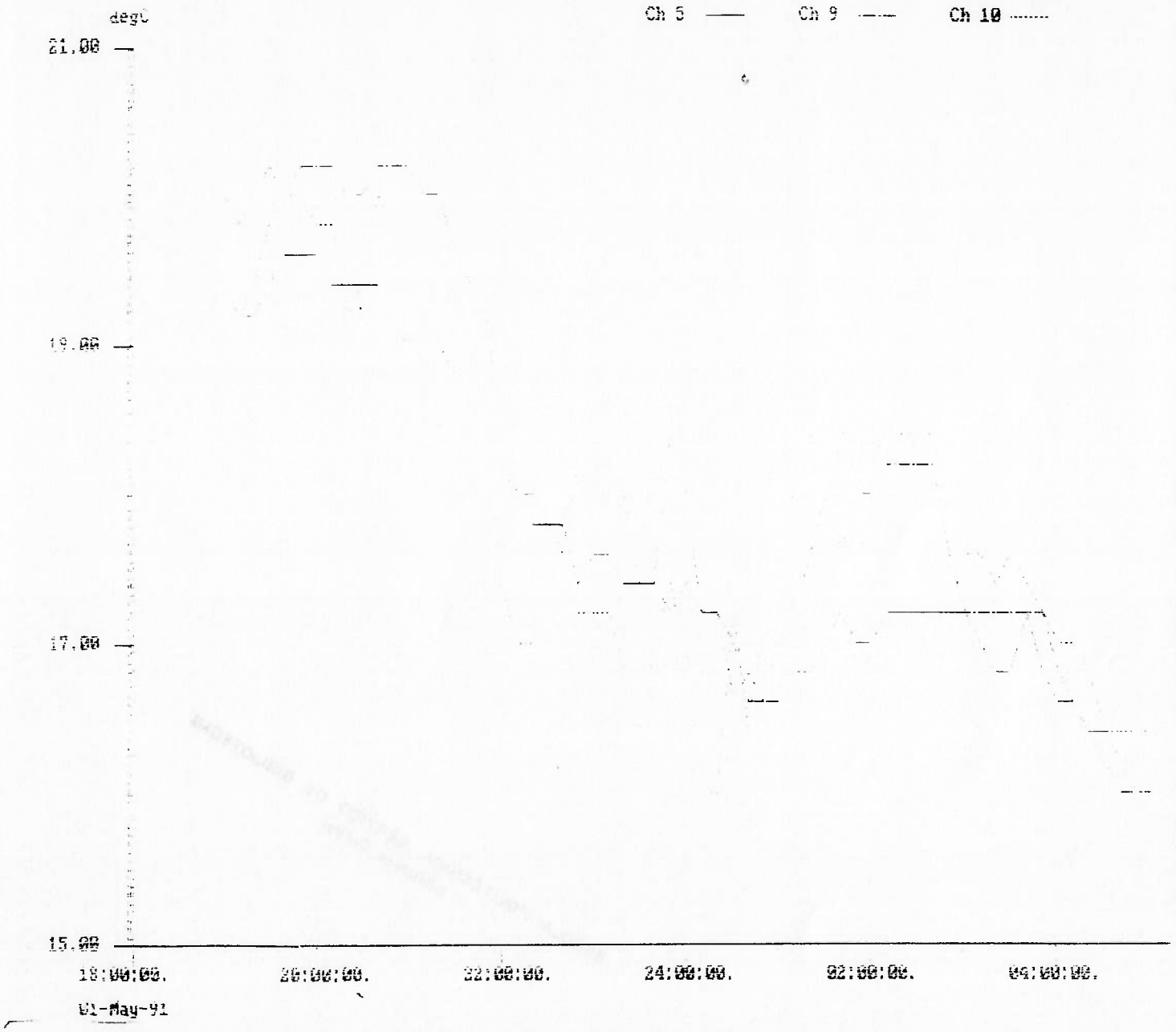


Figura E.7 Temperatura do ar externo (5) e das TSEs da lateral direita (9) e esquerda (10).

Tabela E.5 Temperaturas do ar externo (5) e das TSEs do teto (8) e das laterais direita (9) e esquerda (10).

Rdg no	Time	Ch 5 degC	Ch 8 degC	Ch 9 degC	Ch 10 degC
19	01-May-91 19:09:45	19.200	16.400	19.800	19.200
20	01-May-91 19:19:45	19.200	17.200	20.000	19.400
21	01-May-91 19:29:45	19.400	17.800	20.200	19.800
22	01-May-91 19:39:45	19.400	17.800	20.000	20.000
23	01-May-91 19:49:45	19.600	18.400	20.200	20.000
24	01-May-91 19:59:45	19.600	18.200	20.200	19.800
25	01-May-91 20:09:45	19.400	17.800	20.200	19.800
26	01-May-91 20:19:45	19.400	17.600	20.000	19.200
27	01-May-91 20:29:45	19.400	18.000	20.000	19.400
28	01-May-91 20:39:45	19.400	18.000	20.200	20.000
29	01-May-91 20:49:45	19.200	18.400	20.200	19.800
30	01-May-91 20:59:45	19.000	18.200	20.200	19.600
31	01-May-91 21:09:45	19.200	18.200	20.000	19.200
32	01-May-91 21:19:45	19.000	18.200	20.000	19.200
33	01-May-91 21:29:45	18.800	17.000	19.600	18.400
34	01-May-91 21:39:45	18.600	17.200	19.400	18.400
35	01-May-91 21:49:45	18.400	16.600	19.200	18.400
36	01-May-91 21:59:45	18.200	15.600	19.400	17.400
37	01-May-91 22:09:45	18.000	15.400	19.000	17.000
38	01-May-91 22:19:45	17.200	15.000	19.000	17.000
39	01-May-91 22:29:45	17.800	14.600	17.800	16.800
40	01-May-91 22:39:45	17.800	14.800	17.600	17.000
41	01-May-91 22:49:45	17.400	14.800	18.200	17.200
42	01-May-91 22:59:45	17.600	15.200	18.000	17.200
43	01-May-91 23:09:45	17.600	15.000	18.200	17.200
44	01-May-91 23:19:45	17.400	14.800	18.000	16.800
45	01-May-91 23:29:45	17.400	15.000	17.800	16.400
46	01-May-91 23:39:45	17.400	14.800	17.600	17.000
47	01-May-91 23:49:45	17.200	15.400	18.400	17.400
48	01-May-91 23:59:45	17.400	14.800	18.000	17.000
49	02-May-91 00:09:45	17.200	15.600	17.800	16.800
50	02-May-91 00:19:45	17.200	13.000	17.600	16.000
51	02-May-91 00:29:45	17.000	12.400	16.600	17.200
52	02-May-91 00:39:45	16.600	12.800	16.800	16.600
53	02-May-91 00:49:45	16.600	12.400	16.600	17.200
54	02-May-91 00:59:45	16.800	13.600	17.000	17.600
55	02-May-91 01:09:45	16.800	14.200	17.200	18.000
56	02-May-91 01:19:45	16.800	14.800	17.600	18.400
57	02-May-91 01:29:45	17.000	15.000	18.000	18.800
58	02-May-91 01:39:45	17.200	14.600	17.400	18.400
59	02-May-91 01:49:45	17.000	15.000	18.000	18.400
60	02-May-91 01:59:45	17.000	15.200	18.000	18.200
61	02-May-91 02:09:45	17.200	15.600	18.200	18.400
62	02-May-91 02:19:45	17.200	15.800	18.200	18.400
63	02-May-91 02:29:45	17.200	15.600	18.200	18.400
64	02-May-91 02:39:45	17.200	15.600	18.200	18.400
65	02-May-91 02:49:45	17.200	15.400	17.600	17.800
66	02-May-91 02:59:45	17.200	14.800	17.200	17.600
67	02-May-91 03:09:45	17.000	14.800	17.200	17.600
68	02-May-91 03:19:45	16.800	15.200	17.200	17.400
69	02-May-91 03:29:45	16.800	15.000	17.200	17.600
70	02-May-91 03:39:45	17.200	14.800	17.200	17.400

