Priedai[1]

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[1] – pateikta elektroninėje laikmenoje (CD)

A priedas. Vidurkių skaičiavimo programos tekstas

Ši programa parašyta programiniam paketui FORTRAN, skirta, panaudojant slėgio cilindre jutiklio, degalų purkštuvo adatos jutiklio ir alkūninio veleno padėties jutiklio signalus, apskaičiuoti vidutinius slėgius cilindre, slėgio prieaugį ir purkštuvo adatos eigą kiekviename iš 2048 matavimo taškų per ciklą visiems bandymų režimams. Matavimo ciklų skaičius 100.

```
Program Vidurkiu_skaiciavimas !Papildyta isvestines skaiciavimu 2012 12 23 papildyta adatos signalo integ-
ravimu 2012 12 31
USE DFLIB
!Character failo_pavadinimas*30, kintamuju_pavad !, angle,ch1,ch2
Integer(4) n, length, stulp_sk,i, j, cikl_sk, vieno_cikl_ilg
Real(8) laiko_koef, sukiai, filtras
Real(8), Dimension (:,:), allocatable:: prad_duom,vidurk
Real(8), Dimension (:), allocatable:: suma, sleg_greitis, signalo_integr
CHARACTER($MAXPATH) dir ! Eksp
!--------------------------------------------------------------
!  Get current directory
dir = FILE$CURDRIVE! Eksp
length = GETDRIVEDIRQQ(dir)      ! Eksp
IF (length .GT. 0) THEN                                  !
  WRITE (*,*) 'Current directory is: ' ! Eksp
  WRITE (*,*) dir ! Eksp
ELSE ! Eksp
  WRITE (*,*) 'Failed to get current directory'      ! Eksp                        |
END IF                                   !
!--------------------------------------------------------------
count = delfilesqq ('*.rez')
Print*, 'Iveskite aps/min skaiciu'
Read(5,*) sukiai
Print*, 'Apsisukimai min-1   ',sukiai
Print*, 'filtro dydi, pvz 0.65'
Read(5,*) filtras
Print*, 'filtro dydis=', filtras
!Print*,'valio'
!Pause
Open (3, file='Prad.txt',status='old') !reikes padaryti, kad butu galima ivesti
Open (9, file='Pateikto_failo_vidurk_plus.rez',status='new')
stulp_sk=4 !reikes padaryti ivedima is klaviaturos                ``1!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
n=0
!_________________________________
Do while (.NOT.EOF(3))                    !|
n=n+1                                     !|
Read(3,*) a                            !| Masyvo eiluciu skaiciaus 'n' nustatymas
End do                                    !|
!________________________________!|
Print*,'n=',n
allocate (prad_duom(n,stulp_sk),suma(stulp_sk-2)) !n yra ciklu skaicius
!--------------------------------------------------------------------***********************************
Rewind(3); prad_duom=0.0                                          !|
Do i=1,n                                                              !|      Mazgu failo nuskaity-
mas
Read(3,*) (prad_duom(i,j), j=1,stulp_sk)              !|     Norint, kad nuskaitytu visus 3 stulpelius reikia rasyti:
Enddo                                                                      !|
        (F8.0,ES20.13,ES20.13)') (mazgai(i,j), j=1,3)
```

```
!_________________________________________________________!|                    !TR6            i6mestas
'(I4.3,ES20.13,ES20.13,ES20.13)'
!Vidurkio skaiciavimas
cikl_sk=prad_duom(n,1)
vieno_cikl_ilg=n/cikl_sk ! Vieno bandymo stulpelio ilgis
allocate (vidurk(vieno_cikl_ilg,(stulp_sk-2)),sleg_greitis(vieno_cikl_ilg),signalo_integr(vieno_cikl_ilg) )
Print*, 'cikl_sk=',cikl_sk
Print*, 'vieno_cikl_ilgis=',vieno_cikl_ilg
DO i=1,vieno_cikl_ilg
suma(1)=prad_duom(i,3)
suma(2)=prad_duom(i,4)
   DO j=1,cikl_sk-1
   suma(1)=suma(1)+prad_duom(i+j*vieno_cikl_ilg,3)
   suma(2)=suma(2)+prad_duom(i+j*vieno_cikl_ilg,4)
   Enddo
vidurk(i,1)=suma(1)/cikl_sk
vidurk(i,2)=suma(2)/cikl_sk
!Write(9,'(3(3x,ES13.5))') prad_duom(i,2), vidurk(i,1), vidurk(i,2)
Enddo
!Kampo fi perskaichiavimas i laika t
laiko_koef=60/(sukiai*360)
Print*, 'laiko_koef=',laiko_koef
!Filtravima 'prilyginam 0 jei signalas silpnesnis negu 1e-1
Do i=1,vieno_cikl_ilg
   If (ABS(vidurk(i,2))<filtras) then
   vidurk(i,2)=0.0_8
   endif
Enddo
! Isvestines skaiciavimas 'Slegio kitimo greitis isvestine pagal kampa' sleg_greitis ir purkstuko signalo inte-
gralas
signalo_integr=0.0_8
signalo_integr(1)=(((vidurk(1,2)+vidurk(2,2))/2)*(prad_duom(2,2)-prad_duom(1,2))*laiko_koef)
!reikiapatikslinti
Do i=1,vieno_cikl_ilg-1
sleg_greitis(i)=(vidurk(i+1,1)-vidurk(i,1))/(prad_duom(i+1,2)-prad_duom(i,2))
signalo_integr(i+1)=signalo_integr(i)+(((vidurk(i,2)+vidurk(i+1,2))/2)*(prad_duom(i+1,2)-
prad_duom(i,2))*laiko_koef)
Enddo
! paskutiniame taske (kampas 720 lapsniu - pask kampas), kitima skaiciuojame
sleg_greitis(vieno_cikl_ilg)=(vidurk(1,1)-vidurk(vieno_cikl_ilg,1))/(720-prad_duom(vieno_cikl_ilg,2))
!Irasymas rezultatu i viena faila
!Write (9,'(5(3x,A13))') 'Kampas', 'Slegis_vid', 'atid_sign_gr', 'sleg_kit_gr', 'atid_sign_integr'
Do i=1, vieno_cikl_ilg
Write(9,'(5(3x,ES13.5))') prad_duom(i,2), vidurk(i,1), vidurk(i,2),sleg_greitis(i),signalo_integr(i)
Enddo
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Print*, 'Paskutines eilutes duomenys pasitikrinimui ar gerai nuskaite'
Write(*,'(F5.0,3(ES13.5))') (prad_duom(n,j), j=1,stulp_sk)
Close (3);Close (9)
Print*, 'Aciu uz demesi, vidurkis ir slegio pokytis apskaiciuoti';Pause
End program Vidurkiu_skaiciavimas
```

B priedas. Degiojo mišinio degimo proceso, papildomai tiekiant Brauno dujas, skaitinio modeliavimo programos pradiniai duomenys ir skaičiavimo rezultatai

Ši programa parašyta programiniam paketui FORTRAN, skirta, slėginio uždegimo variklio, veikiančio dyzelinu, biodyzelinu ir papildomai tiekiant Brauno dujas, darbo ciklo termodinaminiam modeliavimui skaitiniu būdu. Panaudojant variklio stendinių bandymų metu surinktus ir apdorotus duomenis sukurta skaitinio modeliavimo programa skaičiuoja termodinaminius variklio darbo ciklo procesus, įvertinant Brauno dujose esančio vandenilio išankstinį užsiliepsnojimą. Priede pateikiami skaitinio modeliavimo duomenys varikliui 1,9 TDI (1Z) dirbant 1900 min-1 sūkiais 46 Nm apkrova. Naudojami degalai:

1. Biodyzelinas (BD);
2. Biodyzelinas + Brauno dujos (BD + HHO).

```
*** PAR_ENGINE_H2(100):
  1 700.0D0      : T initial burning H2, K
  2 11.0D0       : H2 burning velocity
  3 0.03975D0   :R_cyl   0.0795D0
  4 120.0D6      : Q_H2, J/kg
  5 0.99D0        ! nvk_Q_H2
  6     4.0D-8           : mase_H2, kg
  7     6.908D0         ! a_H2 parameter of Wiebe function
  8     0.30D0          ! m_H2 parameter of Wiebe function    1.30D0

*** ENGINE DATA:  AUDI 1.9 TDI   RIMKUS ALFREDAS
    4        : ncyl
*** PAR_ENGINE(100):
  1 0.047750D0       : r skriejikas
  2 0.1500D0     : L svaistiklis
  3 0.0795D0         : D stumoklis
  4 0.02560D-3       : Vh galvutes turis 0.200D-3  0.200D-3  0.13010D-3
  5 425.0D0          : T_wall  625.0D0
  6 20.0D0           : vel_gas  50.0D0
  7 3.60D0          : alfa oro pertekliaus koef.
  8 0.50-6          : plotas tarp cilidro ir ziedu
  9 6.908D0         ! a parameter of Wiebe function
 10 0.632D0           ! m parameter of Wiebe function
*** ALFA_ENGINE(12),
  1 0.0D0         : alfa1
  2 180.0D0       : alfa2
  3 180.0D0       : alfa3
  4 0.0D0          : alfa4
*** PHASE_ENGINE(ncyl,6)
  1 704.0D0  180.0D0  355.0D0   420.0D0  495.D0   19.0D0
  2 704.0D0  180.0D0  355.0D0   420.0D0  495.D0   19.0D0
  3 704.0D0  180.0D0  355.0D0   420.0D0  495.D0   19.0D0
  4 704.0D0  180.0D0  355.0D0   420.0D0  495.D0   19.0D0
*** PAR_MECH(17),
  1 0.0100D0        : I1
  2 0.0100D0        : I2
  3 0.0100D0        : I3
  4 0.0100D0        : I4
  5 0.200D0        : I5 Smabgratis
  6 0.500D0        : amc1
  7 1.500D0        : amc2
  8 0.300D0        : amc3
```

```
  9 0.0500D0       : Rc1
  10 0.1500D0       : alc2
  11 35.00D5       : k12
  12 0.100D1       : c12
  13 0.100D1       : c1
  14 35.00D5      : k23
  15 0.200D1       : c23
  16 0.200D1       : c2
  17 35.00D5      : k34
  18 0.200D1       : c34
  19 0.200D1       : c3
  20 35.00D5      : k45
  21 0.200D1       : c45
  22 0.200D1       : c4
*** AMOMPAS(5):
  1  0.0D0         : a0
  2  0.0D0        : ac1
  3  0.0D0        : as1
  4  0.0D0        : w1
  5  0.0D0        : b
*** Y(nvarb):
  1 0.100D6       : p1
  2 400.0D0       : T1
  3 0.100D6       : p2
  4 400.0D0       : T2  400.0D0
  5 0.100D6       : p3
  6 400.0D0       : T3
  7 0.100D6       : p4
  8 400.0D0       : T4
  9 0.00D0        : af1
 10 387.460D0      : w1,rad/s   94.240D0 198.800D0
 11 0.00D0        : af2
 12 387.460D0        : w2,rad/s   94.240D0
 13 0.00D0        : af3
 14 387.460D0       : w3,rad/s
 15 0.0D0        : af4
 16 387.460D0       : w4,rad/s
 17 0.00D0        : af5
 18 387.460D0       : w5,rad/s

  *** AMASSD_FUEL(ncyl):
  1 13.270D-6               : mass1_fuel
  2 13.270D-6               : mass2_fuel 18.500D-6   2.560D-6 4.42250D-6
10.5600D-6 21.5600D-6 7.5000D
  3 13.270D-6               : mass3_fuel
  4 13.270D-6               : mass4_fuel
*** AQMIN(ncyl):
  1 37.000D6         : Q1_min    37.3000D6
  2 37.000D6         : Q2_min
  3 37.000D6         : Q3_min
  4 37.000D6         : Q4_min
*** ANVKQ(ncyl):
  1 0.95              : nvkQ1 1.3D0
  2 0.95              : nvkQ2
  3 0.95              : nvkQ3
  4 0.95              : nvkQ4

  *** AMASSD_FUEL(ncyl):
```

```
  1 12.060D-6                : mass1_fuel
  2 12.060D-6                : mass2_fuel 18.500D-6   2.560D-6 4.42250D-6
10.5600D-6 21.5600D-6 7.5000D
  3 12.060D-6                : mass3_fuel
  4 12.060D-6                : mass4_fuel
*** AQMIN(ncyl):
  1 37.000D6          : Q1_min    37.3000D6
  2 37.000D6          : Q2_min
  3 37.000D6          : Q3_min
  4 37.000D6          : Q4_min
*** ANVKQ(ncyl):
  1 0.95               : nvkQ1 1.3D0
  2 0.95               : nvkQ2
  3 0.95               : nvkQ3
  4 0.95               : nvkQ4

  *** AMASSD_FUEL(ncyl):
  1 13.270D-6                : mass1_fuel
  2 13.270D-6                : mass2_fuel 18.500D-6   2.560D-6 4.42250D-6
10.5600D-6 21.5600D-6 7.5000D
  3 13.270D-6                : mass3_fuel
  4 13.270D-6                : mass4_fuel
*** AQMIN(ncyl):
  1 37.000D6          : Q1_min    37.3000D6
  2 37.000D6          : Q2_min
  3 37.000D6          : Q3_min
  4 37.000D6          : Q4_min
*** ANVKQ(ncyl):
  1 0.95               : nvkQ1 1.3D0
  2 0.95               : nvkQ2
  3 0.95               : nvkQ3
  4 0.95               : nvkQ4

*** AMASSD_FUEL(ncyl):  be H2
  1 13.270D-6                : mass1_fuel
  2 13.270D-6                : mass2_fuel 18.500D-6   2.560D-6 4.42250D-6
10.5600D-6 21.5600D-6 7.5000D
  3 13.270D-6                : mass3_fuel
  4 13.270D-6                : mass4_fuel
*** AQMIN(ncyl):
  1 37.000D6          : Q1_min    37.3000D6
  2 37.000D6          : Q2_min
  3 37.000D6          : Q3_min
  4 37.000D6          : Q4_min
*** ANVKQ(ncyl):
  1 0.95               : nvkQ1 1.3D0
  2 0.95               : nvkQ2
  3 0.95               : nvkQ3
  4 0.95               : nvkQ4

    COMMON /PARAM_ENGINE_FUEL/ AMASSD_FUEL(12), AQMIN(12), ANVKQ(12)

*** AMASSD_FUEL(ncyl):
  1 55.500D-6                : mass1_fuel
  2 55.500D-6                : mass2_fuel
  3 55.500D-6                    : mass3_fuel
  4 55.500D-6                    : mass4_fuel
*** AQMIN(ncyl):
```

```
  1 37.3000D6            : Q1_min
  2 37.3000D6            : Q2_min
  3 37.3000D6            : Q3_min
  4 37.3000D6            : Q4_min
*** ANVKQ(ncyl):
  1 0.950D0               : nvkQ1 1.3D0
  2 0.950D0               : nvkQ2
  3 0.950D0                   : nvkQ3
  4 0.950D0                   : nvkQ4

    *** AMASSD_FUEL(ncyl):
  1 50.0D-3              : mass1_fuel
  2 50.0D-3              : mass2_fuel
  3 50.0D-3              : mass3_fuel
  4 50.0D-3              : mass4_fuel
*** AQMIN(ncyl):
  1 37300.0D3            : Q1_min
  2 37300.0D3            : Q2_min
  3 37300.0D3            : Q3_min
  4 37300.0D3            : Q4_min
*** ANVKQ(ncyl):
  1 0.750D0               : nvkQ1 1.3D0
  2 0.750D0               : nvkQ2
  3 0.750D0               : nvkQ3
  4 0.750D0                   : nvkQ4

  *** AMASSD_FUEL(ncyl):
  1 18.500D-6                : mass1_fuel
  2 18.500D-6            : mass2_fuel
  3 18.500D-6                : mass3_fuel
  4 18.500D-6                : mass4_fuel
*** AQMIN(ncyl):
  1 37.3000D6            : Q1_min
  2 37.3000D6            : Q2_min
  3 37.3000D6            : Q3_min
  4 37.3000D6            : Q4_min
*** ANVKQ(ncyl):
  1 0.950D0               : nvkQ1 1.3D0
  2 0.950D0               : nvkQ2
  3 0.950D0                   : nvkQ3
  4 0.950D0                   : nvkQ4
```