Continuação da tabela E.5

74	02-Fev-91 03:59:45	16.800	16.800	17.200	17.200
75	02-Fev-91 02:59:45	16.600	14.200	16.800	17.000
76	03-Fev-91 04:09:45	16.600	14.800	16.600	17.000
77	03-Fev-91 04:19:45	16.800	13.600	16.400	16.800
78	03-Fev-91 04:29:45	16.400	13.200	16.800	16.400
79	03-Fev-91 04:39:45	16.200	13.200	16.000	16.400
80	03-Fev-91 04:49:45	16.000	13.800	16.000	16.400
81	03-Fev-91 04:59:45	16.200	13.600	16.000	16.400
82	03-Fev-91 05:09:45	16.400	15.200	17.000	17.000
83	03-Fev-91 05:19:45	16.400	15.000	17.200	17.000
84	03-Fev-91 05:29:45	16.400	14.400	16.800	16.600
85	03-Fev-91 05:39:45	16.400	14.800	17.000	17.000
86	03-Fev-91 05:49:45	16.600	15.800	17.600	17.000
87	03-Fev-91 05:59:45	16.800	15.800	17.800	17.000
88	03-Fev-91 06:09:45	16.800	15.800	17.800	16.800
89	03-Fev-91 06:19:45	17.000	15.800	17.800	16.800
90	03-Fev-91 06:29:45	17.000	15.800	17.800	17.000
91	03-Fev-91 06:39:45	17.000	15.800	17.800	16.800
92	03-Fev-91 06:49:45	17.000	15.800	17.800	16.800
93	03-Fev-91 06:59:45	17.000	15.800	17.800	17.000
94	03-Fev-91 07:09:45	17.000	15.800	17.800	16.800
95	03-Fev-91 07:19:45	17.000	15.800	17.800	16.800
96	03-Fev-91 07:29:45	17.000	15.800	17.800	17.000
97	03-Fev-91 07:39:45	17.000	15.800	17.800	16.800
98	03-Fev-91 07:49:45	17.000	15.800	17.800	17.000
99	03-Fev-91 07:59:45	17.000	15.800	17.800	17.000
100	03-Fev-91 08:09:45	17.000	15.800	17.800	17.000
101	03-Fev-91 08:19:45	17.000	15.800	17.800	17.000
102	03-Fev-91 08:29:45	17.000	15.800	17.800	17.000
103	03-Fev-91 08:39:45	17.000	15.800	17.800	17.000
104	03-Fev-91 08:49:45	17.000	15.800	17.800	17.000
105	03-Fev-91 08:59:45	17.000	15.800	17.800	17.000
106	03-Fev-91 09:09:45	17.000	15.800	17.800	17.000
107	03-Fev-91 09:19:45	17.000	15.800	17.800	17.000
108	03-Fev-91 09:29:45	17.000	15.800	17.800	17.000
109	03-Fev-91 09:39:45	17.000	15.800	17.800	17.000
110	03-Fev-91 09:49:45	17.000	15.800	17.800	17.000
111	03-Fev-91 09:59:45	17.000	15.800	17.800	17.000
112	03-Fev-91 10:09:45	17.000	15.800	17.800	17.000
113	03-Fev-91 10:19:45	17.000	15.800	17.800	17.000
114	03-Fev-91 10:29:45	17.000	15.800	17.800	17.000
115	03-Fev-91 10:39:45	17.000	15.800	17.800	17.000
116	03-Fev-91 10:49:45	17.000	15.800	17.800	17.000
117	03-Fev-91 10:59:45	17.000	15.800	17.800	17.000
118	03-Fev-91 11:09:45	17.000	15.800	17.800	17.000
119	03-Fev-91 11:19:45	17.000	15.800	17.800	17.000
120	03-Fev-91 11:29:45	17.000	15.800	17.800	17.000
121	03-Fev-91 11:39:45	17.000	15.800	17.800	17.000
122	03-Fev-91 11:49:45	17.000	15.800	17.800	17.000
123	03-Fev-91 11:59:45	17.000	15.800	17.800	17.000
124	03-Fev-91 12:09:45	17.000	15.800	17.800	17.000
125	03-Fev-91 12:19:45	17.000	15.800	17.800	17.000
126	03-Fev-91 12:29:45	17.000	15.800	17.800	17.000
127	03-Fev-91 12:39:45	17.000	15.800	17.800	17.000
128	03-Fev-91 12:49:45	17.000	15.800	17.800	17.000
129	03-Fev-91 12:59:45	17.000	15.800	17.800	17.000
130	03-Fev-91 13:09:45	17.000	15.800	17.800	17.000
131	03-Fev-91 13:19:45	17.000	15.800	17.800	17.000
132	03-Fev-91 13:29:45	17.000	15.800	17.800	17.000
133	03-Fev-91 13:39:45	17.000	15.800	17.800	17.000
134	03-Fev-91 13:49:45	17.000	15.800	17.800	17.000
135	03-Fev-91 13:59:45	17.000	15.800	17.800	17.000
136	03-Fev-91 14:09:45	17.000	15.800	17.800	17.000
137	03-Fev-91 14:19:45	17.000	15.800	17.800	17.000
138	03-Fev-91 14:29:45	17.000	15.800	17.800	17.000
139	03-Fev-91 14:39:45	17.000	15.800	17.800	17.000
140	03-Fev-91 14:49:45	17.000	15.800	17.800	17.000
141	03-Fev-91 14:59:45	17.000	15.800	17.800	17.000
142	03-Fev-91 15:09:45	17.000	15.800	17.800	17.000
143	03-Fev-91 15:19:45	17.000	15.800	17.800	17.000
144	03-Fev-91 15:29:45	17.000	15.800	17.800	17.000
145	03-Fev-91 15:39:45	17.000	15.800	17.800	17.000
146	03-Fev-91 15:49:45	17.000	15.800	17.800	17.000
147	03-Fev-91 15:59:45	17.000	15.800	17.800	17.000
148	03-Fev-91 16:09:45	17.000	15.800	17.800	17.000
149	03-Fev-91 16:19:45	17.000	15.800	17.800	17.000
150	03-Fev-91 16:29:45	17.000	15.800	17.800	17.000
151	03-Fev-91 16:39:45	17.000	15.800	17.800	17.000
152	03-Fev-91 16:49:45	17.000	15.800	17.800	17.000
153	03-Fev-91 16:59:45	17.000	15.800	17.800	17.000
154	03-Fev-91 17:09:45	17.000	15.800	17.800	17.000
155	03-Fev-91 17:19:45	17.000	15.800	17.800	17.000
156	03-Fev-91 17:29:45	17.000	15.800	17.800	17.000
157	03-Fev-91 17:39:45	17.000	15.800	17.800	17.000
158	03-Fev-91 17:49:45	17.000	15.800	17.800	17.000
159	03-Fev-91 17:59:45	17.000	15.800	17.800	17.000
160	03-Fev-91 18:09:45	17.000	15.800	17.800	17.000
161	03-Fev-91 18:19:45	17.000	15.800	17.800	17.000
162	03-Fev-91 18:29:45	17.000	15.800	17.800	17.000
163	03-Fev-91 18:39:45	17.000	15.800	17.800	17.000
164	03-Fev-91 18:49:45	17.000	15.800	17.800	17.000
165	03-Fev-91 18:59:45	17.000	15.800	17.800	17.000
166	03-Fev-91 19:09:45	17.000	15.800	17.800	17.000
167	03-Fev-91 19:19:45	17.000	15.800	17.800	17.000
168	03-Fev-91 19:29:45	17.000	15.800	17.800	17.000
169	03-Fev-91 19:39:45	17.000	15.800	17.800	17.000
170	03-Fev-91 19:49:45	17.000	15.800	17.800	17.000
171	03-Fev-91 19:59:45	17.000	15.800	17.800	17.000
172	03-Fev-91 20:09:45	17.000	15.800	17.800	17.000
173	03-Fev-91 20:19:45	17.000	15.800	17.800	17.000
174	03-Fev-91 20:29:45	17.000	15.800	17.800	17.000
175	03-Fev-91 20:39:45	17.000	15.800	17.800	17.000
176	03-Fev-91 20:49:45	17.000	15.800	17.800	17.000
177	03-Fev-91 20:59:45	17.000	15.800	17.800	17.000
178	03-Fev-91 21:09:45	17.000	15.800	17.800	17.000
179	03-Fev-91 21:19:45	17.000	15.800	17.800	17.000
180	03-Fev-91 21:29:45	17.000	15.800	17.800	17.000
181	03-Fev-91 21:39:45	17.000	15.800	17.800	17.000
182	03-Fev-91 21:49:45	17.000	15.800	17.800	17.000
183	03-Fev-91 21:59:45	17.000	15.800	17.800	17.000
184	03-Fev-91 22:09:45	17.000	15.800	17.800	17.000
185	03-Fev-91 22:19:45	17.000	15.800	17.800	17.000
186	03-Fev-91 22:29:45	17.000	15.800	17.800	17.000
187	03-Fev-91 22:39:45	17.000	15.800	17.800	17.000
188	03-Fev-91 22:49:45	17.000	15.800	17.800	17.000
189	03-Fev-91 22:59:45	17.000	15.800	17.800	17.000
190	03-Fev-91 23:09:45	17.000	15.800	17.800	17.000
191	03-Fev-91 23:19:45	17.000	15.800	17.800	17.000
192	03-Fev-91 23:29:45	17.000	15.800	17.800	17.000
193	03-Fev-91 23:39:45	17.000	15.800	17.800	17.000
194	03-Fev-91 23:49:45	17.000	15.800	17.800	17.000
195	03-Fev-91 23:59:45	17.000	15.800	17.800	17.000

E.2.4 Gráficos da TSE do assoalho.

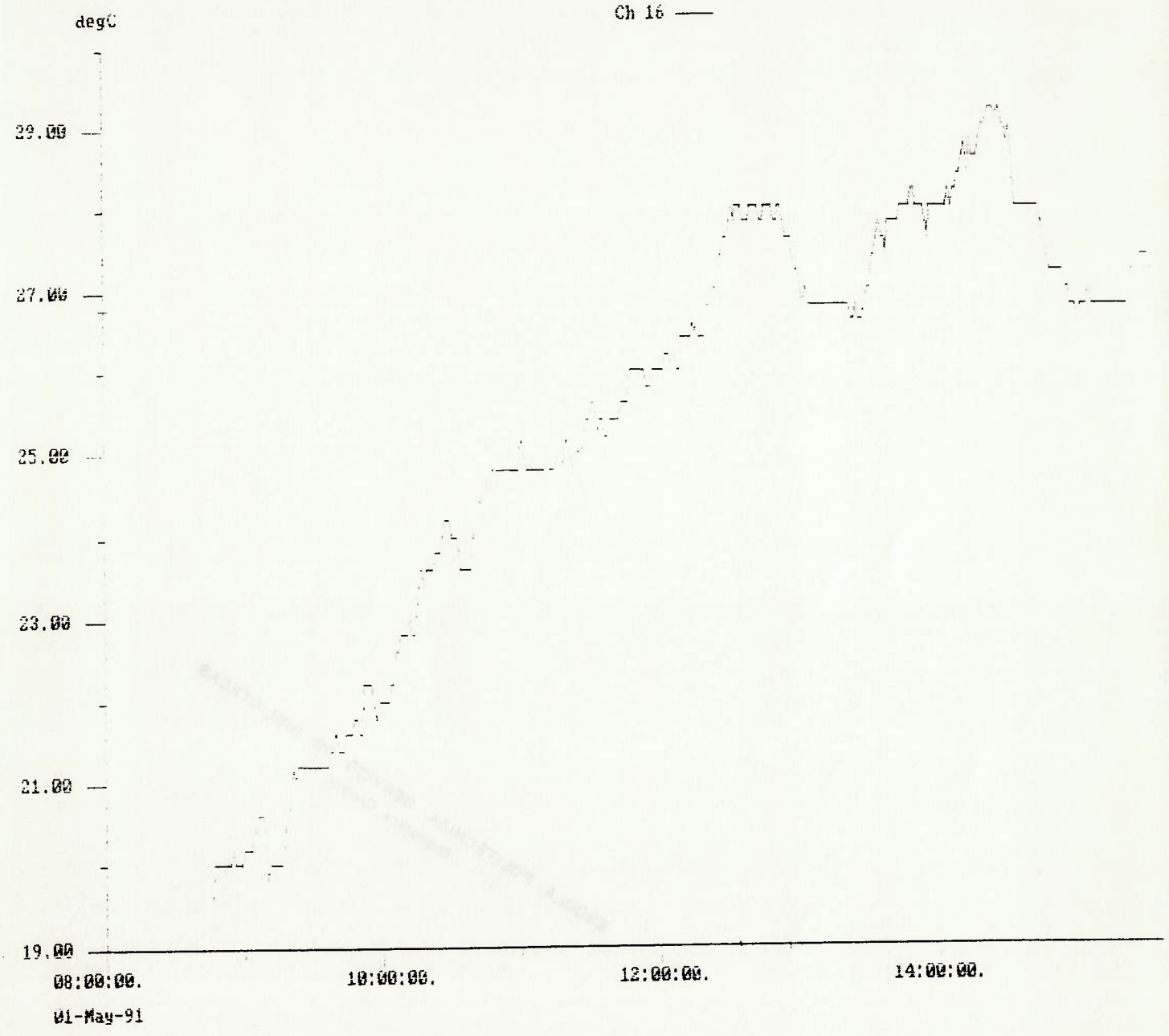


Figura E.8 TSE do assoalho.

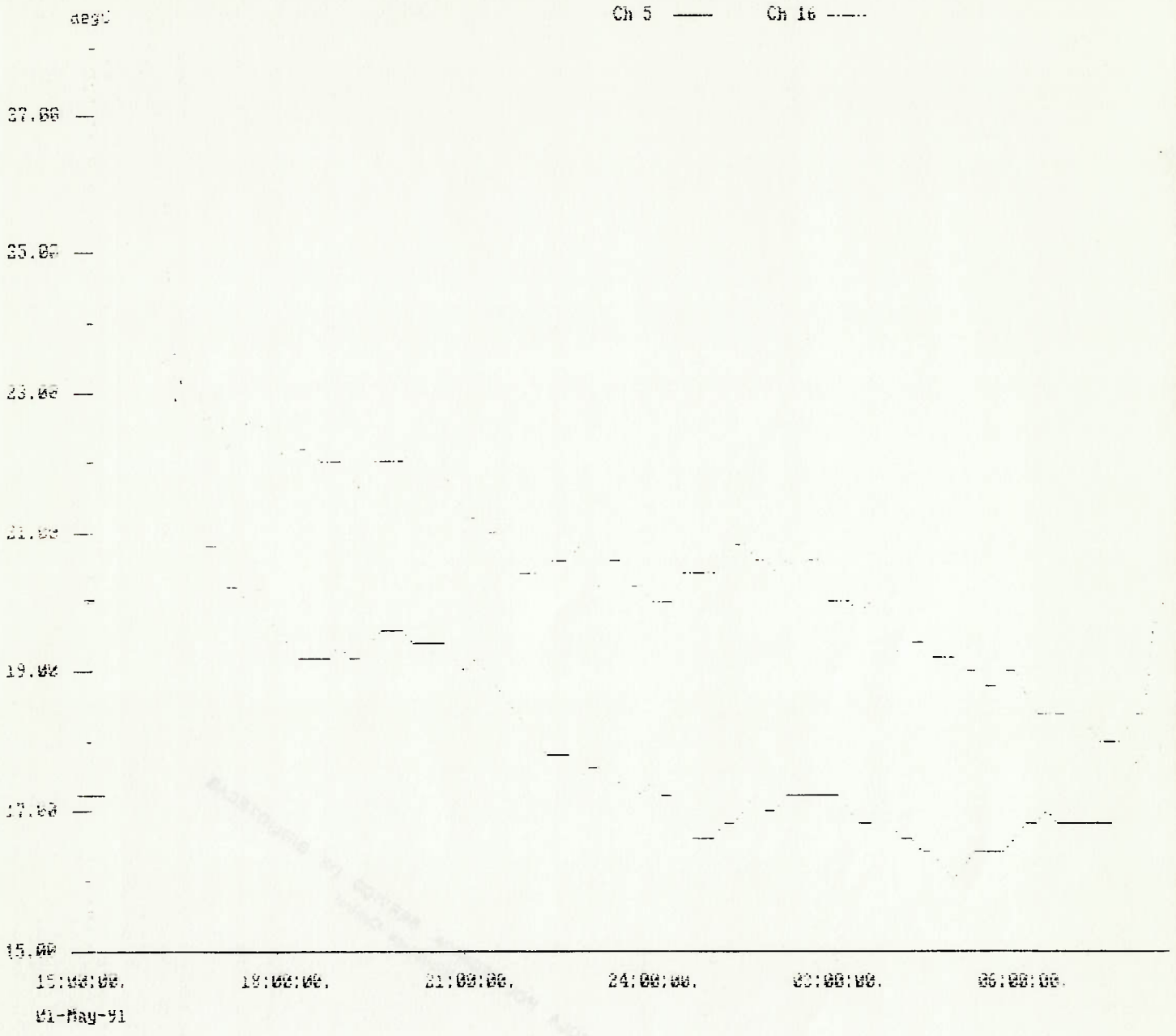


Figura E.9 TSE do assoalho (16) e temperatura do ar externo (5) durante dia 01/03, das 15:30 às 24:00 e das 0:00 às 8:30 do dia 02/03.

Figura E.10 TSE do assoalho (16) e temperatura do ar externo (5).

E.3 Registros do tacógrafo

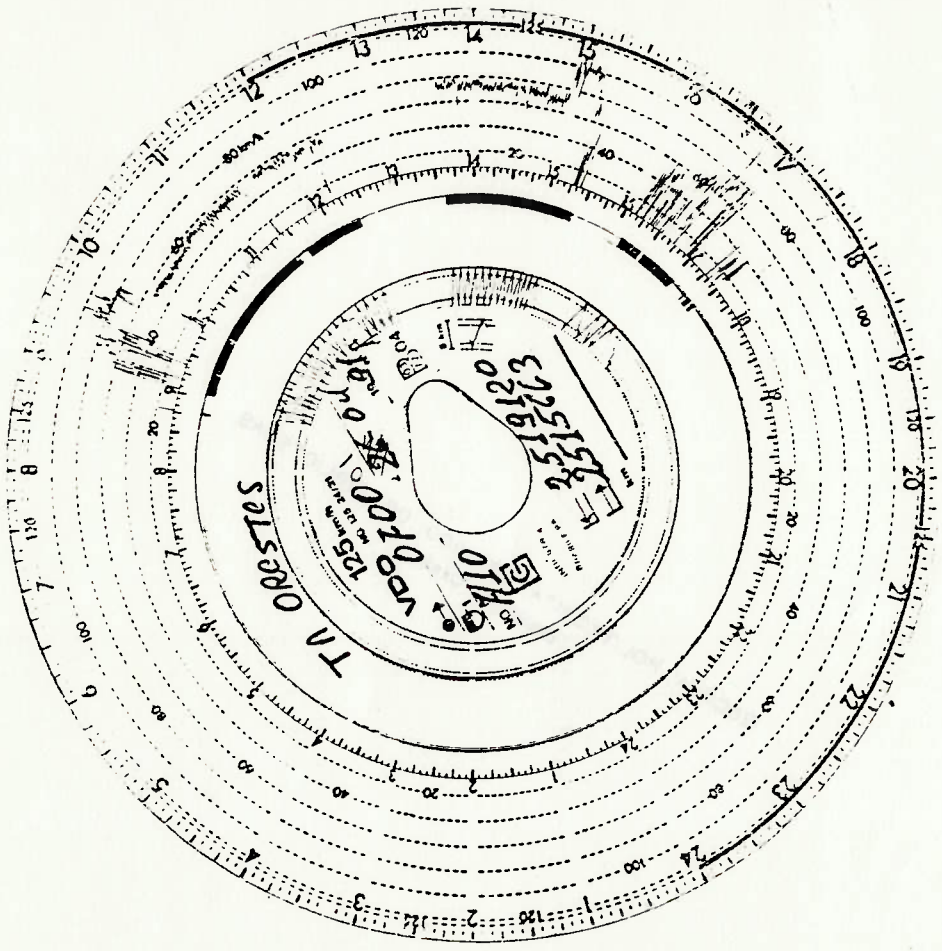


Figura E.11 Registro do tacógrafo do dia 01/03.

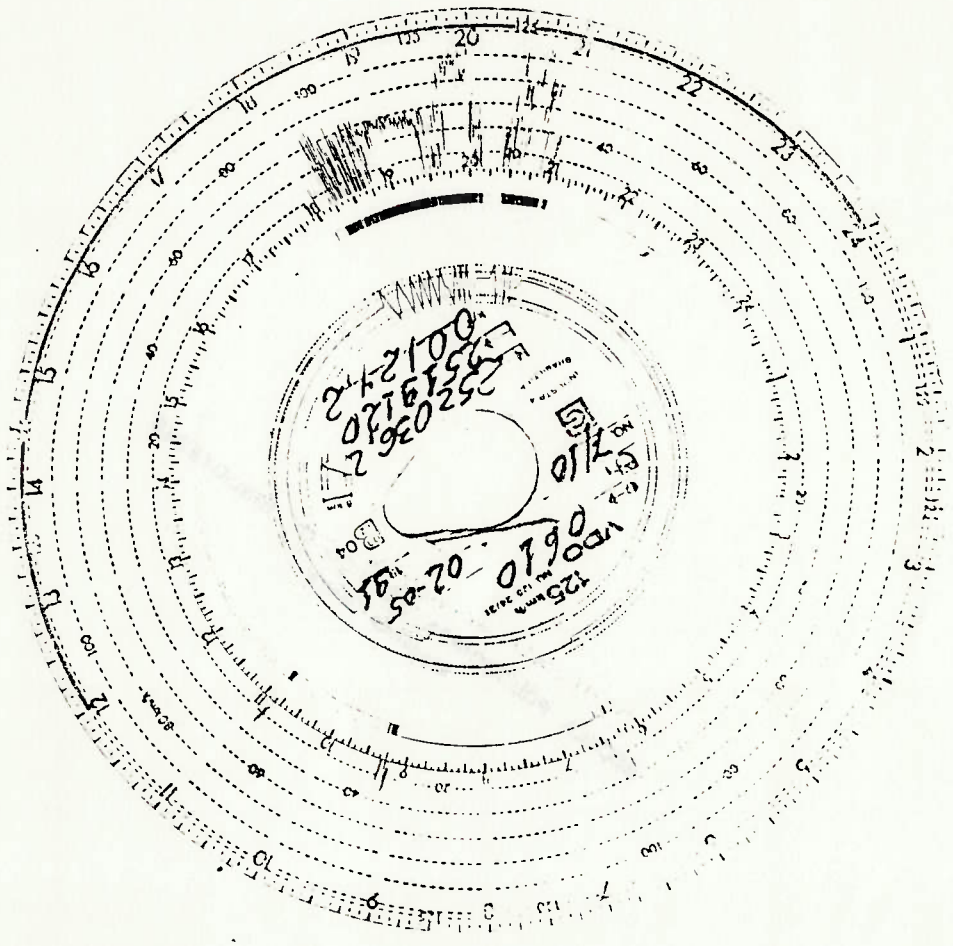


Figura E.12 Registro do tacógrafo do dia 02/03.

E.4 Gráficos das temperaturas relativas à avaliação experimental do cálculo das TSCs