C priedas. AVL BOOST skaitinio modeliavimo programos pradiniai duomenys ir skaičiavimo rezultatai

Ši programa skirta skaitiniu būdu modeliuoti vidaus degimo variklio darbo procesą ir apskaičiuoti variklio termodinaminius, energetinius ir ekologinius parametrus. Priede pateikiami skaitinio modeliavimo duomenys varikliui 1,9 TDI (1Z) dirbant 1900 min^{-1} sūkiais 46 Nm apkrova. Naudojami degalai:

1. Dyzelinas (D);
2. Dyzelinas + Brauno dujos (D + HHO);
3. Biodyzelinas (B);
4. Biodyzelinas + Brauno dujos (B + HHO).

1. Dyzelinas

```
---------------------------------
 AVL - B O O S T
 Version : v2011.2.0.0.0
 Build:    May  8 2012 22:18:13
 System:   x86_64-unknown-winnt
 ---------------------------------

LICENSE
-------
 Boost Main 2011.0@ License will expire in 244 days

 Boost Charging 2011.0@ License will expire in 244 days

PROJECT
-------
 Preprocessor Version :  2011.2
 Calculation date     : 12.06.2013
 File     : Alfredo_D_siluma.bst
 Case Set : "Case Set 1"
 Case     : "Case 1"

 Project ID: "L4 2.5L DI TCI  B x S = 90 x 98 mm Diesel Engine"
 Run ID:     "Full Load Performance (4000 - 1000 rpm)"
 Model date: "28.9.2000"

ELEMENTS
--------
 Element Name        Number

 PIPE                  15
 SYSTEMBOUNDARY         2
 PLENUM                 3
 CYLINDER               4
 MEASURINGPOINT        18
 AIRCOOLER              1
 AIRCLEANER             1
 TURBOCHARGER           1
 ENGINE                 1
 PIPE_END              34
 ASSEMBLED              2
 ALL_PIPES             17
 ALL_PLENUMS            7
 ALL_BOUNDARIES         2
 ALL_CHARGERS           1
 ALL_PIDS               1
 PIPE_VAR_WALL_TEMP    17

GLOBAL DATA
-----------
  Engine Speed :         1900.0  rpm
  Calculationmode:        BOOST  Single
  Cycle Duration:        720.00  degrees
  Max. calc. period:   36000.00  degrees
  Cycles calculated:         50  cycles
  Calc. time steps:     0.53954  degrees (max)
                        0.53125  degrees
                        0.04660  ms
  Traces results step:  1.00000  degrees
  User concentrations:        0
  Ref. pressure:      100000.00  Pa
  Ref. temperature:     298.000  K
  Gas properties:      Variable
```

```
  Gasproperties File:     DIESEL.BGP
     bgp_build_version:   v2010.0.0.0.0
     bgp_build_host:      boost
     bgp_build_user:      boostad
     bgp_build_date:      2010.10.31
     bgp_build_time:      07:00:00
  Lower calorific:  0.42500E+08  J/kg
  Stoic. A/F-ratio:      14.450

  Warnings:                   0
  Convergence errors:         0

PIPES
-----

 Total number of pipe cells:    136

 Pipe   Cells   Cell size       W.Heat     Wall T    Fric. coeff.   Lam. Fric. Coeff.  Heat Factor
Volume
  nr.                [mm]         [kJ]        [K]             [-]                 [-]          [-]
[dm3]
    1       6        30.0        0.000     298.00        0.019000           64.000000     0.000000
0.904779
    2       6        33.3        0.000     298.00        0.019000           64.000000     0.000000
1.005310
    3      32        30.0        0.000     298.00        0.032000           64.000000     0.000000
2.280796
    4      10        30.0        0.000     298.00        0.033000           64.000000     0.000000
0.589049
    5      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    6      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    7      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    8      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    9       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   10       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   11       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   12       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   13       2        30.0        0.000     298.00        0.033000           64.000000     0.000000
0.095426
   14      10        30.0        0.000     298.00        0.019000           64.000000     0.000000
0.848230
   15       6        33.3        0.000     298.00        0.019000           64.000000     0.000000
0.565487
   16      16        31.2        0.000     298.00        0.416333        66123.130902    13.772989
1.000000  COOLER_PIPE     1
   17       6        33.3        0.000     300.00        2.219221       263455.728117     0.000000
1.000000  FILTER_PIPE     1


MEASURINGPOINTS: Average Values
-------------------------------
 Mp. Pipe Location   Diameter  Pressure  Temp. Ms.Temp.  Velo.   Massflow   Massflow To.Ent.f.
To.Ent.f.  Mach. Wtemp.  Converg.
 nr.  nr.      [mm]        [mm]     [bar]     [K]       [K]  [m/s]      [g/s]  [g/cycle]     [kJ/s]
[kJ/cyc.]    [-]    [K]       [-]
  1   2    50.0000     80.0000    0.9974  298.2     298.0    5.0     29.3959     1.8566     -0.005    -
0.0003   0.01  298.0 0.145E-08
  2   2   200.0000     80.0000    0.9974  298.2     298.0    5.0     29.3964     1.8566     -0.005    -
0.0003   0.01  298.0 0.269E-09
  3   3    50.0000     55.0000    0.9968  298.2     297.9   10.7     29.3944     1.8565     -0.005    -
0.0003   0.03  298.0 0.220E-09
  4   3   600.0000     55.0000    0.9968  298.2     297.9   10.7     29.3945     1.8565     -0.005    -
0.0003   0.03  298.0 0.131E-08
  5   4   300.0000     50.0000    0.9869  298.9     297.9   13.1     29.3945     1.8565      0.000
0.0000   0.04  298.0 0.433E-08
  6   5   300.0000     39.5000    0.9852  308.5     306.2    5.5      7.3486     0.4641      0.064
0.0040   0.02  400.0 0.992E-09
  7   6   300.0000     39.5000    0.9852  308.5     306.2    5.5      7.3486     0.4641      0.064
0.0040   0.02  400.0 0.965E-10
```

```
  8   7   300.0000    39.5000    0.9852  308.5    306.2    5.5     7.3486     0.4641     0.064
0.0040   0.02  400.0 0.110E-07
  9   8   300.0000    39.5000    0.9852  308.5    306.2    5.5     7.3486     0.4641     0.064
0.0040   0.02  400.0 0.146E-09
 10   9     0.0000    35.0000    1.0082  667.8    643.8   13.8     7.3840     0.4664     2.739
0.1730   0.03  298.0 0.820E-07
 11  10     0.0000    35.0000    1.0082  667.8    643.8   13.8     7.3840     0.4664     2.739
0.1730   0.03  298.0 0.435E-06
 12  11     0.0000    35.0000    1.0082  667.8    643.8   13.8     7.3840     0.4664     2.739
0.1730   0.03  298.0 0.516E-07
 13  12     0.0000    35.0000    1.0082  667.8    643.8   13.8     7.3840     0.4664     2.739
0.1730   0.03  298.0 0.293E-06
 14   9   160.0000    35.0000    1.0076  622.7    644.3   13.9     7.3773     0.4659     2.742
0.1732   0.03  298.0 0.200E-05
 15  12     0.0000    35.0000    1.0082  667.8    643.8   13.8     7.3840     0.4664     2.739
0.1730   0.03  298.0 0.293E-06
 16  13    30.0000    45.0000    1.0005  643.4    645.1   34.1    29.5374     1.8655    10.957
0.6921   0.07  298.0 0.189E-05
 17  14    50.0000    60.0000    1.0090  647.0    646.4   19.0    29.5374     1.8655    10.956
0.6920   0.04  298.0 0.420E-05
 18  15   100.0000    60.0000    1.0001  646.8    646.6   19.4    29.5314     1.8651    10.957
0.6920   0.04  298.0 0.351E-05

SYSTEMBOUNDARIES
Attachments
-----------
 Type                 Nr.   Pipe       Mass flow
                            Nr.       [g/cycle]
 SYSTEMBOUNDARY        1      1          1.8566
 SYSTEMBOUNDARY        2     15          1.8651

PLENUMS: Average Values
-----------------------
                    Pl. Pressure   Temp.      Mass Wallheat
                    nr.    [bar]     [K]       [g]     [kJ]
 PLENUM              1    0.9869  299.20     1.838    0.000
                                             Attached pipe   4:      1.8565 g/cycle
                                             Attached pipe   5:      0.4641 g/cycle
                                             Attached pipe   6:      0.4641 g/cycle
                                             Attached pipe   7:      0.4641 g/cycle
                                             Attached pipe   8:      0.4641 g/cycle
 PLENUM              2    1.0075  643.25       0.546    0.000
                                             Attached pipe   9:      0.4664 g/cycle
                                             Attached pipe  10:      0.4664 g/cycle
                                             Attached pipe  11:      0.4664 g/cycle
                                             Attached pipe  12:      0.4663 g/cycle
                                             Attached pipe  13:      1.8654 g/cycle
 PLENUM              3    1.0050  646.28       6.502    0.000
                                             Attached pipe  14:      1.8654 g/cycle
                                             Attached pipe  15:      1.8651 g/cycle
 AIRCOOLER           1    0.9967  298.26       2.328    0.000
                                             Attached pipe   3:      1.8565 g/cycle
                                             Attached pipe  16:      1.8565 g/cycle
 AIRCOOLER           1    0.9891  298.90       2.305    0.000
                                             Attached pipe   4:      1.8565 g/cycle
                                             Attached pipe  16:      1.8565 g/cycle
 AIRCLEANER          1    0.9996  298.06       4.672    0.000
                                             Attached pipe   1:      1.8566 g/cycle
                                             Attached pipe  17:      1.8566 g/cycle
 AIRCLEANER          1    0.9976  298.25       4.078    0.000
                                             Attached pipe   2:      1.8566 g/cycle
                                             Attached pipe  17:      1.8566 g/cycle

PLENUMS
Attachments
-----------
 Type                   Nr.   Pipe       Mass flow
                              Nr.       [g/cycle]
 PLENUM                  1      4          1.8565
 PLENUM                  1      5          0.4641
 PLENUM                  1      6          0.4641
 PLENUM                  1      7          0.4641
 PLENUM                  1      8          0.4641
 PLENUM                  2      9          0.4664
 PLENUM                  2     10          0.4664
 PLENUM                  2     11          0.4664
 PLENUM                  2     12          0.4663
```

```
 PLENUM                2     13          1.8654
 PLENUM                3     14          1.8654
 PLENUM                3     15          1.8651
 AIRCOOLER             1      3          1.8565
 AIRCOOLER             1     16          1.8565
 AIRCOOLER             1      4          1.8565
 AIRCOOLER             1     16          1.8565
 AIRCLEANER            1      1          1.8566
 AIRCLEANER            1     17          1.8566
 AIRCLEANER            1      2          1.8566
 AIRCLEANER            1     17          1.8566

TURBOCHARGERS: Average Values
-----------------------------
                  Compressor                          Turbine                                Effi-
ciencies        Calculation
TCh.    Work    Press.rat.  Boostpres.     Work  Press.rat. Dis.coeff. Turb./tot. VTG-pos Comp.
Turb. mech. total      mode
nr.      [kJ]      [-]        [bar]         [kJ]      [-]      [-]        [-]      [-]    [-]    [-]
[-]    [-]
  1     0.0000     1.0000     0.9976     0.0000     1.0011     0.0920     0.0512 1.000    0.750
0.664 0.980 0.488  Wastegateflow
  Attached pipe   2:      1.8566 g/cycle
  Attached pipe   3:      1.8565 g/cycle
  Attached pipe  14:      1.8654 g/cycle
  Attached pipe  13:      1.8654 g/cycle

CYLINDERS: Average Values
-------------------------
                              Total
                             Engine         Cyl.   1       Cyl.   2       Cyl.   3       Cyl.   4
Firing TDC [deg]                                0.00         540.00         180.00         360.00
Bore [mm]                                      79.50          79.50          79.50          79.50
Stroke [mm]                                    95.50          95.50          95.50          95.50
Conrodl. [mm]                                 150.00         150.00         150.00         150.00
Piston pin offset [mm]                         0.00           0.00           0.00           0.00
Swept Vol. [l]                    1.8962       0.4741         0.4741         0.4741         0.4741
Compression ratio [-]                         19.50          19.50          19.50          19.50
Dyn. Comp. ratio [-]                          19.39          19.39           1.04           1.04

Combustion Data:
----------------
Combustion Char.                             2Z-Vibe        2Z-Vibe        2Z-Vibe        2Z-Vibe
Comb.start [deg]                               3.76           3.76           3.76           3.76
Comb.dur.1 [deg]                              41.50          41.50          41.50          41.50
Peak Fir.Pres. [bar]              59.45       59.45          59.45          59.45          59.45
at Crankangle [deg]               11.20       11.20          11.20          11.20          11.20
Peak Pres.Rise[bar/deg]            1.97        1.97           1.97           1.97           1.97
at Crankangle [deg]              -11.91      -11.91         -11.91         -11.91         -11.91
Peak Fir. Temp. [K]             1578.26     1578.26        1578.26        1578.26        1578.26
at Crankangle [deg]               21.68       21.68          21.68          21.68          21.68
Peak T_burned [K]               2718.64     2718.64        2718.64        2718.64        2718.64
at Crankangle [deg]               4.32        4.32           4.32           4.32           4.32
Res. Gascompr. [bar]              1.05        1.05           1.05           1.05           1.05
at Crankangle [deg]             280.11      280.11         280.11         280.11         280.11

Emissions (Classic Species Transport):
--------------------------------------
NOx: Calculated based on MTZ 34 1973 (12).
CO:  Calculated based on SAE 2002-01-0006.
SOOT:  Calculated based on MTZ 5/2002 (63).
NOX   [g/kWh]                   0.479595       0.479600       0.479603       0.479588       0.479589
NOX   [g/h]                     4.559814       1.139969       1.139969       1.139936       1.139940
NOX   [ppm]                        40.59          40.59          40.59          40.59          40.59
CO    [g/kWh]                   0.000000       0.000000       0.000000       0.000000       0.000000
CO    [g/h]                     0.000000       0.000000       0.000000       0.000000       0.000000
CO    [ppm]                         0.00           0.00           0.00           0.00           0.00
Soot  [g/kWh]                   0.046622       0.046623       0.046620       0.046623       0.046623

Performance:
------------
IMEP [bar]                       4.7287         4.7287         4.7287         4.7287         4.7287
Rel. to Ave. [-]                               1.0000         1.0000         1.0000         1.0000
IMEP Exh. [bar]                 -1.1117        -1.1117        -1.1118        -1.1117        -1.1117
IMEP Int. [bar]                  0.9403         0.9403         0.9403         0.9403         0.9403
IMEP Gasex. [bar]               -0.1714        -0.1714        -0.1714        -0.1714        -0.1714
IMEP HP [bar]                    4.9002         4.9002         4.9002         4.9002         4.9002
```