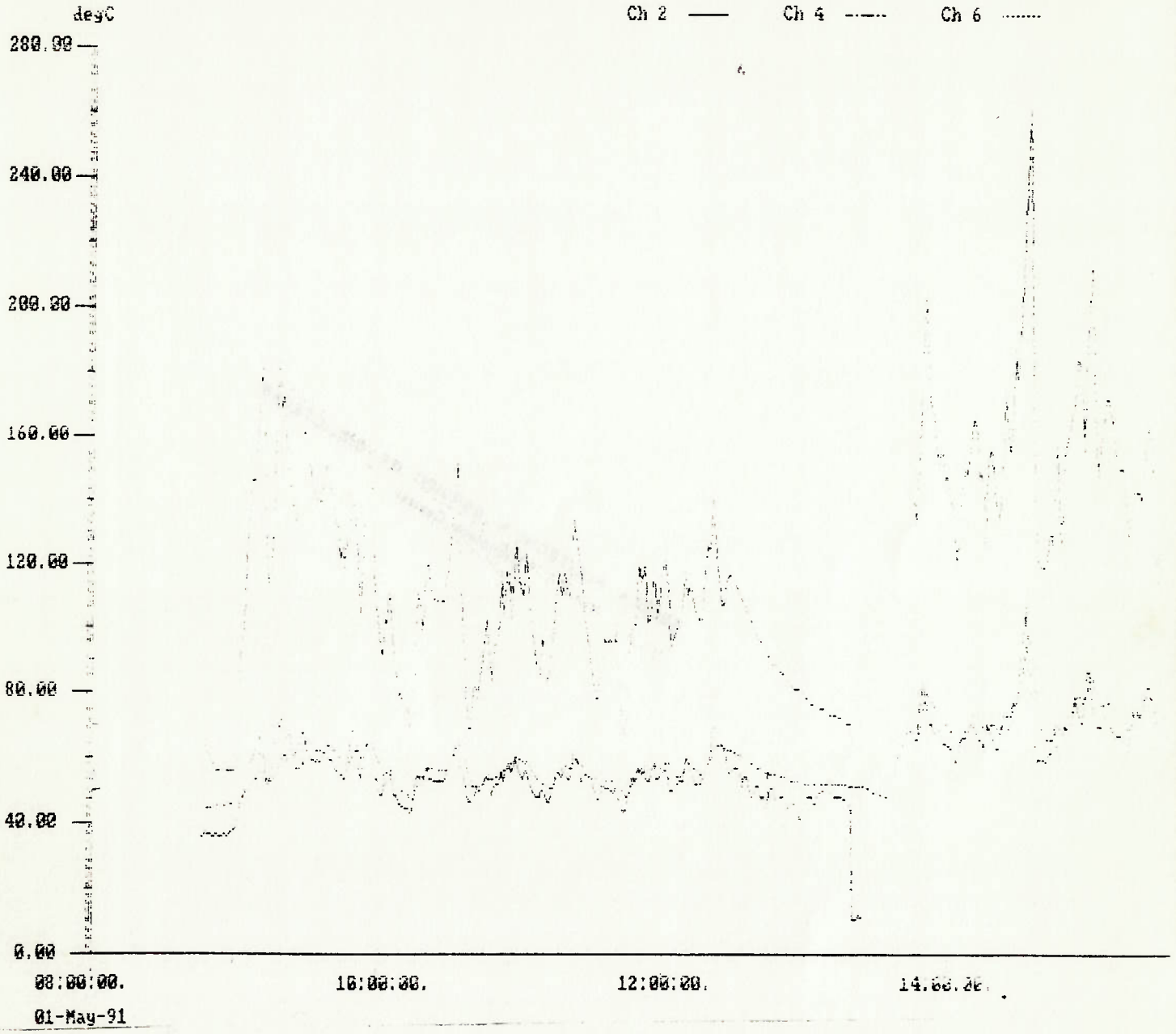


Figura E.13 Temperatura do ar no interior do compartimento (2), do cano de escape (4) e a TSC (6).

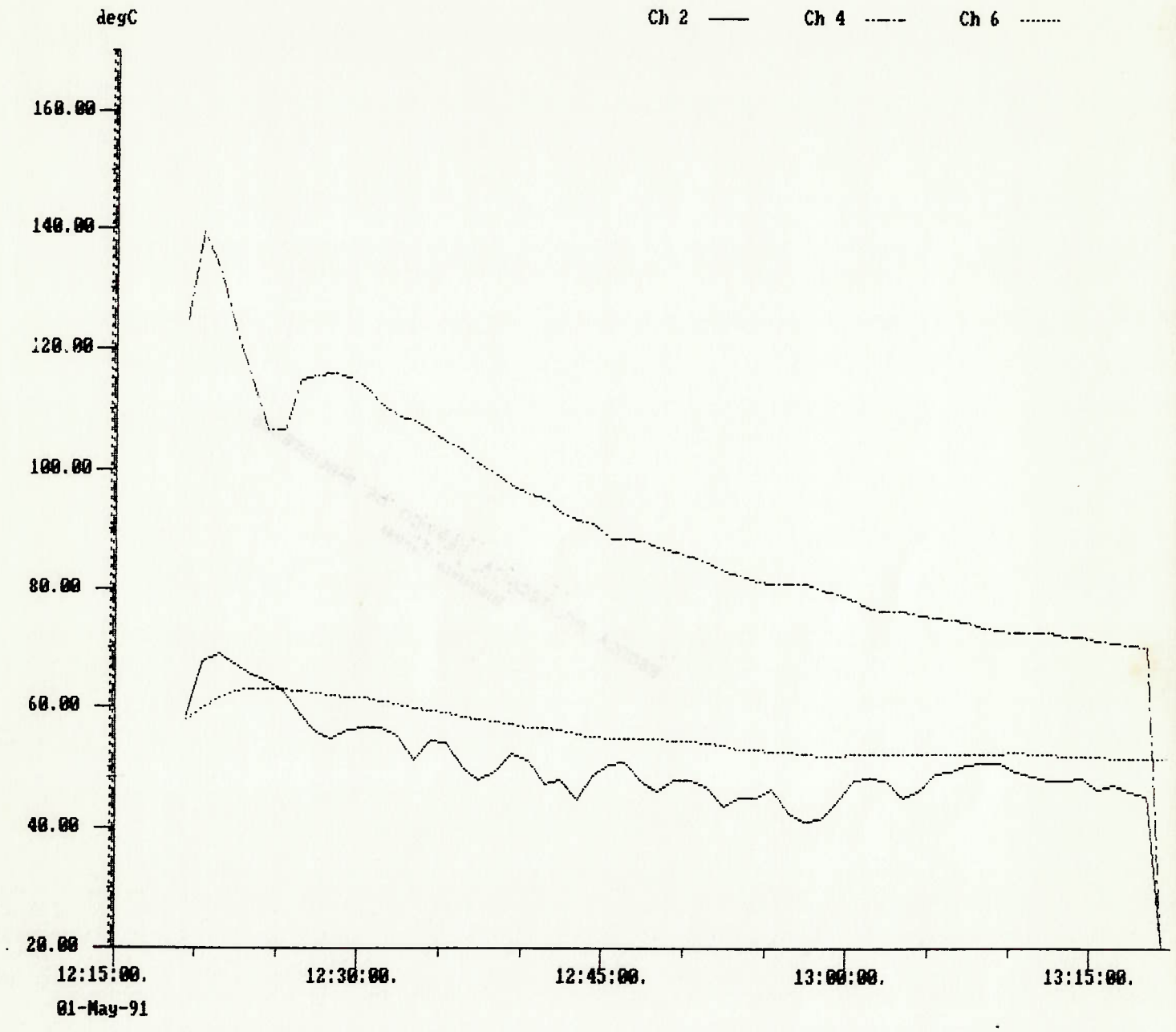


Figura E.14 Temperatura do ar no interior do compartimento (2), do cano de escape (4) e a TSC (6) durante o período em que o motor ficou desligado no dia 01/05.

E.4.1 Tabelas das temperaturas do ar no interior do compartimento (2), do cano de escape (4) e a TSC medida (6).

Rdg no	Time	Ch 2 degC	Ch 4 degC	Ch 6 degC
89	01-May-91 10:15:26.	45.400	74.000	46.800
90	01-May-91 10:16:26.	50.200	93.000	48.200
91	01-May-91 10:17:26.	54.400	110.600	50.800
92	01-May-91 10:18:26.	54.000	106.400	53.000
93	01-May-91 10:19:26.	50.400	95.600	53.400
94	01-May-91 10:20:26.	56.400	118.600	54.200
95	01-May-91 10:21:26.	56.200	120.200	56.400
96	01-May-91 10:22:26.	53.200	112.000	56.600
97	01-May-91 10:23:26.	53.000	109.200	56.400
98	01-May-91 10:24:26.	52.600	108.200	56.200
99	01-May-91 10:25:26.	52.600	107.600	56.000
100	01-May-91 10:26:26.	52.400	108.400	55.800
101	01-May-91 10:27:26.	52.400	107.400	55.600
102	01-May-91 10:28:26.	52.600	107.400	55.600

Rdg no	Time	Ch 2 degC	Ch 4 degC	Ch 6 degC
170	01-May-91 11:36:26.	50.400	94.600	52.600
171	01-May-91 11:37:26.	50.200	95.600	52.600
172	01-May-91 11:38:26.	49.800	94.000	52.600
173	01-May-91 11:39:26.	49.200	94.000	52.400
174	01-May-91 11:40:26.	50.800	97.400	52.800
175	01-May-91 11:41:26.	47.000	84.600	52.400
176	01-May-91 11:42:26.	44.400	73.000	50.600

Rdg no	Time	Ch 2 degC	Ch 4 degC	Ch 6 degC
209	01-May-91 12:15:26.	51.000	101.800	54.800
210	01-May-91 12:16:26.	51.600	101.600	54.600
211	01-May-91 12:17:26.	55.000	115.600	55.000
212	01-May-91 12:18:26.	57.200	125.200	56.800
213	01-May-91 12:19:26.	58.400	124.400	57.800
214	01-May-91 12:20:26.	67.400	139.000	59.600
215	01-May-91 12:21:26.	68.600	132.200	61.400
216	01-May-91 12:22:26.	66.800	122.800	62.400
217	01-May-91 12:23:26.	65.200	114.000	62.800
218	01-May-91 12:24:26.	64.000	106.400	62.800
219	01-May-91 12:25:26.	62.400	106.400	62.600
220	01-May-91 12:26:26.	58.800	114.600	62.200
221	01-May-91 12:27:26.	55.600	115.000	62.000
222	01-May-91 12:28:26.	54.600	115.600	61.600
223	01-May-91 12:29:26.	56.000	114.800	61.400
224	01-May-91 12:30:26.	56.400	113.000	61.200
225	01-May-91 12:31:26.	56.400	110.000	60.600
226	01-May-91 12:32:26.	54.800	108.400	60.200
227	01-May-91 12:33:26.	51.000	107.600	59.600
228	01-May-91 12:34:26.	54.000	106.000	59.000
229	01-May-91 12:35:26.	53.800	104.000	58.800
230	01-May-91 12:36:26.	49.400	102.600	58.200
231	01-May-91 12:37:26.	47.600	100.600	57.800
232	01-May-91 12:38:26.	49.200	98.600	57.200
233	01-May-91 12:39:26.	52.000	97.000	56.800
234	01-May-91 12:40:26.	51.000	95.600	56.400

Rdg no	Time	Ch 2 degC	Ch 4 degC	Ch 6 degC
235	01-May-91 12:41:26.	47.000	94.800	56.200
236	01-May-91 12:42:26.	47.600	92.400	55.800
237	01-May-91 12:43:26.	44.600	91.200	55.200
238	01-May-91 12:44:26.	48.400	90.400	54.800
239	01-May-91 12:45:26.	50.200	88.200	54.600
240	01-May-91 12:46:26.	50.600	88.000	54.600
241	01-May-91 12:47:26.	47.200	87.600	54.400
242	01-May-91 12:48:26.	45.800	86.600	54.400
243	01-May-91 12:49:26.	47.800	86.000	54.000
244	01-May-91 12:50:26.	47.800	85.200	54.000
245	01-May-91 12:51:26.	46.600	84.200	53.800
246	01-May-91 12:52:26.	43.400	82.800	53.400
247	01-May-91 12:53:26.	44.800	81.800	52.800
248	01-May-91 12:54:26.	44.800	80.800	52.600
249	01-May-91 12:55:26.	46.400	80.400	52.400
250	01-May-91 12:56:26.	42.200	80.600	52.200
251	01-May-91 12:57:26.	40.800	80.400	51.800
252	01-May-91 12:58:26.	41.200	79.600	51.600
253	01-May-91 12:59:26.	44.000	78.600	51.600
254	01-May-91 13:00:26.	47.600	77.600	51.800
255	01-May-91 13:01:26.	48.000	76.400	51.800
256	01-May-91 13:02:26.	47.600	75.800	51.800
257	01-May-91 13:03:26.	44.800	75.800	51.800
258	01-May-91 13:04:26.	46.000	75.200	51.800
259	01-May-91 13:05:26.	48.800	74.800	51.800
260	01-May-91 13:06:26.	49.000	74.400	51.800
261	01-May-91 13:07:26.	50.000	74.200	52.000
262	01-May-91 13:08:26.	50.600	73.200	52.000
263	01-May-91 13:09:26.	50.400	72.800	51.800
264	01-May-91 13:10:26.	49.200	72.400	52.200
265	01-May-91 13:11:26.	48.400	72.400	52.000
266	01-May-91 13:12:26.	47.600	72.200	51.800
267	01-May-91 13:13:26.	47.600	71.600	51.600
268	01-May-91 13:14:26.	48.000	71.600	51.600
269	01-May-91 13:15:26.	46.200	71.000	51.600
344	01-May-91 14:30:26.	98.400	236.600	86.200
345	01-May-91 14:31:26.	106.000	259.600	93.200
346	01-May-91 14:32:26.	93.800	243.200	97.400
347	01-May-91 14:33:26.	82.400	197.600	95.600
348	01-May-91 14:34:26.	69.200	158.600	89.400
349	01-May-91 14:35:26.	61.800	132.400	82.000
350	01-May-91 14:36:26.	58.600	119.800	75.600
351	01-May-91 14:37:26.	58.800	118.400	71.000
352	01-May-91 14:38:26.	58.400	117.400	68.200
353	01-May-91 14:39:26.	58.800	118.400	66.400
354	01-May-91 14:40:26.	58.600	119.600	65.200
355	01-May-91 14:41:26.	61.200	130.200	65.000
356	01-May-91 14:42:26.	61.200	125.800	65.200
357	01-May-91 14:43:26.	68.200	149.800	66.000
358	01-May-91 14:44:26.	67.600	156.800	69.400
359	01-May-91 14:45:26.	61.000	134.200	69.200
360	01-May-91 14:46:26.	59.800	126.200	66.600
361	01-May-91 14:47:26.	66.000	152.200	67.600
362	01-May-91 14:48:26.	69.200	158.200	69.400
363	01-May-91 14:49:26.	69.000	161.600	71.400
364	01-May-91 14:50:26.	69.800	165.600	72.800

E.5 DIVERSAS MEDIDAS DE AVALIAÇÃO EXPERIMENTAL GLOBAL DO PROGRAMA SIMULADOR DE CARGA TÉRMICA

E.5.1 Cálculo da vazão de ar no sistema de ar condicionado.

As velocidades medidas perpendiculares aos evaporadores estão na figura E.15 e E.16 abaixo:

0,8	1,5	1,4	1,7	0,8	0,9	0,8	1,4	0,5
1,3	1,7	1,6	2,0	0,6	1,0	1,2	1,2	0,6
2,0	1,8	1,6	1,6	0,7	2,5	1,8	1,2	0,9

Figura E.15 Velocidades do ar na entrada do evaporador do lado esquerdo (m/s).

1,2	1,0	0,6	0,5	1,7	1,6	1,4	1,3	1,1
0,8	1,7	1,1	1,6	2,2	1,9	1,8	1,8	1,5
2,0	3,0	3,1	3,5	2,2	3,0	3,0	2,9	2,0

Figura E.16 Velocidades do ar na entrada do evaporador do lado direito (m/s).

Como ambos evaporadores tem a mesma área e as áreas das regiões dos evaporadores onde foram medidas as velocidades eram iguais à vazão volumétriva for calculada por:

$$Q = (V_1 + V_2).A \qquad \text{(E-1)}$$

onde:

Q = vazão volumétrica no sistema de ar condicionado (m^3/s);

V1 = média aritmética das velocidades medidas no evaporador do lado esquerdo (m/s);

V2 = média aritmética das velocidades medidas no evaporador do lado direito (m/s).

Assim, pela equação (E-1) temos:

$$Q = (1,3 + 1,8).0,1864\ m^2 = 0,5834\ m^3/s$$

Usando-se uma densidade do ar igual a 1,08 kg/m^3 calculada com uma pressão de 0,9.10^5. Para uma temperatura de 20°C (equação de gás perfeito) temos uma vazão mássica de:

$$m_{ar} = 0{,}6324 \text{ kg/s}$$

E.5.2 Cálculo da vazão de ar por infiltração

A vazão de ar será calculada pela equação (3-63). A área efetiva de infiltração será calculada para cada elemento construtivo multiplicando-se a sua área ou comprimento por fatores, D, dados pela tabela 3 do capítulo 23 da referência [10]. Usou-se uma diferença de temperaturas de 1,8°C que é a diferença entre a temperatura interna média (22,2°C) e a temperatura externa (24°C). Segue uma tabela com o cálculo do valor total de infiltração de ar (vazão):

Tabela E.6 Cálculo da vazão de ar por infiltração.

Item	L (m ou m^2)	D	A	B	V (m/s)	Δt (°C)	Q (L/s)
Junção do assoalho	31,6 m	1,5	1,45.10^{-4}	3,2.10^{-4}	—	1,8	0,76
Janelas laterais (LE)	8,18 m^2	2,6	1,45.10-4	3,2.10^{-4}	3	1,8	0,74
(LD)	8,18 m^2	2,6	1,45.10^{-4}	3,2.10^{-4}	—	1,8	0,34
Janela do motorista	1,16m^2	2,6	1,45.10^{-4}	3,2.10^{-4}	—	1,8	0,05
Porta	2,37 m^2	8,0	1,45.10^{-4}	3,2.10^{-4}	3	1,8	0,66
Porta toalete	0,95 m^2	17,0	1,45.10^{-4}	3,2.10^{-4}	0	1,8	0,26
							2,81

Usando-se uma densidade do ar igual a 1,2 kg/m^3 temos:

$$Q = 2{,}81.10^{-3} \text{ m}^3/\text{s}$$

E.5.3 Gráficos da temperatura do ar em diversos locais na cabine para a avaliação do cálculo da CTT.

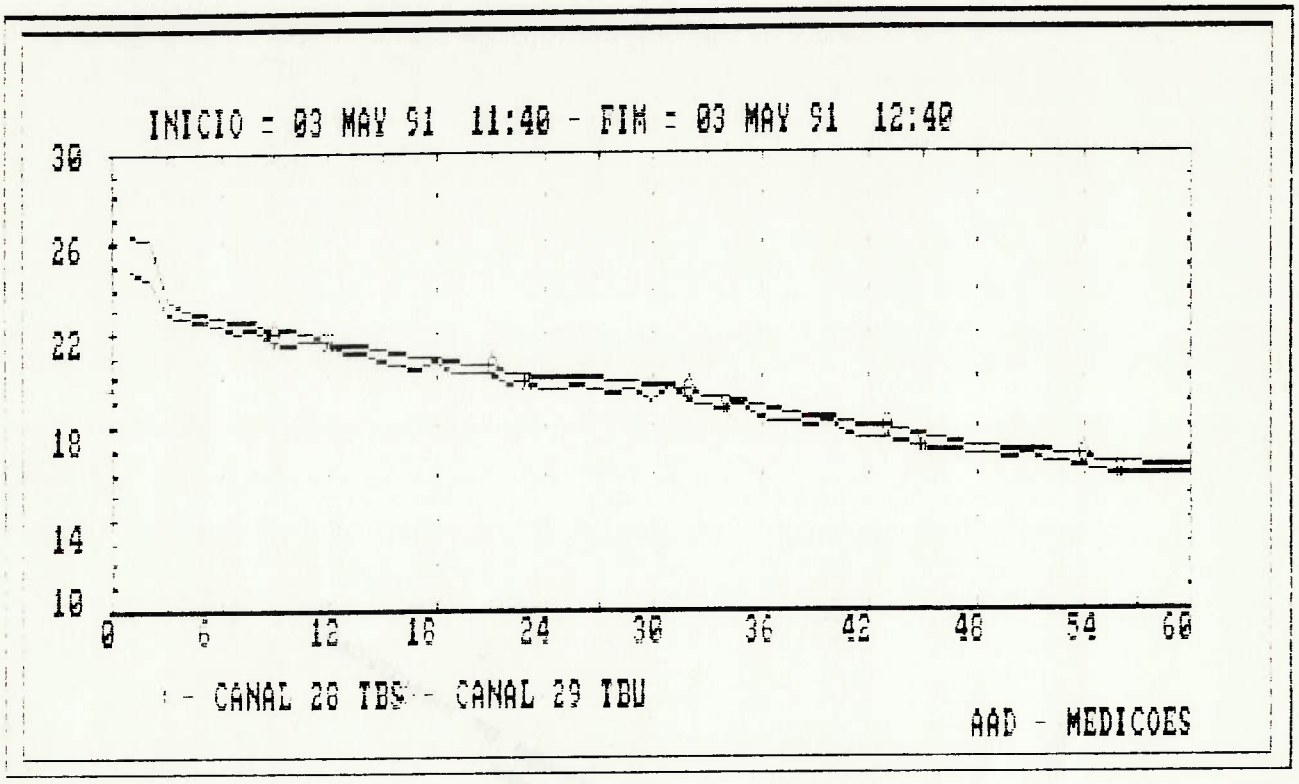


Figura E.17 Temperatura do ar interno medido pelos termopares 28 e 29 (v. figura D.3).

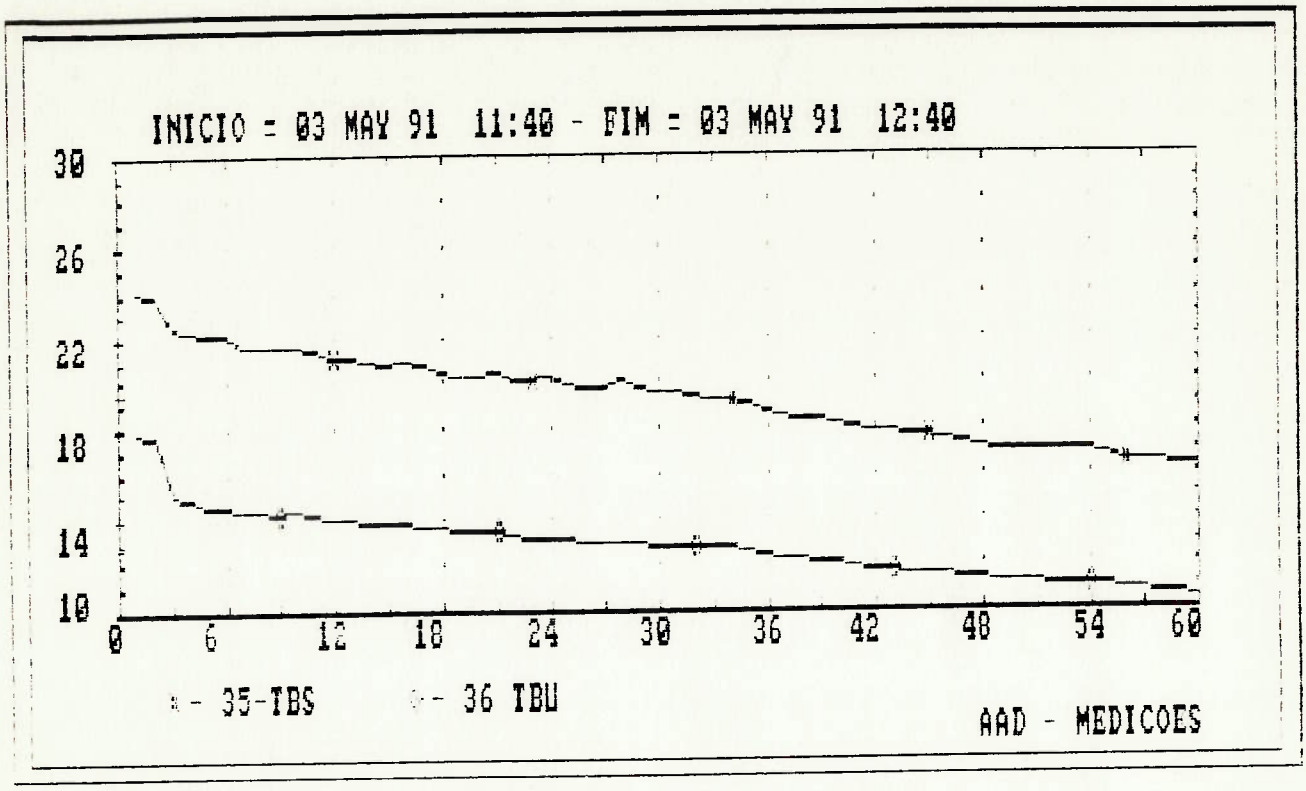


Figura E.18 Temperatura do ar interior medido pelo termopar nº 35 e nº 36 (v. figura D.3).