FMEP [bar]	1.5620	1.5620	1.5620	1.5620	1.5620
BMEP [bar]	3.1667	3.1667	3.1667	3.1667	3.1667
AMEP;SMEP [bar]	0.0000	0.0000	0.0000	0.0000	0.0000
ISFC [g/kWh]	185.1650	185.1646	185.1654	185.1651	185.1648
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
ISFC (tr.f.) [g/kWh]	185.1650	185.1646	185.1654	185.1651	185.1648
BSFC [g/kWh]	276.4979	276.4972	276.4988	276.4981	276.4975
Indicated Eff. [-]	0.4575	0.4575	0.4575	0.4575	0.4575
Iso vol. comb. Eff [-]	0.9068	0.9068	0.9068	0.9068	0.9068
Polytropic Coeff. [-]		1.3608	1.3608	1.3608	1.3608
Fuel Mass Balance:					

Inj. Fuelmass [g]	0.046120	0.011530	0.011530	0.011530	0.011530
Asp.Trap. Fuelmass [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Fuelmassfl.(A+I) [g/s]	0.730233	0.182558	0.182558	0.182558	0.182558
Fuelmass tot.trap. [g]	0.046120	0.011530	0.011530	0.011530	0.011530
Trapped Fuelm.fl.[g/s]	0.730233	0.182558	0.182558	0.182558	0.182558
Trapp. Eff. Fuel [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Energy Balance Cylinder:					

Fuel Energy [kJ]	1.96010	0.49002	0.49002	0.49002	0.49002
Released Energy [kJ]	1.95829	0.48957	0.48957	0.48957	0.48957
-> Brake Power [%]	30.664	30.664	30.663	30.663	30.664
-> Loss: Friction [%]	15.125	15.125	15.125	15.125	15.125
-> Loss: Piston [%]	7.553	7.553	7.553	7.553	7.553
-> Loss: Head [%]	6.178	6.178	6.178	6.178	6.178
-> Loss: Liner [%]	4.946	4.946	4.946	4.946	4.946
-> Loss: Int. Port [%]	-0.605	-0.605	-0.605	-0.605	-0.605
-> Loss: Exh. Port [%]	0.000	0.000	0.000	0.000	0.000
-> Loss: Exh. Gas [%]	34.516	34.516	34.516	34.516	34.516
Eff. Rel. Energy [kJ]	1.95829	0.48957	0.48957	0.48957	0.48957
Gross Rel. Energy [kJ]	1.95829	0.48957	0.48957	0.48957	0.48957
Eff.Gross Rel.Ener.[kJ]	1.95829	0.48957	0.48957	0.48957	0.48957
Energy Balance [-]	0.9991	0.9991	0.9991	0.9991	0.9991
Eff. Energy Balance [-]	0.9991	0.9991	0.9991	0.9991	0.9991
Blowby:					

Blowbymass [g]	-0.037136	-0.009284	-0.009284	-0.009284	-0.009284
Blowbymassfl. [g/s]	-0.587988	-0.146997	-0.146997	-0.146997	-0.146997
Blowby Heat Flow [kJ]	-0.031052	-0.007763	-0.007763	-0.007763	-0.007763
Reference Values at SHP:					

Pressure at SHP[bar]	1.0396	1.0396	1.0396	1.0396	1.0396
Temperature [K]	363.93	363.93	363.93	363.93	363.93
Air Massfl. [g/s]	29.398476	7.349631	7.349635	7.349605	7.349605
Fuel Massfl. [g/s]	0.730233	0.182558	0.182558	0.182558	0.182558
Trapp. Eff. Air [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Trapp. Eff.Fuel [-]	1.0000	1.0000	1.0000	1.0000	1.0000
A/F-Ratio (Cmb.) [-]	41.54	41.54	41.54	41.54	41.54
Excess Air Ratio [-]	2.8748	2.8748	2.8748	2.8748	2.8748
Residual Gas:					

Res.gas content [-]	0.0616	0.0616	0.0616	0.0616	0.0616
Com.Prod.Mass. at EO [g]	1.987156	0.496789	0.496789	0.496789	0.496789
Res.gas mass at SHP [g]	0.121895	0.030473	0.030473	0.030474	0.030474
Res.gas aspirated IN [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Res.gas from intake [g]	0.000963	0.000482	0.000482	0.000000	0.000000
Rel. to Total [-]	0.0079	0.0158	0.0158	0.0000	0.0000
Res.gas flow EX [g]	1.862785	0.465696	0.465697	0.465696	0.465696
Res.gas from exhaust [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Rel. to Total [-]	0.0000	0.0000	0.0000	0.0000	0.0000
Gas Exchange:					

Volumetric Eff. [-]	0.8377	0.8377	0.8377	0.8377	0.8377
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8523	0.8523	0.8523	0.8523	0.8523
Total Mass at SHP[g]	1.9786	0.4947	0.4947	0.4947	0.4947
Mass Delivered [g]	1.85649	0.46412	0.46412	0.46412	0.46412
Mass Delivered [g/s]	29.39446	7.34862	7.34862	7.34862	7.34859
Delivery Ratio [-]	0.8376	0.8376	0.8376	0.8376	0.8376
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000

Rel. To PL 1 [-]	0.8522	0.8522	0.8522	0.8522	0.8522
Av.Airmass at SHP[g]	1.9325	0.4831	0.4831	0.4831	0.4831
Air Delivered [g]	1.85675	0.46419	0.46419	0.46419	0.46419
Air Delivered [g/s]	29.39848	7.34963	7.34963	7.34961	7.34961
Airdeliveryratio [-]	0.8377	0.8377	0.8377	0.8377	0.8377
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8523	0.8523	0.8523	0.8523	0.8523
Airmass Trapped [g]	1.85675	0.46419	0.46419	0.46419	0.46419
Airmass Trapped [g/s]	29.39848	7.34963	7.34963	7.34961	7.34961
Trapp. Eff. Air [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Airpurity [-]	0.9767	0.9767	0.9767	0.9767	0.9767
Dyn. Swirl [-]	1.9617	1.9617	1.9617	1.9617	1.9617
Dyn. Tumble [-]	0.0000	0.0000	0.0000	0.0000	0.0000

Wall Heatlosses:

Piston [kJ]	-0.1479	-0.0370	-0.0370	-0.0370	-0.0370
Cylinderhead [kJ]	-0.12099	-0.03025	-0.03025	-0.03025	-0.03025
Cylinderliner [kJ]	-0.09686	-0.02422	-0.02422	-0.02422	-0.02422
Sum of Wallheat [kJ]	-0.36576	-0.09144	-0.09144	-0.09144	-0.09144
Wall Heatlosses in High Pressure Phase:					
Piston HP [kJ]	-0.15781	-0.03945	-0.03945	-0.03945	-0.03945
Cylinderhead HP [kJ]	-0.12640	-0.03160	-0.03160	-0.03160	-0.03160
Cylinderliner HP [kJ]	-0.07847	-0.01962	-0.01962	-0.01962	-0.01962
Sum of Wallheat HP [kJ]	-0.36268	-0.09067	-0.09067	-0.09067	-0.09067
Wall Heatlosses Related to Heatinput:					
Piston [-]	-0.0755	-0.0755	-0.0755	-0.0755	-0.0755
Cylinderhead [-]	-0.0617	-0.0617	-0.0617	-0.0617	-0.0617
Cylinderliner [-]	-0.0494	-0.0494	-0.0494	-0.0494	-0.0494
Sum of Wallheat [-]	-0.1866	-0.1866	-0.1866	-0.1866	-0.1866
M. Eff. HTC [W/m2/K]	287.99	287.99	287.98	287.98	287.99
M. Eff. Temp. [K]	914.24	914.24	914.24	914.24	914.24

Reference Values at EO:

Pressure [bar]	2.28	2.28	2.28	2.28	2.28
Temperature [K]	773.63	773.63	773.63	773.63	773.63
A/F-Ratio [-]	39.79	39.79	39.79	39.79	39.79
Com.Prod.Conc. [-]	0.99858	0.99858	0.99858	0.99858	0.99858
Fuel Concentr. [-]	0.000000	0.000000	0.000000	0.000000	0.000000

Average Values of Pipeattachements:

Attached Pipe	5	6	7	8
Vlv/Prt.Op.Clr.0mm[deg]	344.00	344.00	344.00	344.00
Vlv/Prt.Op.Eff.0mm[deg]	377.55	377.55	377.55	377.55
Vlv/Prt.Op.Eff.1mm[deg]	394.00	394.00	394.00	394.00
Vlv/Prt.Op.Udef.mm[deg]	377.55	377.55	377.55	377.55
Vlv/Prt.Cl.Clr.0mm[deg]	584.00	584.00	584.00	584.00
Vlv/Prt.Cl.Eff.0mm[deg]	550.45	550.45	550.45	550.45
Vlv/Prt.Cl.Eff.1mm[deg]	534.00	534.00	534.00	534.00
Vlv/Prt.Cl.Udef.mm[deg]	550.45	550.45	550.45	550.45
Cam Phasing [deg]	0.00	0.00	0.00	0.00
Massflow [g/cycle]	0.464123	0.464124	0.464123	0.464122
Wallheat [kJ/cycle]	0.002963	0.002963	0.002963	0.002963
rel.to Heatinp.[-]	0.0060	0.0060	0.0060	0.0060
Swirl Entry [-]	2.0889	2.0889	2.0889	2.0889
Attached Pipe	9	10	11	12
Vlv/Prt.Op.Clr.0mm[deg]	135.00	135.00	135.00	135.00
Vlv/Prt.Op.Eff.0mm[deg]	155.00	155.00	155.00	155.00
Vlv/Prt.Op.Eff.1mm[deg]	183.33	183.33	183.33	183.33
Vlv/Prt.Op.Udef.mm[deg]	155.00	155.00	155.00	155.00
Vlv/Prt.Cl.Clr.0mm[deg]	375.00	375.00	375.00	375.00
Vlv/Prt.Cl.Eff.0mm[deg]	355.00	355.00	355.00	355.00
Vlv/Prt.Cl.Eff.1mm[deg]	326.67	326.67	326.67	326.67
Vlv/Prt.Cl.Udef.mm[deg]	355.00	355.00	355.00	355.00
Cam Phasing [deg]	0.00	0.00	0.00	0.00
Massflow [g/cycle]	0.466358	0.466359	0.466358	0.466358
Wallheat [kJ/cycle]	0.000000	0.000000	0.000000	0.000000
rel.to Heatinp.[-]	0.0000	0.0000	0.0000	0.0000
Swirl Entry [-]	0.0000	0.0000	0.0000	0.0000

ASSEMBLED: Average Values

Type	Nr.	----------Inlet----------	---------Outlet----------	----------

-Core----------

```
                    Pressure Temperat.   Mass    Pressure Temperat.   Mass     Rej.Heat   Rej.Heat
Fric. coeff.  Heat Factor
                      [bar]     [K]        [g]     [bar]      [K]       [g]       [kJ]       [kW]
[-]           [-]
 AIRCOOLER     1    0.9967   298.26     2.328    0.9891   298.90     2.305     0.0003     0.0047
0.416333    13.772989
 AIRCLEANER    1    0.9996   298.06     4.672    0.9976   298.25     4.078     0.0000     0.0000
2.219221     0.000000

ASSEMBLED
Attachments
-----------
 Type                 Nr.   Pipe       Mass flow
                            Nr.       [g/cycle]
 AIRCOOLER             1      3          1.8565
 AIRCOOLER             1      4          1.8565
 AIRCLEANER            1      1          1.8566
 AIRCLEANER            1      2          1.8566

OVERALL ENGINE PERFORMANCE:
===========================

Indicated Torque          :     71.35 Nm                    Indicated Specific Torque :     37.63
Nm/l
Indicated Power           :     14.20 kW,        19.30 PS   Indicated Specific Power  :      7.49
kW/l,      10.18 PS/l
Friction Torque           :     23.57 Nm                    Friction Power            :      4.69
kW
Effective Torque          :     47.78 Nm                    Effective Specific Torque :     25.20
Nm/l
Effective Power           :      9.51 kW,        12.93 PS   Effective Specific Power  :      5.01
kW/l,       6.82 PS/l

Required time for reading the inputfile and initialisation:       0.03 min
Required time for the calculation: ..........................     0.85 min
Required time for writing the outputfile: ...................     0.02 min
Required total time: ........................................     0.90 min
Required total CPU-time: ....................................    52.35 sec
```