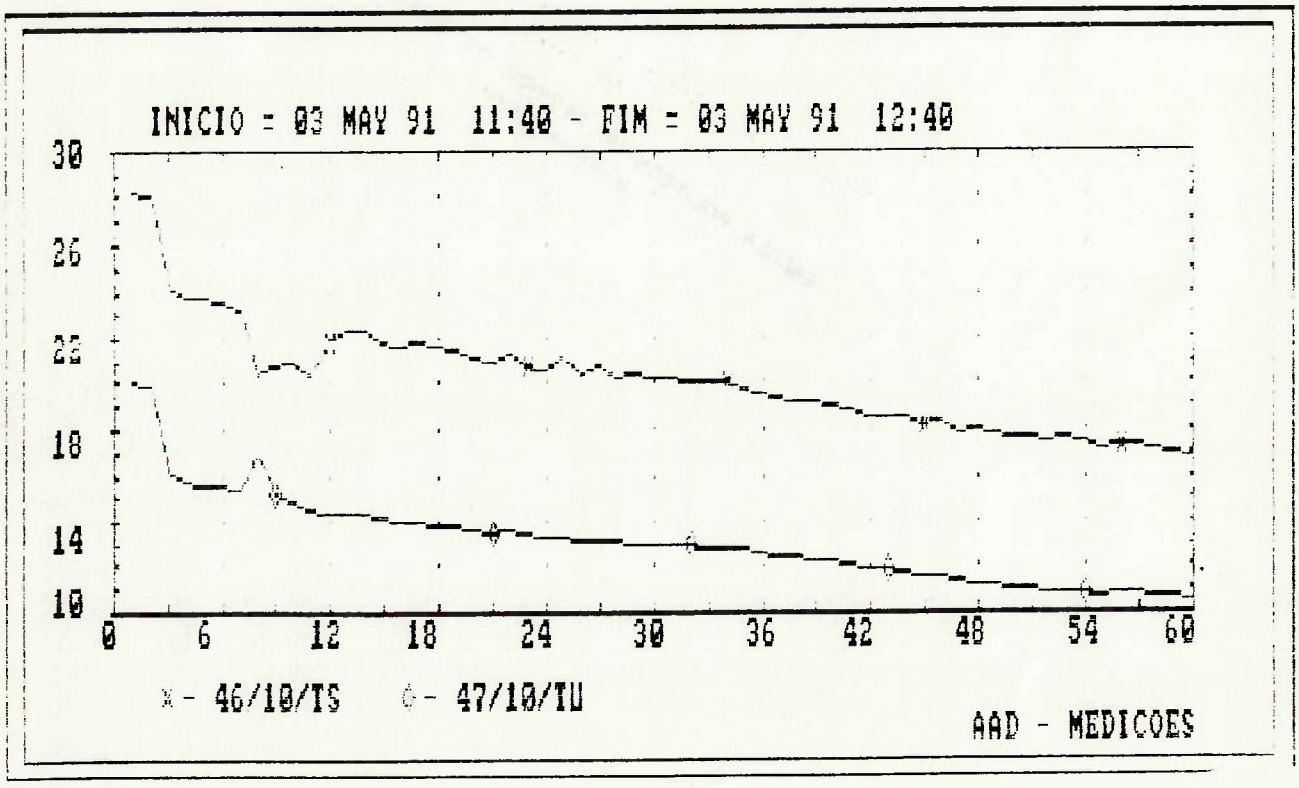


Figura E.19 Temperatura do ar interior medido pelo termopar nº 46 e nº 47 (v. figura D.3).

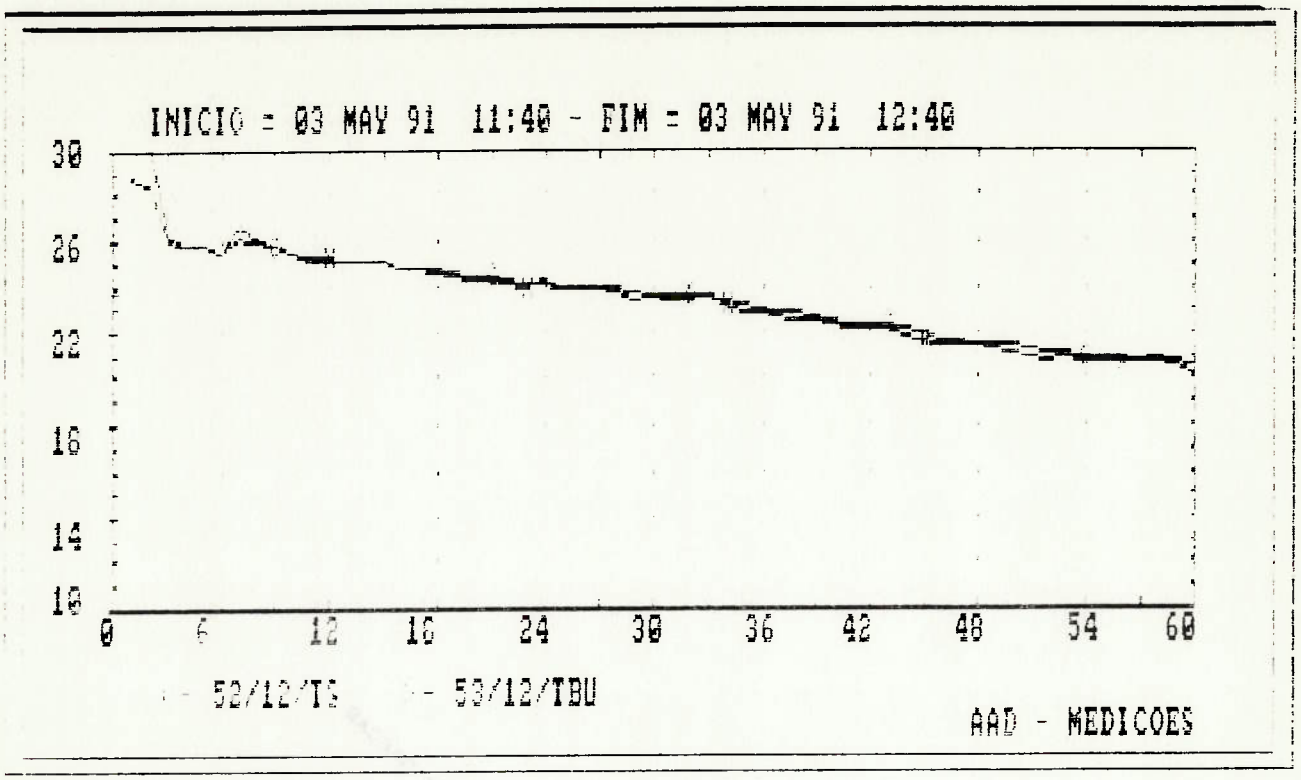


Figura E.20 Temperatura do ar interior medido pelo termopar nº 52 e nº 53 (v. figura D.3).

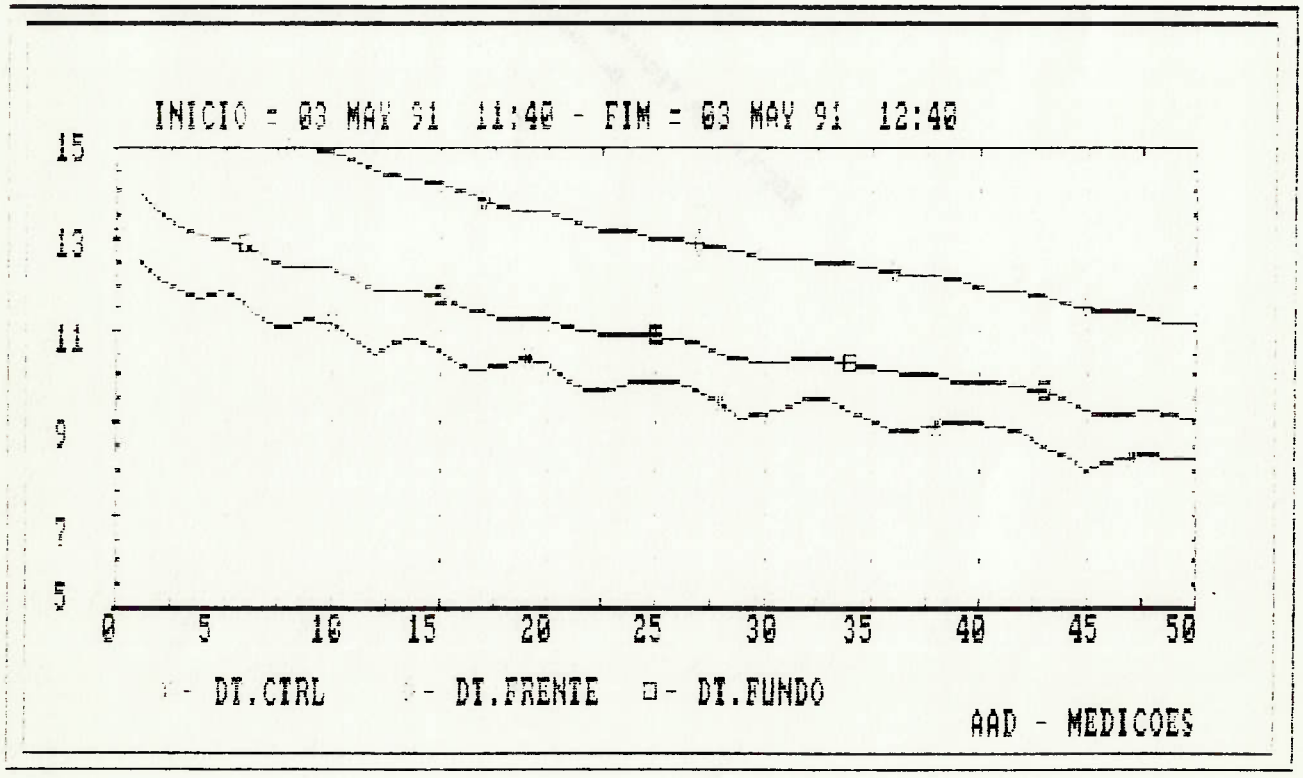


Figura E.21 Temperaturas do ar de insuflamento na frente, meio e fundo do veículo (v. figura D.3).