2. Dyzelinas + Brauno dujos (D + HHO)

```
 --------------------------------
 AVL - B O O S T
 Version : v2011.2.0.0.0
 Build:    May  8 2012 22:18:13
 System:   x86_64-unknown-winnt
 --------------------------------

LICENSE
-------
 Boost Main 2011.0@ License will expire in 244 days

 Boost Charging 2011.0@ License will expire in 244 days

PROJECT
-------
 Preprocessor Version :  2011.2
 Calculation date     : 12.06.2013
 File     : Alfredo_D_HHO_siluma.bst
 Case Set : "Case Set 1"
 Case     : "Case 1"

 Project ID: "L4 2.5L DI TCI  B x S = 90 x 98 mm Diesel Engine"
 Run ID:     "Full Load Performance (4000 - 1000 rpm)"
 Model date: "28.9.2000"

ELEMENTS
--------
 Element Name        Number

 PIPE                  15
 SYSTEMBOUNDARY         2
 PLENUM                 3
 CYLINDER               4
 MEASURINGPOINT        18
 AIRCOOLER              1
 AIRCLEANER             1
 TURBOCHARGER           1
```

```
 ENGINE                 1
 PIPE_END              34
 ASSEMBLED              2
 ALL_PIPES             17
 ALL_PLENUMS            7
 ALL_BOUNDARIES         2
 ALL_CHARGERS           1
 ALL_PIDS               1
 PIPE_VAR_WALL_TEMP    17

GLOBAL DATA
-----------
  Engine Speed :          1900.0  rpm
  Calculationmode:         BOOST  Single
  Cycle Duration:         720.00  degrees
  Max. calc. period:    36000.00  degrees
  Cycles calculated:          50  cycles
  Calc. time steps:      0.53954  degrees (max)
                         0.53061  degrees
                         0.04654  ms
  Traces results step:   1.00000  degrees
  User concentrations:         0
  Ref. pressure:       100000.00  Pa
  Ref. temperature:      298.000  K
  Gas properties:       Variable
  Gasproperties File:      DIESEL.BGP
     bgp_build_version:    v2010.0.0.0.0
     bgp_build_host:       boost
     bgp_build_user:       boostad
     bgp_build_date:       2010.10.31
     bgp_build_time:       07:00:00
  Lower calorific:   0.42500E+08  J/kg
  Stoic. A/F-ratio:       14.450

  Warnings:                    0
  Convergence errors:          0

PIPES
-----

 Total number of pipe cells:    136

 Pipe   Cells   Cell size       W.Heat     Wall T    Fric. coeff.   Lam. Fric. Coeff.  Heat Factor
Volume
  nr.                [mm]         [kJ]        [K]             [-]                 [-]          [-]
[dm3]
    1       6        30.0        0.000     298.00        0.019000           64.000000     0.000000
0.904779
    2       6        33.3        0.000     298.00        0.019000           64.000000     0.000000
1.005310
    3      32        30.0        0.000     298.00        0.032000           64.000000     0.000000
2.280796
    4      10        30.0        0.000     298.00        0.033000           64.000000     0.000000
0.589049
    5      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    6      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    7      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    8      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    9       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   10       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   11       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   12       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   13       2        30.0        0.000     298.00        0.033000           64.000000     0.000000
0.095426
   14      10        30.0        0.000     298.00        0.019000           64.000000     0.000000
0.848230
   15       6        33.3        0.000     298.00        0.019000           64.000000     0.000000
0.565487
```

```
   16      16        31.2        0.000     298.00        0.416333        66123.130902    13.772989
1.000000  COOLER_PIPE     1
   17       6        33.3        0.000     300.00        2.219221       263455.728117     0.000000
1.000000  FILTER_PIPE     1


MEASURINGPOINTS: Average Values
-------------------------------
 Mp. Pipe Location   Diameter  Pressure  Temp. Ms.Temp.  Velo.   Massflow   Massflow To.Ent.f.
To.Ent.f.  Mach. Wtemp.  Converg.
 nr.  nr.     [mm]       [mm]     [bar]    [K]      [K]  [m/s]      [g/s]  [g/cycle]    [kJ/s]
[kJ/cyc.]    [-]    [K]       [-]
  1   2    50.0000    80.0000    0.9974  298.2    298.0   5.0    29.4043     1.8571    -0.005    -
0.0003   0.01  298.0 0.101E-06
  2   2   200.0000    80.0000    0.9974  298.2    298.0   5.0    29.4047     1.8571    -0.005    -
0.0003   0.01  298.0 0.131E-07
  3   3    50.0000    55.0000    0.9968  298.2    297.9  10.7    29.4028     1.8570    -0.005    -
0.0003   0.03  298.0 0.133E-07
  4   3   600.0000    55.0000    0.9968  298.2    297.9  10.7    29.4028     1.8570    -0.005    -
0.0003   0.03  298.0 0.231E-07
  5   4   300.0000    50.0000    0.9869  298.9    297.9  13.1    29.4028     1.8570     0.000
0.0000   0.04  298.0 0.538E-08
  6   5   300.0000    39.5000    0.9852  308.5    306.2   5.5     7.3507     0.4643     0.064
0.0040   0.02  400.0 0.946E-10
  7   6   300.0000    39.5000    0.9852  308.5    306.2   5.5     7.3507     0.4643     0.064
0.0040   0.02  400.0 0.652E-10
  8   7   300.0000    39.5000    0.9852  308.5    306.2   5.5     7.3507     0.4643     0.064
0.0040   0.02  400.0 0.888E-08
  9   8   300.0000    39.5000    0.9852  308.5    306.2   5.5     7.3507     0.4643     0.064
0.0040   0.02  400.0 0.219E-08
 10   9     0.0000    35.0000    1.0083  671.1    648.3  13.9     7.3863     0.4665     2.778
0.1754   0.03  298.0 0.909E-07
 11  10     0.0000    35.0000    1.0083  671.1    648.3  13.9     7.3863     0.4665     2.778
0.1754   0.03  298.0 0.524E-06
 12  11     0.0000    35.0000    1.0083  671.1    648.3  13.9     7.3863     0.4665     2.778
0.1754   0.03  298.0 0.788E-07
 13  12     0.0000    35.0000    1.0083  671.1    648.3  13.9     7.3863     0.4665     2.778
0.1754   0.03  298.0 0.301E-06
 14   9   160.0000    35.0000    1.0076  626.5    648.9  14.0     7.3796     0.4661     2.781
0.1756   0.03  298.0 0.140E-05
 15  12     0.0000    35.0000    1.0083  671.1    648.3  13.9     7.3863     0.4665     2.778
0.1754   0.03  298.0 0.301E-06
 16  13    30.0000    45.0000    1.0005  647.9    649.7  34.4    29.5467     1.8661    11.111
0.7017   0.07  298.0 0.203E-05
 17  14    50.0000    60.0000    1.0091  651.7    651.0  19.2    29.5467     1.8661    11.109
0.7016   0.04  298.0 0.358E-05
 18  15   100.0000    60.0000    1.0001  651.4    651.2  19.5    29.5400     1.8657    11.111
0.7017   0.04  298.0 0.352E-05

SYSTEMBOUNDARIES
Attachments
------------
 Type                  Nr.   Pipe       Mass flow
                           Nr.        [g/cycle]
 SYSTEMBOUNDARY         1      1          1.8571
 SYSTEMBOUNDARY         2     15          1.8657

PLENUMS: Average Values
-----------------------
                   Pl. Pressure   Temp.      Mass Wallheat
                   nr.    [bar]     [K]       [g]     [kJ]
 PLENUM             1    0.9869  299.20     1.838    0.000
                                           Attached pipe   4:      1.8570 g/cycle
                                           Attached pipe   5:      0.4643 g/cycle
                                           Attached pipe   6:      0.4643 g/cycle
                                           Attached pipe   7:      0.4643 g/cycle
                                           Attached pipe   8:      0.4643 g/cycle
 PLENUM             2    1.0076  647.76     0.542    0.000
                                           Attached pipe   9:      0.4665 g/cycle
                                           Attached pipe  10:      0.4665 g/cycle
                                           Attached pipe  11:      0.4665 g/cycle
                                           Attached pipe  12:      0.4665 g/cycle
                                           Attached pipe  13:      1.8660 g/cycle
 PLENUM             3    1.0051  650.91     6.456    0.000
                                           Attached pipe  14:      1.8659 g/cycle
                                           Attached pipe  15:      1.8657 g/cycle
 AIRCOOLER          1    0.9967  298.26     2.328    0.000
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                                         Attached pipe   3:      1.8570 g/cycle
                                         Attached pipe  16:      1.8570 g/cycle
 AIRCOOLER          1    0.9891  298.90    2.305    0.000
                                         Attached pipe   4:      1.8570 g/cycle
                                         Attached pipe  16:      1.8570 g/cycle
 AIRCLEANER         1    0.9996  298.06    4.672    0.000
                                         Attached pipe   1:      1.8571 g/cycle
                                         Attached pipe  17:      1.8571 g/cycle
 AIRCLEANER         1    0.9976  298.25    4.078    0.000
                                         Attached pipe   2:      1.8571 g/cycle
                                         Attached pipe  17:      1.8571 g/cycle
```

PLENUMS
Attachments

Type	Nr.	Pipe Nr.	Mass flow [g/cycle]
PLENUM	1	4	1.8570
PLENUM	1	5	0.4643
PLENUM	1	6	0.4643
PLENUM	1	7	0.4643
PLENUM	1	8	0.4643
PLENUM	2	9	0.4665
PLENUM	2	10	0.4665
PLENUM	2	11	0.4665
PLENUM	2	12	0.4665
PLENUM	2	13	1.8660
PLENUM	3	14	1.8659
PLENUM	3	15	1.8657
AIRCOOLER	1	3	1.8570
AIRCOOLER	1	16	1.8570
AIRCOOLER	1	4	1.8570
AIRCOOLER	1	16	1.8570
AIRCLEANER	1	1	1.8571
AIRCLEANER	1	17	1.8571
AIRCLEANER	1	2	1.8571
AIRCLEANER	1	17	1.8571

TURBOCHARGERS: Average Values

```
                 Compressor                                  Turbine                              Effi-
ciencies        Calculation
TCh.    Work    Press.rat.  Boostpres.     Work  Press.rat. Dis.coeff. Turb./tot. VTG-pos Comp.
Turb. mech. total      mode
nr.      [kJ]      [-]       [bar]         [kJ]      [-]       [-]        [-]      [-]    [-]    [-]
[-]    [-]
  1     0.0000     1.0000     0.9976     0.0000     1.0011     0.0920     0.0512 1.000    0.750
0.664 0.980 0.488  Wastegateflow
  Attached pipe   2:      1.8571 g/cycle
  Attached pipe   3:      1.8570 g/cycle
  Attached pipe  14:      1.8660 g/cycle
  Attached pipe  13:      1.8660 g/cycle
```

CYLINDERS: Average Values

	Total Engine	Cyl. 1	Cyl. 2	Cyl. 3	Cyl. 4
Firing TDC [deg]		0.00	540.00	180.00	360.00
Bore [mm]		79.50	79.50	79.50	79.50
Stroke [mm]		95.50	95.50	95.50	95.50
Conrodl. [mm]		150.00	150.00	150.00	150.00
Piston pin offset [mm]		0.00	0.00	0.00	0.00
Swept Vol. [l]	1.8962	0.4741	0.4741	0.4741	0.4741
Compression ratio [-]		19.50	19.50	19.50	19.50
Dyn. Comp. ratio [-]		19.39	19.39	1.04	1.04

Combustion Data:

	Total Engine	Cyl. 1	Cyl. 2	Cyl. 3	Cyl. 4
Combustion Char.		2Z-Vibe	2Z-Vibe	2Z-Vibe	2Z-Vibe
Comb.start [deg]		2.54	2.54	2.54	2.54
Comb.dur.1 [deg]		43.90	43.90	43.90	43.90
Peak Fir.Pres. [bar]	58.33	58.33	58.33	58.33	58.33
at Crankangle [deg]	-0.39	-0.39	-0.39	-0.39	-0.39
Peak Pres.Rise[bar/deg]	1.98	1.98	1.98	1.98	1.98
at Crankangle [deg]	-12.12	-12.12	-12.12	-12.12	-12.12
Peak Fir. Temp. [K]	1555.41	1555.41	1555.41	1555.41	1555.41
at Crankangle [deg]	23.04	23.04	23.04	23.04	23.04

Peak T_burned [K]	2698.35	2698.35	2698.35	2698.35	2698.35
at Crankangle [deg]	3.24	3.24	3.24	3.24	3.24
Res. Gascompr. [bar]	1.05	1.05	1.05	1.05	1.05
at Crankangle [deg]	280.44	280.44	280.44	280.44	280.44

Emissions (Classic Species Transport):

NOx: Calculated based on MTZ 34 1973 (12).
CO: Calculated based on SAE 2002-01-0006.
SOOT: Calculated based on MTZ 5/2002 (63).

NOX [g/kWh]	0.523350	0.523356	0.523360	0.523342	0.523343
NOX [g/h]	4.937416	1.234372	1.234372	1.234335	1.234338
NOX [ppm]	43.94	43.94	43.94	43.94	43.94
CO [g/kWh]	0.000000	0.000000	0.000000	0.000000	0.000000
CO [g/h]	0.000000	0.000000	0.000000	0.000000	0.000000
CO [ppm]	0.00	0.00	0.00	0.00	0.00
Soot [g/kWh]	0.054939	0.054940	0.054936	0.054940	0.054940

Performance:

IMEP [bar]	4.7043	4.7043	4.7043	4.7043	4.7043
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
IMEP Exh. [bar]	-1.1118	-1.1118	-1.1118	-1.1118	-1.1118
IMEP Int. [bar]	0.9399	0.9399	0.9399	0.9399	0.9399
IMEP Gasex. [bar]	-0.1719	-0.1719	-0.1719	-0.1719	-0.1719
IMEP HP [bar]	4.8762	4.8762	4.8762	4.8762	4.8762
FMEP [bar]	1.5620	1.5620	1.5620	1.5620	1.5620
BMEP [bar]	3.1423	3.1423	3.1423	3.1423	3.1423
AMEP;SMEP [bar]	0.0000	0.0000	0.0000	0.0000	0.0000
ISFC [g/kWh]	186.1270	186.1266	186.1274	186.1271	186.1268
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
ISFC (tr.f.) [g/kWh]	186.1270	186.1266	186.1274	186.1271	186.1268
BSFC [g/kWh]	278.6485	278.6477	278.6495	278.6488	278.6482
Indicated Eff. [-]	0.4551	0.4551	0.4551	0.4551	0.4551
Iso vol. comb. Eff [-]	0.8989	0.8989	0.8989	0.8989	0.8989
Polytropic Coeff. [-]		1.3612	1.3612	1.3612	1.3612

Fuel Mass Balance:

Inj. Fuelmass [g]	0.046120	0.011530	0.011530	0.011530	0.011530
Asp.Trap. Fuelmass [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Fuelmassfl.(A+I) [g/s]	0.730233	0.182558	0.182558	0.182558	0.182558
Fuelmass tot.trap. [g]	0.046120	0.011530	0.011530	0.011530	0.011530
Trapped Fuelm.fl.[g/s]	0.730233	0.182558	0.182558	0.182558	0.182558
Trapp. Eff. Fuel [-]	1.0000	1.0000	1.0000	1.0000	1.0000

Energy Balance Cylinder:

Fuel Energy [kJ]	1.96010	0.49002	0.49002	0.49002	0.49002
Released Energy [kJ]	1.95815	0.48954	0.48954	0.48954	0.48954
-> Brake Power [%]	30.429	30.429	30.429	30.429	30.429
-> Loss: Friction [%]	15.126	15.126	15.126	15.126	15.126
-> Loss: Piston [%]	7.367	7.367	7.367	7.367	7.367
-> Loss: Head [%]	6.033	6.033	6.033	6.033	6.033
-> Loss: Liner [%]	5.015	5.015	5.015	5.015	5.015
-> Loss: Int. Port [%]	-0.605	-0.605	-0.605	-0.605	-0.605
-> Loss: Exh. Port [%]	0.000	0.000	0.000	0.000	0.000
-> Loss: Exh. Gas [%]	35.012	35.012	35.013	35.012	35.012
Eff. Rel. Energy [kJ]	1.95814	0.48954	0.48954	0.48954	0.48954
Gross Rel. Energy [kJ]	1.95815	0.48954	0.48954	0.48954	0.48954
Eff.Gross Rel.Ener.[kJ]	1.95814	0.48954	0.48954	0.48954	0.48954
Energy Balance [-]	0.9990	0.9990	0.9990	0.9990	0.9990
Eff. Energy Balance [-]	0.9990	0.9990	0.9990	0.9990	0.9990

Blowby:

Blowbymass [g]	-0.037070	-0.009268	-0.009268	-0.009268	-0.009268
Blowbymassfl. [g/s]	-0.586947	-0.146737	-0.146737	-0.146736	-0.146737
Blowby Heat Flow [kJ]	-0.030780	-0.007695	-0.007695	-0.007695	-0.007695

Reference Values at SHP:

Pressure at SHP[bar]	1.0396	1.0396	1.0396	1.0396	1.0396
Temperature [K]	363.96	363.96	363.96	363.96	363.96
Air Massfl. [g/s]	29.407057	7.351775	7.351779	7.351751	7.351752
Fuel Massfl. [g/s]	0.730233	0.182558	0.182558	0.182558	0.182558
Trapp. Eff. Air [-]	1.0000	1.0000	1.0000	1.0000	1.0000

Trapp. Eff.Fuel [-]	1.0000	1.0000	1.0000	1.0000	1.0000
A/F-Ratio (Cmb.) [-]	41.55	41.55	41.55	41.55	41.55
Excess Air Ratio [-]	2.8756	2.8756	2.8756	2.8756	2.8756
Residual Gas:					

Res.gas content [-]	0.0612	0.0612	0.0612	0.0612	0.0612
Com.Prod.Mass. at EO [g]	1.986735	0.496684	0.496684	0.496684	0.496684
Res.gas mass at SHP [g]	0.121128	0.030281	0.030281	0.030283	0.030283
Res.gas aspirated IN [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Res.gas from intake [g]	0.000954	0.000477	0.000477	0.000000	0.000000
Rel. to Total [-]	0.0079	0.0157	0.0157	0.0000	0.0000
Res.gas flow EX [g]	1.863166	0.465791	0.465792	0.465791	0.465791
Res.gas from exhaust [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Rel. to Total [-]	0.0000	0.0000	0.0000	0.0000	0.0000
Gas Exchange:					

Volumetric Eff. [-]	0.8380	0.8380	0.8380	0.8380	0.8380
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8525	0.8525	0.8525	0.8525	0.8525
Total Mass at SHP[g]	1.9784	0.4946	0.4946	0.4946	0.4946
Mass Delivered [g]	1.85702	0.46426	0.46426	0.46426	0.46425
Mass Delivered [g/s]	29.40282	7.35071	7.35071	7.35071	7.35069
Delivery Ratio [-]	0.8379	0.8379	0.8379	0.8379	0.8379
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8524	0.8524	0.8524	0.8524	0.8524
Av.Airmass at SHP[g]	1.9325	0.4831	0.4831	0.4831	0.4831
Air Delivered [g]	1.85729	0.46432	0.46432	0.46432	0.46432
Air Delivered [g/s]	29.40706	7.35178	7.35178	7.35175	7.35175
Airdeliveryratio [-]	0.8380	0.8380	0.8380	0.8380	0.8380
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8525	0.8525	0.8525	0.8525	0.8525
Airmass Trapped [g]	1.85729	0.46432	0.46432	0.46432	0.46432
Airmass Trapped [g/s]	29.40706	7.35178	7.35178	7.35175	7.35175
Trapp. Eff. Air [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Airpurity [-]	0.9768	0.9768	0.9768	0.9768	0.9768
Dyn. Swirl [-]	1.9626	1.9627	1.9627	1.9626	1.9626
Dyn. Tumble [-]	0.0000	0.0000	0.0000	0.0000	0.0000
Wall Heatlosses:					

Piston [kJ]	-0.1442	-0.0361	-0.0361	-0.0361	-0.0361
Cylinderhead [kJ]	-0.11813	-0.02953	-0.02953	-0.02953	-0.02953
Cylinderliner [kJ]	-0.09820	-0.02455	-0.02455	-0.02455	-0.02455
Sum of Wallheat [kJ]	-0.36058	-0.09015	-0.09015	-0.09015	-0.09015
Wall Heatlosses in High Pressure Phase:					
Piston HP [kJ]	-0.15380	-0.03845	-0.03845	-0.03845	-0.03845
Cylinderhead HP [kJ]	-0.12327	-0.03082	-0.03082	-0.03082	-0.03082
Cylinderliner HP [kJ]	-0.07906	-0.01976	-0.01976	-0.01976	-0.01976
Sum of Wallheat HP [kJ]	-0.35613	-0.08903	-0.08903	-0.08903	-0.08903
Wall Heatlosses Related to Heatinput:					
Piston [-]	-0.0736	-0.0736	-0.0736	-0.0736	-0.0736
Cylinderhead [-]	-0.0603	-0.0603	-0.0603	-0.0603	-0.0603
Cylinderliner [-]	-0.0501	-0.0501	-0.0501	-0.0501	-0.0501
Sum of Wallheat [-]	-0.1840	-0.1840	-0.1840	-0.1840	-0.1840
M. Eff. HTC [W/m2/K]	286.30	286.30	286.30	286.30	286.30
M. Eff. Temp. [K]	908.28	908.28	908.28	908.28	908.28
Reference Values at EO:					

Pressure [bar]	2.30	2.30	2.30	2.30	2.30
Temperature [K]	779.87	779.87	779.87	779.87	779.87
A/F-Ratio [-]	39.79	39.79	39.79	39.79	39.79
Com.Prod.Conc. [-]	0.99847	0.99847	0.99847	0.99847	0.99847
Fuel Concentr. [-]	0.000000	0.000000	0.000000	0.000000	0.000000
Average Values of Pipeattachements:					

Attached Pipe		5	6	7	8
Vlv/Prt.Op.Clr.0mm[deg]		344.00	344.00	344.00	344.00
Vlv/Prt.Op.Eff.0mm[deg]		377.55	377.55	377.55	377.55
Vlv/Prt.Op.Eff.1mm[deg]		394.00	394.00	394.00	394.00
Vlv/Prt.Op.Udef.mm[deg]		377.55	377.55	377.55	377.55
Vlv/Prt.Cl.Clr.0mm[deg]		584.00	584.00	584.00	584.00
Vlv/Prt.Cl.Eff.0mm[deg]		550.45	550.45	550.45	550.45

```
Vlv/Prt.Cl.Eff.1mm[deg]                          534.00         534.00         534.00         534.00
Vlv/Prt.Cl.Udef.mm[deg]                          550.45         550.45         550.45         550.45
Cam Phasing [deg]                                  0.00           0.00           0.00           0.00
Massflow [g/cycle]                             0.464255       0.464256       0.464255       0.464254
Wallheat [kJ/cycle]                            0.002961       0.002961       0.002961       0.002961
rel.to Heatinp.[-]                               0.0060         0.0060         0.0060         0.0060
Swirl Entry [-]                                  2.0891         2.0891         2.0891         2.0891
 Attached Pipe                                        9             10             11             12
Vlv/Prt.Op.Clr.0mm[deg]                          135.00         135.00         135.00         135.00
Vlv/Prt.Op.Eff.0mm[deg]                          155.00         155.00         155.00         155.00
Vlv/Prt.Op.Eff.1mm[deg]                          183.33         183.33         183.33         183.33
Vlv/Prt.Op.Udef.mm[deg]                          155.00         155.00         155.00         155.00
Vlv/Prt.Cl.Clr.0mm[deg]                          375.00         375.00         375.00         375.00
Vlv/Prt.Cl.Eff.0mm[deg]                          355.00         355.00         355.00         355.00
Vlv/Prt.Cl.Eff.1mm[deg]                          326.67         326.67         326.67         326.67
Vlv/Prt.Cl.Udef.mm[deg]                          355.00         355.00         355.00         355.00
Cam Phasing [deg]                                  0.00           0.00           0.00           0.00
Massflow [g/cycle]                             0.466506       0.466506       0.466506       0.466506
Wallheat [kJ/cycle]                            0.000000       0.000000       0.000000       0.000000
rel.to Heatinp.[-]                               0.0000         0.0000         0.0000         0.0000
Swirl Entry [-]                                  0.0000         0.0000         0.0000         0.0000

ASSEMBLED: Average Values
-------------------------
 Type         Nr.  ----------Inlet-----------   ---------Outlet-----------    ----------------------
-Core----------------------
                  Pressure Temperat.   Mass    Pressure Temperat.   Mass     Rej.Heat   Rej.Heat
Fric. coeff.  Heat Factor
                    [bar]     [K]        [g]     [bar]      [K]       [g]       [kJ]       [kW]
[-]           [-]
 AIRCOOLER     1    0.9967   298.26     2.328    0.9891   298.90     2.305     0.0003     0.0047
0.416333    13.772989
 AIRCLEANER    1    0.9996   298.06     4.672    0.9976   298.25     4.078     0.0000     0.0000
2.219221     0.000000

ASSEMBLED
Attachments
-----------
 Type                 Nr.   Pipe       Mass flow
                            Nr.       [g/cycle]
 AIRCOOLER             1      3          1.8570
 AIRCOOLER             1      4          1.8570
 AIRCLEANER            1      1          1.8571
 AIRCLEANER            1      2          1.8571

OVERALL ENGINE PERFORMANCE:
===========================

Indicated Torque          :     70.99 Nm                    Indicated Specific Torque :     37.44
Nm/l
Indicated Power           :     14.12 kW,        19.20 PS   Indicated Specific Power  :      7.45
kW/l,      10.13 PS/l
Friction Torque           :     23.57 Nm                    Friction Power            :      4.69
kW
Effective Torque          :     47.42 Nm                    Effective Specific Torque :     25.01
Nm/l
Effective Power           :      9.43 kW,        12.83 PS   Effective Specific Power  :      4.98
kW/l,       6.76 PS/l

Required time for reading the inputfile and initialisation:       0.02 min
Required time for the calculation: ..........................      0.87 min
Required time for writing the outputfile: ...................      0.00 min
Required total time: ........................................      0.88 min
Required total CPU-time: ....................................     52.07 sec
```