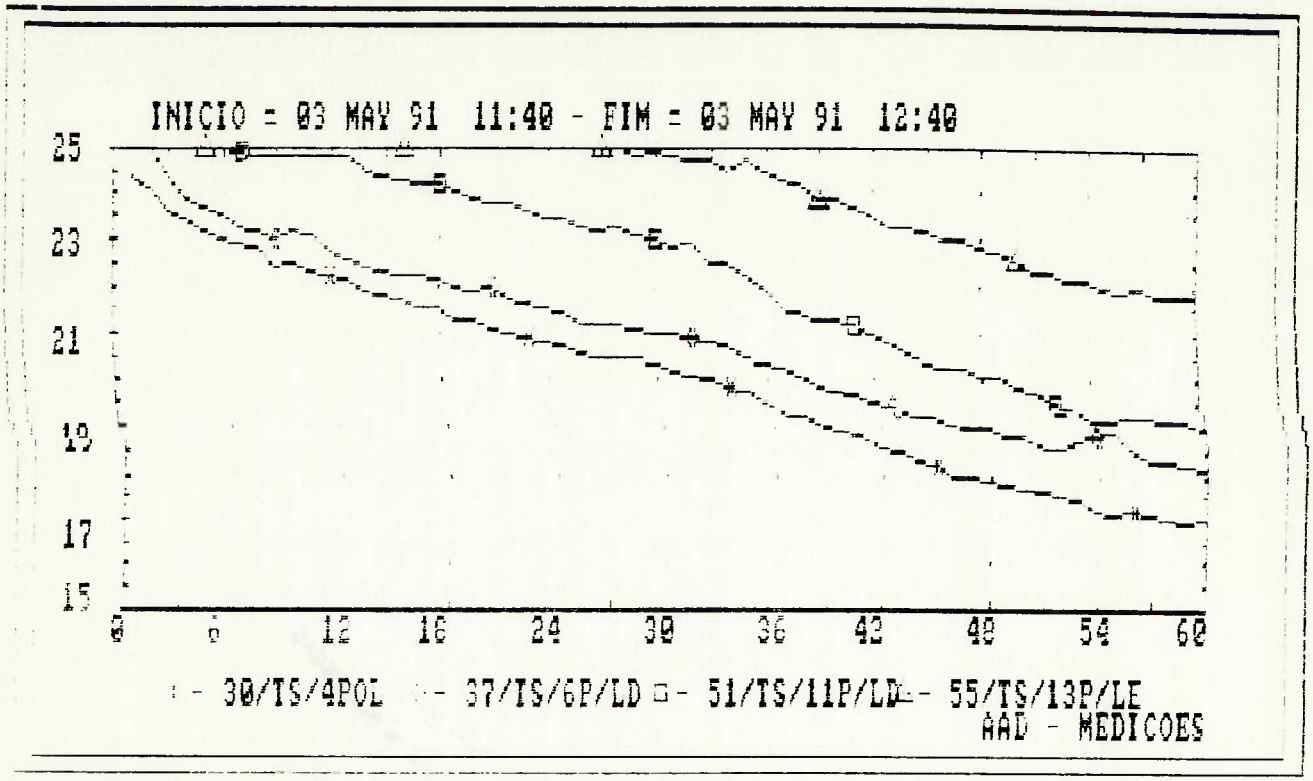


Figura E.22 Temperaturas do ar interior medido pelo termopar nº 30, 37, 55 e 51 (v. figura D.3).

E.6 Cálculo da emissividade do ar

A emissividade de um gás que contém CO_2 e vapor de água pode ser calculada de acordo com a seguinte expressão da referência [13].

$$\varepsilon g = C_c.e_c + C_a.\varepsilon_a - \Delta\varepsilon \qquad \text{(E-2)}$$

onde:

$C_{c,a}$ = fator de correção para pressões atmosféricas de 1 atm;

$\varepsilon_{c,a}$ = emissividade do CO_2 e do vapor de água para a pressão de 1 atm;

$\Delta\varepsilon$ = correção para gases que contém CO_2 e vapor de água.

Para os cálculos foram adotados os seguintes valores:

- Pressão atmosférica de São Paulo = 0,9 atm;
- Pressão parcial do vapor d'água = 1,8155 kpa;
- Pressão parcial de CO_2 = 0,03 kpa (porcentagem molar de CO2 = 0,03%).

É necessário também se admitir um "comprimento de feixe efetivo", Le, que é função da geometria do sistema. Para volumes entre dois planos infinitos a referência [13] na tabela 8.2 indica um comprimento e feixe efetivo igual a 1,8 vezes a distância entre estes planos. Como nosso caso é uma superfície exposta ao ar livre, vamos adotar para o vapor de água um Le igual a 400 m e para o CO_2 igual a 5.000 m, supondo que a composição do ar para o CO_2 não mude significativamente até esta altitude.

Com os dados apresentados, através dos gráficos [13] 8-35, 8-36, 8-37 e 8-38, obteve-se os seguintes valores:

$C_a = 0,97$; $\varepsilon_a = 0,64$;

$C_c = 1$; $\varepsilon_c = 0,18$;

$\Delta\varepsilon = 0,035$

Assim, pela equação (E-2):

$\varepsilon_g = 0,97.0,64 + 1.0,18 - 0,035 = 0,7658 \approx 0,76$

E.7 Coeficientes ópticos dos vidros Blindex

Vidro transparente, 5 mm

a_0 =	-0,0042	t_0 =	-0,00464
a_1 =	1,39189	$t1$ =	2,53554
a_2 =	-2,92537	t_2 =	-3,19423
a_3 =	3,05010	t_3 =	0,55314
a_4 =	-1,65711	t_4 =	1,89080
a_5 =	0,36976	t_5 =	-1,07666

Vidro cinza, 6 mm

a_0 =	-0,00311	t_0 =	-0,00366
a_1 =	2,70016	$t1$ =	2,01316
a_2 =	-3,27922	t_2 =	-6,52756
a_3 =	-0,17579	t_3 =	10,71373
a_4 =	2,73208	t_4 =	-8,40232
a_5 =	-1,35551	t_5 =	2,53943

Vidro verde, 6mm

a_0 =	-0,00311	t_0 =	-0,00361
a_1 =	2,70016	$t1$ =	2,01316
a_2 =	-3,27922	t_2 =	-6,52756
a_3 =	-0,17579	t_3 =	10,71373
a_4 =	2,73208	t_4 =	-8,40232
a_5 =	-1,35551	t_5 =	2,53943

E.8 Cálculo das massas interiores no interior do ônibus 0371-RSD

O cálculo da massa de materiais em forma de placa será:

$$M = A.e.\rho \qquad \text{(E-3)}$$

onde:

A = Área da placa, m_2;
e = espessura, m;
ρ = densidade do material, kg/m^3.

Todas as áreas se referem às áreas calculadas no item D.1.

a) Massa de vidro

. Área dos vidros = 12,42 m^2;

. espessura = 5 mm;

. densidade = 2.700 kg/m^3 [13];

. através da equação (E-3) temos M = 168 kg.

b) Massa de madeira

. Área do peso da cabine (Pinho) = 30,9 m^2;

. espessura = 16 mm;

. densidade = 640 kg/m^3 [13];

. através da equação (E-3) temos M = 307 kg.

c) Massa de plástico

. Área do teto e da parede traseira = 30 m^2;

. espessura = 3 mm;

. densidade = 1.190 kg/m^3 [13].

d) Massa de aço

— Dutos de ar

. Área dos dutos de ar = 39,00 m^2;

. espessura das chapas = 2 mm;

. densidade = 7.833 kg/m^3 [13];

. através da equação (E-3) temos M = 610 kg.

— Estruturas das cadeiras

Usando-se o peso estimado pela engenharia da MBB de 30 kg por cadeira temos:

M = 30 kg/cadeira .46 cadeiras = 1.380 kg

— Esquadrias das janelas

Usando a massa estimada pela engenharia da MBB de 8 kg por esquadria das janelas temos:

M = 8 kg/janela.14 janelas = 22 kg

Somando-se o peso das esquadrias das janelas, dutos de ar e as cadeiras, temos:

M = 2.012 kg.

E.9 Mapas do trecho realizado na rodovia Castelo Branco e do pátio da MBB.

Figura E.23 Mapa do trecho São Paulo-Tatuí da Castelo Branco.

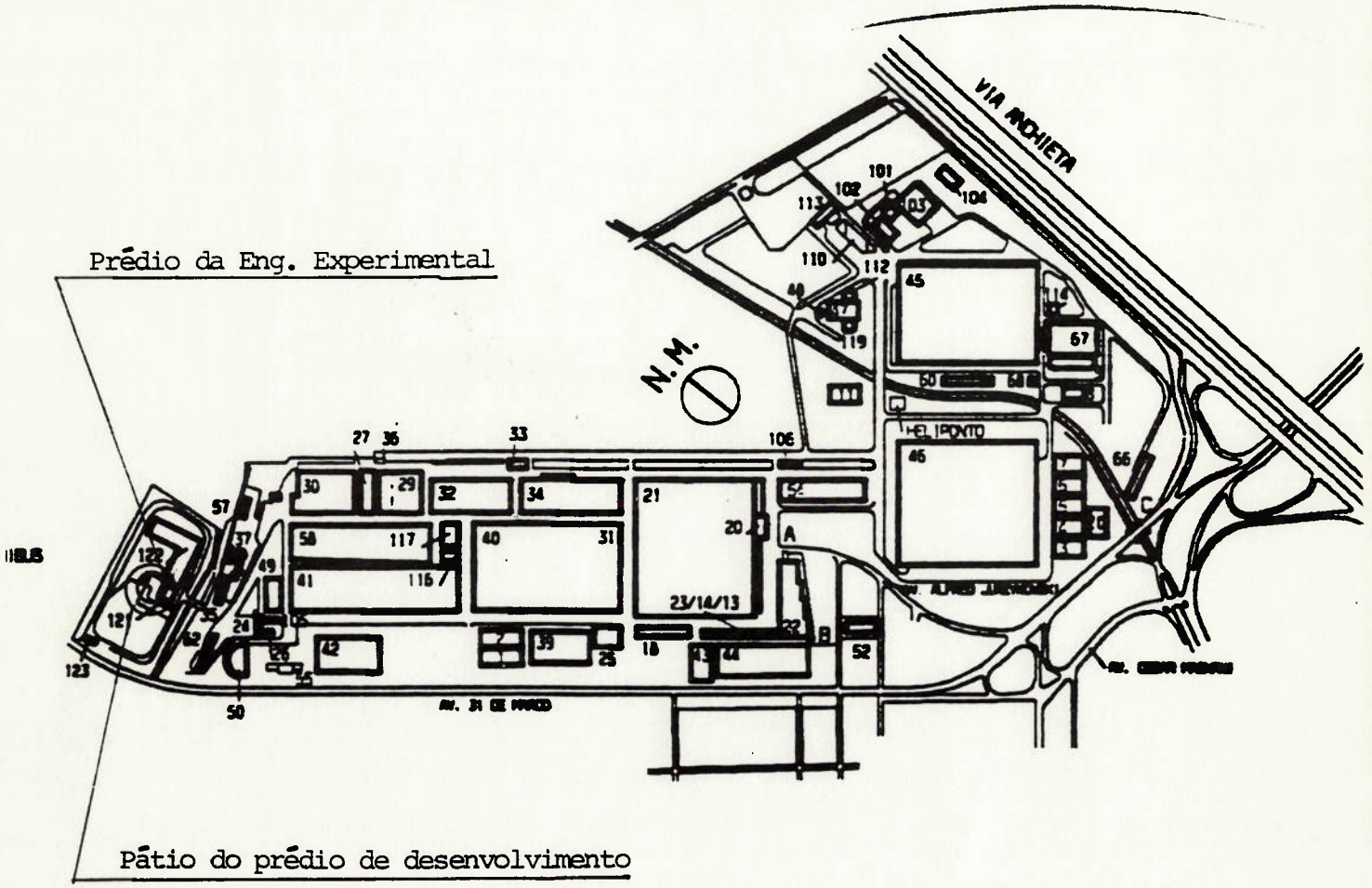


Figura E.24 Mapa de localização do pátio do prédio de desenvolvimento na MBB.