3. Biodyzelinas (BD)

```
--------------------------------
 AVL - B O O S T
 Version : v2011.2.0.0.0
 Build:    May  8 2012 22:18:13
 System:   x86_64-unknown-winnt
 --------------------------------

LICENSE
-------
 Boost Main 2011.0@ License will expire in 244 days
```

```
 Boost Charging 2011.0@ License will expire in 244 days

PROJECT
-------
 Preprocessor Version :  2011.2
 Calculation date     : 12.06.2013
 File     : Alfredo_BD_siluma.bst
 Case Set : "Case Set 1"
 Case     : "Case 1"

 Project ID: "L4 2.5L DI TCI  B x S = 90 x 98 mm Diesel Engine"
 Run ID:     "Full Load Performance (4000 - 1000 rpm)"
 Model date: "28.9.2000"

ELEMENTS
--------
 Element Name        Number

 PIPE                  15
 SYSTEMBOUNDARY         2
 PLENUM                 3
 CYLINDER               4
 MEASURINGPOINT        18
 AIRCOOLER              1
 AIRCLEANER             1
 TURBOCHARGER           1
 ENGINE                 1
 PIPE_END              34
 ASSEMBLED              2
 ALL_PIPES             17
 ALL_PLENUMS            7
 ALL_BOUNDARIES         2
 ALL_CHARGERS           1
 ALL_PIDS               1
 PIPE_VAR_WALL_TEMP    17

GLOBAL DATA
-----------
  Engine Speed :         1900.0  rpm
  Calculationmode:        BOOST  Single
  Cycle Duration:        720.00  degrees
  Max. calc. period:   36000.00  degrees
  Cycles calculated:         50  cycles
  Calc. time steps:     0.53954  degrees (max)
                        0.53484  degrees
                        0.04692  ms
  Traces results step:  1.00000  degrees
  User concentrations:         0
  Ref. pressure:      100000.00  Pa
  Ref. temperature:     298.000  K
  Gas properties:      Variable
  Gasproperties File:     DIESEL.BGP
     bgp_build_version:   v2010.0.0.0.0
     bgp_build_host:      boost
     bgp_build_user:      boostad
     bgp_build_date:      2010.10.31
     bgp_build_time:      07:00:00
  Lower calorific:  0.37000E+08  J/kg
  Stoic. A/F-ratio:      12.660

  Warnings:                    0
  Convergence errors:          0

PIPES
-----

 Total number of pipe cells:    136

 Pipe   Cells   Cell size       W.Heat     Wall T    Fric. coeff.   Lam. Fric. Coeff.  Heat Factor
Volume
  nr.                [mm]          [kJ]        [K]              [-]                 [-]          [-]
[dm3]
    1       6        30.0         0.000     298.00         0.019000           64.000000     0.000000
0.904779
    2       6        33.3         0.000     298.00         0.019000           64.000000     0.000000
1.005310
```

```
    3      32        30.0        0.000     298.00        0.032000           64.000000     0.000000
2.280796
    4      10        30.0        0.000     298.00        0.033000           64.000000     0.000000
0.589049
    5      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    6      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    7      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    8      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    9       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   10       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   11       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   12       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   13       2        30.0        0.000     298.00        0.033000           64.000000     0.000000
0.095426
   14      10        30.0        0.000     298.00        0.019000           64.000000     0.000000
0.848230
   15       6        33.3        0.000     298.00        0.019000           64.000000     0.000000
0.565487
   16      16        31.2        0.000     298.00        0.416333        66123.130902    13.772989
1.000000  COOLER_PIPE     1
   17       6        33.3        0.000     300.00        2.219221       263455.728117     0.000000
1.000000  FILTER_PIPE     1


MEASURINGPOINTS: Average Values
-------------------------------
 Mp. Pipe Location   Diameter  Pressure  Temp. Ms.Temp.  Velo.   Massflow   Massflow To.Ent.f.
To.Ent.f.  Mach. Wtemp.  Converg.
 nr.  nr.      [mm]        [mm]     [bar]    [K]       [K]  [m/s]      [g/s]  [g/cycle]    [kJ/s]
[kJ/cyc.]    [-]    [K]       [-]
  1   2    50.0000     80.0000    0.9974  298.2    298.0    5.0    29.3469     1.8535    -0.005    -
0.0003   0.01  298.0 0.380E-08
  2   2   200.0000     80.0000    0.9975  298.2    298.0    5.0    29.3474     1.8535    -0.005    -
0.0003   0.01  298.0 0.470E-09
  3   3    50.0000     55.0000    0.9968  298.2    297.9   10.6    29.3455     1.8534    -0.005    -
0.0003   0.03  298.0 0.163E-09
  4   3   600.0000     55.0000    0.9968  298.2    297.9   10.6    29.3455     1.8534    -0.005    -
0.0003   0.03  298.0 0.439E-08
  5   4   300.0000     50.0000    0.9869  298.9    297.9   13.1    29.3455     1.8534     0.000
0.0000   0.04  298.0 0.103E-07
  6   5   300.0000     39.5000    0.9853  308.6    306.2    5.5     7.3364     0.4634     0.064
0.0040   0.02  400.0 0.964E-09
  7   6   300.0000     39.5000    0.9853  308.6    306.2    5.5     7.3364     0.4634     0.064
0.0040   0.02  400.0 0.319E-09
  8   7   300.0000     39.5000    0.9853  308.6    306.2    5.5     7.3364     0.4634     0.064
0.0040   0.02  400.0 0.118E-07
  9   8   300.0000     39.5000    0.9853  308.6    306.2    5.5     7.3363     0.4633     0.064
0.0040   0.02  400.0 0.499E-09
 10   9     0.0000     35.0000    1.0076  646.8    614.2   13.2     7.3806     0.4661     2.489
0.1572   0.03  298.0 0.749E-07
 11  10     0.0000     35.0000    1.0076  646.8    614.2   13.2     7.3806     0.4661     2.489
0.1572   0.03  298.0 0.321E-06
 12  11     0.0000     35.0000    1.0076  646.9    614.2   13.2     7.3806     0.4661     2.489
0.1572   0.03  298.0 0.146E-06
 13  12     0.0000     35.0000    1.0076  646.8    614.2   13.2     7.3806     0.4661     2.489
0.1572   0.03  298.0 0.639E-07
 14   9   160.0000     35.0000    1.0071  596.9    614.7   13.3     7.3752     0.4658     2.492
0.1574   0.03  298.0 0.232E-05
 15  12     0.0000     35.0000    1.0076  646.8    614.2   13.2     7.3806     0.4661     2.489
0.1572   0.03  298.0 0.639E-07
 16  13    30.0000     45.0000    1.0005  614.0    615.3   32.5    29.5245     1.8647     9.957
0.6289   0.07  298.0 0.304E-05
 17  14    50.0000     60.0000    1.0083  616.7    616.4   18.2    29.5249     1.8647     9.956
0.6288   0.04  298.0 0.675E-05
 18  15   100.0000     60.0000    1.0001  616.7    616.6   18.5    29.5180     1.8643     9.957
0.6289   0.04  298.0 0.400E-05

SYSTEMBOUNDARIES
Attachments
```

Type	Nr.	Pipe Nr.	Mass flow [g/cycle]
SYSTEMBOUNDARY	1	1	1.8535
SYSTEMBOUNDARY	2	15	1.8643

PLENUMS: Average Values

	Pl. nr.	Pressure [bar]	Temp. [K]	Mass [g]	Wallheat [kJ]
PLENUM	1	0.9869	299.20	1.838	0.000

Attached pipe 4: 1.8534 g/cycle
Attached pipe 5: 0.4634 g/cycle
Attached pipe 6: 0.4634 g/cycle
Attached pipe 7: 0.4634 g/cycle
Attached pipe 8: 0.4633 g/cycle

	Pl. nr.	Pressure [bar]	Temp. [K]	Mass [g]	Wallheat [kJ]
PLENUM	2	1.0070	613.90	0.571	0.000

Attached pipe 9: 0.4661 g/cycle
Attached pipe 10: 0.4662 g/cycle
Attached pipe 11: 0.4662 g/cycle
Attached pipe 12: 0.4661 g/cycle
Attached pipe 13: 1.8646 g/cycle

	Pl. nr.	Pressure [bar]	Temp. [K]	Mass [g]	Wallheat [kJ]
PLENUM	3	1.0046	616.36	6.814	0.000

Attached pipe 14: 1.8646 g/cycle
Attached pipe 15: 1.8643 g/cycle

	Pl. nr.	Pressure [bar]	Temp. [K]	Mass [g]	Wallheat [kJ]
AIRCOOLER	1	0.9967	298.26	2.328	0.000

Attached pipe 3: 1.8534 g/cycle
Attached pipe 16: 1.8534 g/cycle

	Pl. nr.	Pressure [bar]	Temp. [K]	Mass [g]	Wallheat [kJ]
AIRCOOLER	1	0.9891	298.90	2.305	0.000

Attached pipe 4: 1.8534 g/cycle
Attached pipe 16: 1.8534 g/cycle

	Pl. nr.	Pressure [bar]	Temp. [K]	Mass [g]	Wallheat [kJ]
AIRCLEANER	1	0.9996	298.06	4.672	0.000

Attached pipe 1: 1.8535 g/cycle
Attached pipe 17: 1.8535 g/cycle

	Pl. nr.	Pressure [bar]	Temp. [K]	Mass [g]	Wallheat [kJ]
AIRCLEANER	1	0.9976	298.25	4.078	0.000

Attached pipe 2: 1.8535 g/cycle
Attached pipe 17: 1.8535 g/cycle

PLENUMS
Attachments

Type	Nr.	Pipe Nr.	Mass flow [g/cycle]
PLENUM	1	4	1.8534
PLENUM	1	5	0.4634
PLENUM	1	6	0.4634
PLENUM	1	7	0.4634
PLENUM	1	8	0.4633
PLENUM	2	9	0.4661
PLENUM	2	10	0.4662
PLENUM	2	11	0.4662
PLENUM	2	12	0.4661
PLENUM	2	13	1.8646
PLENUM	3	14	1.8646
PLENUM	3	15	1.8643
AIRCOOLER	1	3	1.8534
AIRCOOLER	1	16	1.8534
AIRCOOLER	1	4	1.8534
AIRCOOLER	1	16	1.8534
AIRCLEANER	1	1	1.8535
AIRCLEANER	1	17	1.8535
AIRCLEANER	1	2	1.8535
AIRCLEANER	1	17	1.8535

TURBOCHARGERS: Average Values

	Compressor			Turbine					Efficiencies				Calculation
TCh. nr.	Work [kJ]	Press.rat. [-]	Boostpres. [bar]	Work [kJ]	Press.rat. [-]	Dis.coeff. [-]	Turb./tot. [-]	VTG-pos [-]	Comp. [-]	Turb. [-]	mech. [-]	total [-]	mode
1	0.0000	1.0000	0.9976	0.0000	1.0010	0.0920	0.0515	1.000	0.750	0.664	0.980	0.488	Wastegateflow

Attached pipe 2: 1.8535 g/cycle
Attached pipe 3: 1.8534 g/cycle
Attached pipe 14: 1.8646 g/cycle

Attached pipe 13: 1.8646 g/cycle

CYLINDERS: Average Values

	Total Engine	Cyl. 1	Cyl. 2	Cyl. 3	Cyl. 4
Firing TDC [deg]		0.00	540.00	180.00	360.00
Bore [mm]		79.50	79.50	79.50	79.50
Stroke [mm]		95.50	95.50	95.50	95.50
Conrodl. [mm]		150.00	150.00	150.00	150.00
Piston pin offset [mm]		0.00	0.00	0.00	0.00
Swept Vol. [l]	1.8962	0.4741	0.4741	0.4741	0.4741
Compression ratio [-]		19.50	19.50	19.50	19.50
Dyn. Comp. ratio [-]		19.39	19.39	1.04	1.04

Combustion Data:

Combustion Char.		2Z-Vibe	2Z-Vibe	2Z-Vibe	2Z-Vibe
Comb.start [deg]		4.44	4.44	4.44	4.44
Comb.dur.1 [deg]		37.70	37.70	37.70	37.70
Peak Fir.Pres. [bar]	60.14	60.14	60.14	60.14	60.14
at Crankangle [deg]	11.32	11.32	11.32	11.32	11.32
Peak Pres.Rise[bar/deg]	1.98	1.98	1.98	1.98	1.98
at Crankangle [deg]	-12.34	-12.34	-12.34	-12.34	-12.34
Peak Fir. Temp. [K]	1545.99	1545.99	1545.99	1545.99	1545.99
at Crankangle [deg]	19.64	19.64	19.64	19.64	19.64
Peak T_burned [K]	2670.19	2670.19	2670.19	2670.19	2670.19
at Crankangle [deg]	4.86	4.86	4.86	4.86	4.86
Res. Gascompr. [bar]	1.05	1.05	1.05	1.05	1.05
at Crankangle [deg]	280.75	280.75	280.75	280.75	280.75

Emissions (Classic Species Transport):

NOx: Calculated based on MTZ 34 1973 (12).
CO: Calculated based on SAE 2002-01-0006.
SOOT: Calculated based on MTZ 5/2002 (63).

NOX [g/kWh]	0.067013	0.067014	0.067014	0.067012	0.067012
NOX [g/h]	0.558465	0.139618	0.139618	0.139614	0.139615
NOX [ppm]	4.97	4.97	4.97	4.97	4.97
CO [g/kWh]	0.000000	0.000000	0.000000	0.000000	0.000000
CO [g/h]	0.000000	0.000000	0.000000	0.000000	0.000000
CO [ppm]	0.00	0.00	0.00	0.00	0.00
Soot [g/kWh]	0.059550	0.059551	0.059548	0.059550	0.059550

Performance:

IMEP [bar]	4.3377	4.3377	4.3377	4.3377	4.3377
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
IMEP Exh. [bar]	-1.1119	-1.1119	-1.1119	-1.1119	-1.1119
IMEP Int. [bar]	0.9426	0.9426	0.9426	0.9426	0.9426
IMEP Gasex. [bar]	-0.1693	-0.1693	-0.1693	-0.1693	-0.1693
IMEP HP [bar]	4.5071	4.5071	4.5071	4.5070	4.5071
FMEP [bar]	1.5620	1.5620	1.5620	1.5620	1.5620
BMEP [bar]	2.7757	2.7757	2.7757	2.7757	2.7757
AMEP;SMEP [bar]	0.0000	0.0000	0.0000	0.0000	0.0000
ISFC [g/kWh]	211.1344	211.1343	211.1349	211.1344	211.1338
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
ISFC (tr.f.) [g/kWh]	211.1344	211.1343	211.1349	211.1344	211.1338
BSFC [g/kWh]	329.9467	329.9465	329.9481	329.9468	329.9454
Indicated Eff. [-]	0.4608	0.4608	0.4608	0.4608	0.4608
Iso vol. comb. Eff [-]	0.9164	0.9164	0.9164	0.9164	0.9164
Polytropic Coeff. [-]		1.3607	1.3607	1.3607	1.3607

Fuel Mass Balance:

Inj. Fuelmass [g]	0.048240	0.012060	0.012060	0.012060	0.012060
Asp.Trap. Fuelmass [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Fuelmassfl.(A+I) [g/s]	0.763800	0.190950	0.190950	0.190950	0.190950
Fuelmass tot.trap. [g]	0.048240	0.012060	0.012060	0.012060	0.012060
Trapped Fuelm.fl.[g/s]	0.763800	0.190950	0.190950	0.190950	0.190950
Trapp. Eff. Fuel [-]	1.0000	1.0000	1.0000	1.0000	1.0000

Energy Balance Cylinder:

Fuel Energy [kJ]	1.78488	0.44622	0.44622	0.44622	0.44622
Released Energy [kJ]	1.78324	0.44581	0.44581	0.44581	0.44581
-> Brake Power [%]	29.516	29.516	29.516	29.516	29.516

-> Loss: Friction [%]	16.610	16.610	16.610	16.610	16.610
-> Loss: Piston [%]	7.633	7.633	7.633	7.633	7.633
-> Loss: Head [%]	6.274	6.274	6.274	6.274	6.274
-> Loss: Liner [%]	4.567	4.567	4.567	4.567	4.567
-> Loss: Int. Port [%]	-0.661	-0.661	-0.661	-0.661	-0.661
-> Loss: Exh. Port [%]	0.000	0.000	0.000	0.000	0.000
-> Loss: Exh. Gas [%]	34.362	34.362	34.362	34.362	34.362
Eff. Rel. Energy [kJ]	1.78323	0.44581	0.44581	0.44581	0.44581
Gross Rel. Energy [kJ]	1.78324	0.44581	0.44581	0.44581	0.44581
Eff.Gross Rel.Ener.[kJ]	1.78323	0.44581	0.44581	0.44581	0.44581
Energy Balance [-]	0.9991	0.9991	0.9991	0.9991	0.9991
Eff. Energy Balance [-]	0.9991	0.9991	0.9991	0.9991	0.9991

Blowby:

Blowbymass [g]	-0.037017	-0.009254	-0.009254	-0.009254	-0.009254
Blowbymassfl. [g/s]	-0.586101	-0.146525	-0.146526	-0.146525	-0.146525
Blowby Heat Flow [kJ]	-0.030024	-0.007506	-0.007506	-0.007506	-0.007506

Reference Values at SHP:

Pressure at SHP[bar]	1.0398	1.0398	1.0398	1.0398	1.0398
Temperature [K]	363.57	363.57	363.57	363.57	363.57
Air Massfl. [g/s]	29.349542	7.337407	7.337406	7.337364	7.337365
Fuel Massfl. [g/s]	0.763800	0.190950	0.190950	0.190950	0.190950
Trapp. Eff. Air [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Trapp. Eff.Fuel [-]	1.0000	1.0000	1.0000	1.0000	1.0000
A/F-Ratio (Cmb.) [-]	39.78	39.78	39.78	39.78	39.78
Excess Air Ratio [-]	3.1424	3.1424	3.1424	3.1424	3.1424

Residual Gas:

Res.gas content [-]	0.0642	0.0642	0.0642	0.0642	0.0642
Com.Prod.Mass. at EO [g]	1.991538	0.497884	0.497885	0.497884	0.497884
Res.gas mass at SHP [g]	0.127161	0.031789	0.031789	0.031791	0.031791
Res.gas aspirated IN [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Res.gas from intake [g]	0.001136	0.000568	0.000568	0.000000	0.000000
Rel. to Total [-]	0.0089	0.0179	0.0179	0.0000	0.0000
Res.gas flow EX [g]	1.861876	0.465469	0.465469	0.465469	0.465469
Res.gas from exhaust [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Rel. to Total [-]	0.0000	0.0000	0.0000	0.0000	0.0000

Gas Exchange:

Volumetric Eff. [-]	0.8364	0.8364	0.8364	0.8364	0.8364
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8509	0.8509	0.8509	0.8509	0.8509
Total Mass at SHP[g]	1.9808	0.4952	0.4952	0.4952	0.4952
Mass Delivered [g]	1.85340	0.46335	0.46335	0.46335	0.46335
Mass Delivered [g/s]	29.34547	7.33638	7.33638	7.33638	7.33634
Delivery Ratio [-]	0.8362	0.8362	0.8362	0.8362	0.8362
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8507	0.8507	0.8507	0.8507	0.8507
Av.Airmass at SHP[g]	1.9363	0.4841	0.4841	0.4841	0.4841
Air Delivered [g]	1.85366	0.46342	0.46342	0.46341	0.46341
Air Delivered [g/s]	29.34954	7.33741	7.33741	7.33736	7.33736
Airdeliveryratio [-]	0.8364	0.8364	0.8364	0.8364	0.8364
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8509	0.8509	0.8509	0.8509	0.8509
Airmass Trapped [g]	1.85366	0.46342	0.46342	0.46341	0.46341
Airmass Trapped [g/s]	29.34954	7.33741	7.33741	7.33736	7.33736
Trapp. Eff. Air [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Airpurity [-]	0.9775	0.9775	0.9775	0.9775	0.9775
Dyn. Swirl [-]	1.9558	1.9558	1.9558	1.9558	1.9558
Dyn. Tumble [-]	0.0000	0.0000	0.0000	0.0000	0.0000

Wall Heatlosses:

Piston [kJ]	-0.1361	-0.0340	-0.0340	-0.0340	-0.0340
Cylinderhead [kJ]	-0.11188	-0.02797	-0.02797	-0.02797	-0.02797
Cylinderliner [kJ]	-0.08145	-0.02036	-0.02036	-0.02036	-0.02036
Sum of Wallheat [kJ]	-0.32944	-0.08236	-0.08236	-0.08236	-0.08236
Wall Heatlosses in High Pressure Phase:					
Piston HP [kJ]	-0.14842	-0.03710	-0.03710	-0.03710	-0.03710
Cylinderhead HP [kJ]	-0.11912	-0.02978	-0.02978	-0.02978	-0.02978
Cylinderliner HP [kJ]	-0.06937	-0.01734	-0.01734	-0.01734	-0.01734

Sum of Wallheat HP [kJ]	-0.33691	-0.08423	-0.08423	-0.08423	-0.08423
Wall Heatlosses Related to Heatinput:					
Piston [-]	-0.0763	-0.0763	-0.0763	-0.0763	-0.0763
Cylinderhead [-]	-0.0627	-0.0627	-0.0627	-0.0627	-0.0627
Cylinderliner [-]	-0.0456	-0.0456	-0.0456	-0.0456	-0.0456
Sum of Wallheat [-]	-0.1846	-0.1846	-0.1846	-0.1846	-0.1846
M. Eff. HTC [W/m2/K]	286.61	286.61	286.61	286.61	286.61
M. Eff. Temp. [K]	890.55	890.55	890.55	890.55	890.55

Reference Values at EO:

Pressure [bar]	2.15	2.15	2.15	2.15	2.15
Temperature [K]	729.56	729.56	729.56	729.56	729.56
A/F-Ratio [-]	37.98	37.98	37.98	37.98	37.98
Com.Prod.Conc. [-]	0.99855	0.99855	0.99855	0.99855	0.99855
Fuel Concentr. [-]	0.000000	0.000000	0.000000	0.000000	0.000000

Average Values of Pipeattachements:

Attached Pipe	5	6	7	8
Vlv/Prt.Op.Clr.0mm[deg]	344.00	344.00	344.00	344.00
Vlv/Prt.Op.Eff.0mm[deg]	377.55	377.55	377.55	377.55
Vlv/Prt.Op.Eff.1mm[deg]	394.00	394.00	394.00	394.00
Vlv/Prt.Op.Udef.mm[deg]	377.55	377.55	377.55	377.55
Vlv/Prt.Cl.Clr.0mm[deg]	584.00	584.00	584.00	584.00
Vlv/Prt.Cl.Eff.0mm[deg]	550.45	550.45	550.45	550.45
Vlv/Prt.Cl.Eff.1mm[deg]	534.00	534.00	534.00	534.00
Vlv/Prt.Cl.Udef.mm[deg]	550.45	550.45	550.45	550.45
Cam Phasing [deg]	0.00	0.00	0.00	0.00
Massflow [g/cycle]	0.463350	0.463350	0.463350	0.463348
Wallheat [kJ/cycle]	0.002946	0.002946	0.002946	0.002946
rel.to Heatinp.[-]	0.0066	0.0066	0.0066	0.0066
Swirl Entry [-]	2.0881	2.0881	2.0881	2.0881
Attached Pipe	9	10	11	12
Vlv/Prt.Op.Clr.0mm[deg]	135.00	135.00	135.00	135.00
Vlv/Prt.Op.Eff.0mm[deg]	155.00	155.00	155.00	155.00
Vlv/Prt.Op.Eff.1mm[deg]	183.33	183.33	183.33	183.33
Vlv/Prt.Op.Udef.mm[deg]	155.00	155.00	155.00	155.00
Vlv/Prt.Cl.Clr.0mm[deg]	375.00	375.00	375.00	375.00
Vlv/Prt.Cl.Eff.0mm[deg]	355.00	355.00	355.00	355.00
Vlv/Prt.Cl.Eff.1mm[deg]	326.67	326.67	326.67	326.67
Vlv/Prt.Cl.Udef.mm[deg]	355.00	355.00	355.00	355.00
Cam Phasing [deg]	0.00	0.00	0.00	0.00
Massflow [g/cycle]	0.466144	0.466145	0.466145	0.466145
Wallheat [kJ/cycle]	0.000000	0.000000	0.000000	0.000000
rel.to Heatinp.[-]	0.0000	0.0000	0.0000	0.0000
Swirl Entry [-]	0.0000	0.0000	0.0000	0.0000

ASSEMBLED: Average Values

Type	Nr.	Inlet			Outlet				
-Core-									
		Pressure	Temperat.	Mass	Pressure	Temperat.	Mass	Rej.Heat	Rej.Heat
Fric. coeff.	Heat Factor	[bar]	[K]	[g]	[bar]	[K]	[g]	[kJ]	[kW]
[-]	[-]								
AIRCOOLER	1	0.9967	298.26	2.328	0.9891	298.90	2.305	0.0003	0.0047
0.416333	13.772989								
AIRCLEANER	1	0.9996	298.06	4.672	0.9976	298.25	4.078	0.0000	0.0000
2.219221	0.000000								

ASSEMBLED
Attachments

Type	Nr.	Pipe Nr.	Mass flow [g/cycle]
AIRCOOLER	1	3	1.8534
AIRCOOLER	1	4	1.8534
AIRCLEANER	1	1	1.8535
AIRCLEANER	1	2	1.8535

OVERALL ENGINE PERFORMANCE:
==========

Indicated Torque : 65.45 Nm Indicated Specific Torque : 34.52 Nm/l

```
Indicated Power           :     13.02 kW,        17.71 PS   Indicated Specific Power  :      6.87
kW/l,       9.34 PS/l
Friction Torque           :     23.57 Nm                    Friction Power            :      4.69
kW
Effective Torque          :     41.88 Nm                    Effective Specific Torque :     22.09
Nm/l
Effective Power           :      8.33 kW,        11.33 PS   Effective Specific Power  :      4.39
kW/l,       5.98 PS/l

Required time for reading the inputfile and initialisation:       0.02 min
Required time for the calculation: .........................      0.83 min
Required time for writing the outputfile: ..................      0.00 min
Required total time: .......................................      0.85 min
Required total CPU-time: ...................................     50.72 sec
```