NOMENCLATURA		
SÍMBOLO		UNIDADE
A	área da superfície	m^2
A	coeficiente de empilhamento	$(L/s)^2(cm)^{-4}(m/s)^{-2}$
A	coeficiente experimental da radiação direta normal (Eq. 4.8.)	W/m^2
A_c	área de uma superfície do compartimento do motor	m^2
A_m	área de uma superfície do motor	m^2
A_v	área do vidro	m^2
a_j	coeficientes ópticos dos vidros Blindex (Eq. 4.16.)	
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineer, Inc.	
B	coeficiente experimental da radiação direta normal (Eq. 4.8.)	
B	coeficiente do vento	$(L/s)^2(cm)^{-4}(m/s)^{-2}$
C	fator de irradiação difusa do céu (Eq. 3.9.)	
C	coeficiente de interpolação da Eq (4.37.)	
CB	compartimento de bagagem	
Cl	índice de claridade	
CM	compartimento do motor	
Cp_{ar}	calor específico do ar	J/kg^0C
CT	carga térmica	W
CTT	carga térmica total	W
$(CTT)_m$	carga térmica total medida	W
dst	dia do ano	
E_s	emissividade para radiação de compirmento de onda curta	
E_e	emissividade para radiação de comprimento de onda longa	
e_i	espessura dos materiais que compõem as paredes da cabine	m
EPUSP	Escola Politécnica da Universidade de São Paulo	
ET	equação do tempo	minutos
F_{sc}	fator de forma entre a superfície e o céu	
F_{ss}	fator de forma entre a superfície e o solo	
F_{A-B}	fator de forma entre a superfície A e B	
g	aceleração da gravidade	m/s^2
G_j	insolação incidente no vidro	W/m^2
H	ângulo horário	radianos
h_{ce}	coeficiente de troca de calor por convecção do lado interno do comprimento do motor	$W/m^{2\,0}C$
h_c	coeficiente de troca de calor por convecção externa médio	$W/m^{2\,0}C$
h_i	coeficiente de troca de calor por convecção interno	$W/m^{2\,0}C$

HSA	hora solar aparente	horas
I_d	irradiação difusa do céu	W/m^2
I_{dn}	irradiação direta normal	W/m^2
I_D	irradiação direta	W/m^2
I_e	intapia do ar externo	J/kg de ar seco
I_i	intapia do ar interno	J/kg de ar seco
I_r	irradiação refletida	W/m^2
I_t	irradiação total	W/m^2
K_{ar}	condutividade térmica do ar	$W/m\ ^0C$
K_i	condutividade térmica dos materiais das paredes	$W/m\ ^0C$
I_m	entalpia média do ar interno da cabine	J/kg de ar seco
I_{in}	entalpia média do ar insuflado na cabine	J/kg de ar seco
L	área efetiva de infiltração	cm^2
L	comprimento da superfície no sentido do escoamento	m
LAT	latitude	graus
LON	longitude	graus
M	massa	kg
$\dot{m}ar$	vazão massica do ar	kg/s
MBB	Mercedes Bens do Brasil	
MPL	meridiano de referência do fuso local	radianos
Q	fluxo de ar (Eq. 4-63)	L/s
Q	calor transmitido por unidade de tempo	W
Q	fluxo de calor	W/m^2
Q_a	radiação atmosférica absorvida	W/m^2
Q_c	fluxo de calor por convecção	W/m^2
Q_k	fluxo de calor por condução	W/m^2
Q_r	radiação da superfície emitida	W/m^2
Q_r	troca de calor por radiação entre a superfície do compartimento do motor e o motor	W/m^2
Q_s	radiação solar total absorvida	W/m^2
Q_t	radiação terrestre absorvida	W/m^2
R	somatória das resistências superficiais de radiação e de fator de forma (Eq. 4.48.)	
R_c	resistência de condução	$m^2\ ^0C/W$
R_{ci}	resistência de convecção interna	$m^2\ ^0C/W$
R_{cc}	resistência de convecção do lado interno do compartimento do motor	$m^2\ ^0C/W$
R_t	resistência térmica total	$m^2\ ^0C/W$
rpm	rotações por minuto	
R_r	resistência de radiação linearizada	$m^2\ ^0C/W$
SCT	programa simulador de carga térmica	
T	temperatura	^0C
T_{ar}	temperatura do ar no interior do compartimento do motor	^0C

TBS	temperatura do bulbo seco	^0C
TBU	temperatura do bulbo úmido	^0C
TCL	hora civil local	horas
T_e	temperatura do ar externo à cabine ou externo	^0C
T_f	temperatura de filme	^0C
T_i	temperatura do ar interno à cabine ou interno	^0C
T_{in}	temperatura média do ar insuflado na cabine ou temperatura média de insuflamento	^0C
t	tempo	s
t_J	coeficientes ópticos dos vidros Blindex	
T_m	temperatura do motor	^0C
TSC	temperatura da superfície interna do comprimento do motor	^0C
TSEs	temperaturas superficiais exteriores	^0C
T_{solo}	temperatura do solo	^0C
TSE [i]	variável da rotina do cálculo das TSEs	K
TSE - anterior [i]	variável da rotina do cálculo das TSEs	K
U	coeficiente de transferência global de calor	$W/^0C$
V	velocidade do ar	m/s
X	variável dos polinômicos das constantes experimentais solares (Eq A do item do Apêndice A)	

NOMENCLATURA		
α_D	absortividade dos vidros par radiação solar direta	
α_d	absortividade dos vidros para radiação solar direta	
α_I	absortividade para comprimento de onda longo (infravermelho)	
α_p	absortividade solar das paredes	
β	ângulo de azimute solar	graus
β	coeficiente de expansão volumétrica	l/k
Δt	diferença de tempo	s
ΔT	diferencial de temperaturas	^0C
γ	ângulo de declinação terrestre	graus
ε_a	emissividade do vapor de água	
ε_{atm}	emissividade da atmosfera	
ε_c	emissividade do dióxido de carbono	
ε_c	emissividade da superfície interna do comprimento do motor	
ε_m	emissividade da superfície do motor (canos de escape)	
ε_{solo}	emissividade do solo	
ε_{sup}	emissividade da superfície	
θ	ângulo de incidência (item 4.2.1.)	graus
μ	viscosidade dinâmica	$N.s/m^2$
υ	viscosidade cinemática	m^2/s
ρ_s	refletividade do solo	
Σ	ângulo de inclinação da superfície (item 4.2.1.)	graus
σ	constante de Stefan-Boltzman	$W.m^2k^4$
τ_D	transmissividade da radiação solar direta	
τ_d	transmissividade da radiação solar difusa	
ϕ	azimento solar (item 4.2.1.)	radiano
Ψ	azimento da superfície	radianos

ADIMENSIONAIS	
Pr	Número de Prandtl = $Cp.\mu/k$
$\overline{Nu}_L$	Número de Nusselt médio sobre a superfície = $Ne.L/K_{ar}$
Gr_j	$Gr_j = g.\beta (TSE-Te) L^3/\upsilon^2$
ReL	Número de Reynolds = $V . L/\upsilon$

REFERÊNCIAS BIBLIOGRÁFICAS

1. COULSON, D. *The air conditining of Motor vehicle.* I.H.V.E.J., nº 33. pp 37-347. Fevereiro de 1966

2. GAC, A. *Importance des echanges radiatifs dans le bilan termique d'un engin de transport.* Reviu Generale du Froid, nº 11. pp 1289-1296. Novembro de 1968.

3. HOSLER, T.W. *Guidelines for evaluation of cab temperature.* (SAE Paper nº 730696, 1973)

4. LEMKE, A.D. *An evaluation of transit bus air conditioning systems.* (SAE Paper, nº 750402, 1975).

5. RUTH, D.W. *Simulation modeling of automobile confort cooling requiriments.* ASHRAE Journal, nº 5, pp 53-55, Maio de 1975.

6. JOHNSON, T.J. *Truck climate controls: past, present and future climate controls for the truck cab.* (SAE Paper nº820971, 1982).

7. CHIOU, J.P. *Application of solar-powered ventilator in automobiles.* (SAE Paper nº 860585, 1986).

8. ASHRAE, *Handbook of fundamentals.* New York, 1972, 688p.

9. ASHRAE. *Handbook of fundamentals.* New York, 1982.

10. ASHRAE. *Handbook of fundamentals.* New York, 1989.

11. POSATA, NICOLA. *Cálculo de ganho de calor por irradiação solar.* Trabalho de formatura — Departamento de Engenharia Mecânica — Universidade de São Paulo.

12. KREITH, FRANK. *Princípios de transmissão de calor.* São Paulo, Edgard Blüscher, 1977. 550p.

13. HOLMAN, JACK PHILIP. *Transferência de calor.* São Paulo, MacGraw-Hill do Brasil, 1983. 639p.

14. WEAST, R.C., ASTLE, M.J. E BEGER, W.H. (editores). *CRC Handbook of chemistry and physics*, 66ª edição. *CRC Press*, Flórida, 1985-1986. pp E-390, E-391.

15. FUJII, T, E H. IMURA. *Natural convection heat transfer from a plate with orbitrary inclination.* Int. J. Heat Mass Transfer, vol 15, p. 755, 1972.

16. CHURCHILL, S.W., E M. BERNSTEIN, *A Correlating equation for forced convection from gases and liquids to a circular cylinder in crossflow.* J. Heat Transfer, vol 99, pp 300-306, 1977.

17. SCHLICHTING, H. *Boundary layer teory.* New York, MacGraw-Hill Book Company, 1979.

18. SILVA, R.M. *Manual de termodinâmica e transferência de calor.* São Paulo, Grêmio Politécnico-DLP, 1980. 348p.