4. Biodyzelinas + Brauno dujos (BD + HHO)

```
 ---------------------------------
  AVL - B O O S T
  Version : v2011.2.0.0.0
  Build:    May  8 2012 22:18:13
  System:   x86_64-unknown-winnt
  ---------------------------------

LICENSE
-------
  Boost Main 2011.0@ License will expire in 244 days

  Boost Charging 2011.0@ License will expire in 244 days

PROJECT
-------
  Preprocessor Version :  2011.2
  Calculation date     : 12.06.2013
  File     : Alfredo_BD_HHO_siluma.bst
  Case Set : "Case Set 1"
  Case     : "Case 1"

  Project ID: "L4 2.5L DI TCI  B x S = 90 x 98 mm Diesel Engine"
  Run ID:     "Full Load Performance (4000 - 1000 rpm)"
  Model date: "28.9.2000"

ELEMENTS
--------
  Element Name        Number

  PIPE                  15
  SYSTEMBOUNDARY         2
  PLENUM                 3
  CYLINDER               4
  MEASURINGPOINT        18
  AIRCOOLER              1
  AIRCLEANER             1
  TURBOCHARGER           1
  ENGINE                 1
  PIPE_END              34
  ASSEMBLED              2
  ALL_PIPES             17
  ALL_PLENUMS            7
  ALL_BOUNDARIES         2
  ALL_CHARGERS           1
  ALL_PIDS               1
  PIPE_VAR_WALL_TEMP    17

GLOBAL DATA
-----------
   Engine Speed :         1900.0  rpm
   Calculationmode:        BOOST  Single
   Cycle Duration:        720.00  degrees
   Max. calc. period:   36000.00  degrees
   Cycles calculated:         50  cycles
   Calc. time steps:     0.53954  degrees (max)
                         0.53189  degrees
                         0.04666  ms
   Traces results step:  1.00000  degrees
   User concentrations:        0
   Ref. pressure:      100000.00  Pa
   Ref. temperature:     298.000  K
```

```
  Gas properties:      Variable
  Gasproperties File:     DIESEL.BGP
     bgp_build_version:   v2010.0.0.0.0
     bgp_build_host:      boost
     bgp_build_user:      boostad
     bgp_build_date:      2010.10.31
     bgp_build_time:      07:00:00
  Lower calorific:  0.37000E+08  J/kg
  Stoic. A/F-ratio:      12.660

  Warnings:                   0
  Convergence errors:         0

PIPES
-----

 Total number of pipe cells:    136

 Pipe   Cells   Cell size       W.Heat     Wall T    Fric. coeff.   Lam. Fric. Coeff.  Heat Factor
Volume
  nr.                [mm]         [kJ]        [K]             [-]                 [-]          [-]
[dm3]
    1       6        30.0        0.000     298.00        0.019000           64.000000     0.000000
0.904779
    2       6        33.3        0.000     298.00        0.019000           64.000000     0.000000
1.005310
    3      32        30.0        0.000     298.00        0.032000           64.000000     0.000000
2.280796
    4      10        30.0        0.000     298.00        0.033000           64.000000     0.000000
0.589049
    5      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    6      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    7      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    8      10        30.0        0.004     400.00        0.035000           64.000000     1.000000
0.367625
    9       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   10       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   11       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   12       6        30.0        0.000     298.00        0.035000           64.000000     0.000000
0.173180
   13       2        30.0        0.000     298.00        0.033000           64.000000     0.000000
0.095426
   14      10        30.0        0.000     298.00        0.019000           64.000000     0.000000
0.848230
   15       6        33.3        0.000     298.00        0.019000           64.000000     0.000000
0.565487
   16      16        31.2        0.000     298.00        0.416333        66123.130902    13.772989
1.000000  COOLER_PIPE     1
   17       6        33.3        0.000     300.00        2.219221       263455.728117     0.000000
1.000000  FILTER_PIPE     1


MEASURINGPOINTS: Average Values
-------------------------------
 Mp. Pipe Location   Diameter  Pressure  Temp. Ms.Temp.  Velo.   Massflow   Massflow To.Ent.f.
To.Ent.f.  Mach. Wtemp.  Converg.
 nr.  nr.      [mm]        [mm]     [bar]     [K]       [K]  [m/s]      [g/s]  [g/cycle]    [kJ/s]
[kJ/cyc.]    [-]    [K]       [-]
  1   2    50.0000     80.0000    0.9974  298.2     298.0    5.0    29.3870     1.8560    -0.005    -
0.0003   0.01  298.0 0.193E-07
  2   2   200.0000     80.0000    0.9974  298.2     298.0    5.0    29.3874     1.8560    -0.005    -
0.0003   0.01  298.0 0.820E-08
  3   3    50.0000     55.0000    0.9968  298.2     297.9   10.6    29.3856     1.8559    -0.005    -
0.0003   0.03  298.0 0.404E-08
  4   3   600.0000     55.0000    0.9968  298.2     297.9   10.7    29.3856     1.8559    -0.005    -
0.0003   0.03  298.0 0.528E-07
  5   4   300.0000     50.0000    0.9869  298.9     297.9   13.1    29.3856     1.8559     0.000
0.0000   0.04  298.0 0.262E-08
  6   5   300.0000     39.5000    0.9852  308.5     306.2    5.5     7.3464     0.4640     0.064
0.0040   0.02  400.0 0.681E-09
```

```
  7   6   300.0000    39.5000    0.9852  308.5    306.2    5.5     7.3464     0.4640     0.064
0.0040   0.02  400.0 0.196E-09
  8   7   300.0000    39.5000    0.9852  308.5    306.2    5.5     7.3464     0.4640     0.064
0.0040   0.02  400.0 0.911E-08
  9   8   300.0000    39.5000    0.9852  308.5    306.2    5.5     7.3464     0.4640     0.064
0.0040   0.02  400.0 0.567E-09
 10   9     0.0000    35.0000    1.0082  663.7    638.6   13.8     7.4086     0.4679     2.707
0.1709   0.03  298.0 0.114E-06
 11  10     0.0000    35.0000    1.0082  663.7    638.6   13.8     7.4086     0.4679     2.707
0.1709   0.03  298.0 0.352E-06
 12  11     0.0000    35.0000    1.0082  663.7    638.6   13.8     7.4086     0.4679     2.707
0.1709   0.03  298.0 0.250E-07
 13  12     0.0000    35.0000    1.0082  663.7    638.6   13.8     7.4086     0.4679     2.707
0.1709   0.03  298.0 0.248E-06
 14   9   160.0000    35.0000    1.0075  618.2    639.2   13.8     7.4020     0.4675     2.709
0.1711   0.03  298.0 0.279E-05
 15  12     0.0000    35.0000    1.0082  663.7    638.6   13.8     7.4086     0.4679     2.707
0.1709   0.03  298.0 0.248E-06
 16  13    30.0000    45.0000    1.0005  638.2    639.9   33.9    29.6358     1.8717    10.826
0.6838   0.07  298.0 0.144E-05
 17  14    50.0000    60.0000    1.0090  641.7    641.1   18.9    29.6358     1.8717    10.825
0.6837   0.04  298.0 0.412E-05
 18  15   100.0000    60.0000    1.0001  641.5    641.3   19.3    29.6292     1.8713    10.826
0.6838   0.04  298.0 0.332E-05

SYSTEMBOUNDARIES
Attachments
-----------
 Type                  Nr.   Pipe       Mass flow
                             Nr.       [g/cycle]
 SYSTEMBOUNDARY         1      1          1.8560
 SYSTEMBOUNDARY         2     15          1.8713

PLENUMS: Average Values
-----------------------
                    Pl. Pressure   Temp.      Mass Wallheat
                    nr.    [bar]     [K]       [g]     [kJ]
 PLENUM              1    0.9869  299.20     1.838    0.000
                                             Attached pipe   4:      1.8559 g/cycle
                                             Attached pipe   5:      0.4640 g/cycle
                                             Attached pipe   6:      0.4640 g/cycle
                                             Attached pipe   7:      0.4640 g/cycle
                                             Attached pipe   8:      0.4640 g/cycle
 PLENUM              2    1.0075  638.09     0.550    0.000
                                             Attached pipe   9:      0.4679 g/cycle
                                             Attached pipe  10:      0.4679 g/cycle
                                             Attached pipe  11:      0.4679 g/cycle
                                             Attached pipe  12:      0.4679 g/cycle
                                             Attached pipe  13:      1.8716 g/cycle
 PLENUM              3    1.0050  641.07     6.554    0.000
                                             Attached pipe  14:      1.8716 g/cycle
                                             Attached pipe  15:      1.8713 g/cycle
 AIRCOOLER           1    0.9967  298.26     2.328    0.000
                                             Attached pipe   3:      1.8559 g/cycle
                                             Attached pipe  16:      1.8559 g/cycle
 AIRCOOLER           1    0.9891  298.90     2.305    0.000
                                             Attached pipe   4:      1.8559 g/cycle
                                             Attached pipe  16:      1.8559 g/cycle
 AIRCLEANER          1    0.9996  298.06     4.672    0.000
                                             Attached pipe   1:      1.8560 g/cycle
                                             Attached pipe  17:      1.8560 g/cycle
 AIRCLEANER          1    0.9976  298.25     4.078    0.000
                                             Attached pipe   2:      1.8560 g/cycle
                                             Attached pipe  17:      1.8560 g/cycle

PLENUMS
Attachments
-----------
 Type                    Nr.   Pipe       Mass flow
                               Nr.       [g/cycle]
 PLENUM                   1      4          1.8559
 PLENUM                   1      5          0.4640
 PLENUM                   1      6          0.4640
 PLENUM                   1      7          0.4640
 PLENUM                   1      8          0.4640
 PLENUM                   2      9          0.4679
 PLENUM                   2     10          0.4679
```

```
 PLENUM               2     11          0.4679
 PLENUM               2     12          0.4679
 PLENUM               2     13          1.8716
 PLENUM               3     14          1.8716
 PLENUM               3     15          1.8713
 AIRCOOLER            1      3          1.8559
 AIRCOOLER            1     16          1.8559
 AIRCOOLER            1      4          1.8559
 AIRCOOLER            1     16          1.8559
 AIRCLEANER           1      1          1.8560
 AIRCLEANER           1     17          1.8560
 AIRCLEANER           1      2          1.8560
 AIRCLEANER           1     17          1.8560

TURBOCHARGERS: Average Values
-----------------------------
                  Compressor                           Turbine                                  Effi-
ciencies        Calculation
TCh.    Work    Press.rat.  Boostpres.     Work  Press.rat. Dis.coeff. Turb./tot. VTG-pos Comp.
Turb. mech. total      mode
nr.      [kJ]      [-]       [bar]         [kJ]       [-]       [-]         [-]       [-]    [-]    [-]
[-]    [-]
  1    0.0000     1.0000     0.9976     0.0000     1.0011     0.0920     0.0513 1.000    0.750
0.664 0.980 0.488  Wastegateflow
  Attached pipe   2:      1.8560 g/cycle
  Attached pipe   3:      1.8559 g/cycle
  Attached pipe  14:      1.8716 g/cycle
  Attached pipe  13:      1.8716 g/cycle

CYLINDERS: Average Values
-------------------------
                               Total
                              Engine         Cyl.   1       Cyl.   2       Cyl.   3       Cyl.   4
Firing TDC [deg]                                  0.00          540.00          180.00          360.00
Bore [mm]                                        79.50           79.50           79.50           79.50
Stroke [mm]                                      95.50           95.50           95.50           95.50
Conrodl. [mm]                                   150.00          150.00          150.00          150.00
Piston pin offset [mm]                            0.00            0.00            0.00            0.00
Swept Vol. [l]                   1.8962          0.4741          0.4741          0.4741          0.4741
Compression ratio [-]                            19.50           19.50           19.50           19.50
Dyn. Comp. ratio [-]                             19.39           19.39            1.04            1.04

Combustion Data:
----------------
Combustion Char.                               2Z-Vibe         2Z-Vibe         2Z-Vibe         2Z-Vibe
Comb.start [deg]                                  3.30            3.30            3.30            3.30
Comb.dur.1 [deg]                                 38.00           38.00           38.00           38.00
Peak Fir.Pres. [bar]              60.54          60.54           60.54           60.54           60.54
at Crankangle [deg]               11.75          11.75           11.75           11.75           11.75
Peak Pres.Rise[bar/deg]            1.97           1.97            1.97            1.97            1.97
at Crankangle [deg]              -12.26         -12.26          -12.26          -12.26          -12.26
Peak Fir. Temp. [K]             1594.55        1594.55         1594.55         1594.55         1594.55
at Crankangle [deg]               20.78          20.78           20.78           20.78           20.78
Peak T_burned [K]               2676.60        2676.60         2676.60         2676.60         2676.60
at Crankangle [deg]                3.78           3.78            3.78            3.78            3.78
Res. Gascompr. [bar]               1.05           1.05            1.05            1.05            1.05
at Crankangle [deg]              280.30         280.30          280.30          280.30          280.30

Emissions (Classic Species Transport):
--------------------------------------
NOx: Calculated based on MTZ 34 1973 (12).
CO:  Calculated based on SAE 2002-01-0006.
SOOT:  Calculated based on MTZ 5/2002 (63).
NOX   [g/kWh]               0.094409       0.094410        0.094411        0.094407        0.094407
NOX   [g/h]                 0.905442       0.226364        0.226364        0.226356        0.226357
NOX   [ppm]                     8.03           8.03            8.03            8.03            8.03
CO    [g/kWh]               0.000000       0.000000        0.000000        0.000000        0.000000
CO    [g/h]                 0.000000       0.000000        0.000000        0.000000        0.000000
CO    [ppm]                     0.00           0.00            0.00            0.00            0.00
Soot  [g/kWh]               0.044166       0.044167        0.044162        0.044167        0.044167

Performance:
------------
IMEP [bar]                       4.7564         4.7564          4.7564          4.7564          4.7564
Rel. to Ave. [-]                                1.0000          1.0000          1.0000          1.0000
IMEP Exh. [bar]                 -1.1120        -1.1120         -1.1120         -1.1120         -1.1120
IMEP Int. [bar]                  0.9407         0.9407          0.9407          0.9407          0.9407
```

IMEP Gasex. [bar]	-0.1714	-0.1714	-0.1714	-0.1713	-0.1713
IMEP HP [bar]	4.9277	4.9278	4.9277	4.9277	4.9277
FMEP [bar]	1.5620	1.5620	1.5620	1.5620	1.5620
BMEP [bar]	3.1944	3.1944	3.1944	3.1944	3.1944
AMEP;SMEP [bar]	0.0000	0.0000	0.0000	0.0000	0.0000
ISFC [g/kWh]	211.5499	211.5495	211.5503	211.5499	211.5496
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
ISFC (tr.f.) [g/kWh]	211.5499	211.5495	211.5503	211.5499	211.5496
BSFC [g/kWh]	314.9938	314.9930	314.9948	314.9939	314.9932
Indicated Eff. [-]	0.4599	0.4599	0.4599	0.4599	0.4599
Iso vol. comb. Eff [-]	0.9133	0.9133	0.9133	0.9133	0.9133
Polytropic Coeff. [-]		1.3608	1.3608	1.3608	1.3608
Fuel Mass Balance:					

Inj. Fuelmass [g]	0.053000	0.013250	0.013250	0.013250	0.013250
Asp.Trap. Fuelmass [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Fuelmassfl.(A+I) [g/s]	0.839167	0.209792	0.209792	0.209792	0.209792
Fuelmass tot.trap. [g]	0.053000	0.013250	0.013250	0.013250	0.013250
Trapped Fuelm.fl.[g/s]	0.839167	0.209792	0.209792	0.209792	0.209792
Trapp. Eff. Fuel [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Energy Balance Cylinder:					

Fuel Energy [kJ]	1.96100	0.49025	0.49025	0.49025	0.49025
Released Energy [kJ]	1.95913	0.48978	0.48978	0.48978	0.48978
-> Brake Power [%]	30.918	30.918	30.918	30.918	30.918
-> Loss: Friction [%]	15.118	15.118	15.118	15.118	15.118
-> Loss: Piston [%]	7.676	7.676	7.676	7.676	7.676
-> Loss: Head [%]	6.275	6.275	6.275	6.275	6.275
-> Loss: Liner [%]	4.857	4.857	4.857	4.857	4.857
-> Loss: Int. Port [%]	-0.604	-0.604	-0.604	-0.604	-0.604
-> Loss: Exh. Port [%]	0.000	0.000	0.000	0.000	0.000
-> Loss: Exh. Gas [%]	34.079	34.079	34.079	34.079	34.079
Eff. Rel. Energy [kJ]	1.95912	0.48978	0.48978	0.48978	0.48978
Gross Rel. Energy [kJ]	1.95913	0.48978	0.48978	0.48978	0.48978
Eff.Gross Rel.Ener.[kJ]	1.95912	0.48978	0.48978	0.48978	0.48978
Energy Balance [-]	0.9990	0.9990	0.9990	0.9990	0.9990
Eff. Energy Balance [-]	0.9990	0.9990	0.9990	0.9990	0.9990
Blowby:					

Blowbymass [g]	-0.037233	-0.009308	-0.009308	-0.009308	-0.009308
Blowbymassfl. [g/s]	-0.589529	-0.147382	-0.147383	-0.147382	-0.147382
Blowby Heat Flow [kJ]	-0.031287	-0.007822	-0.007822	-0.007822	-0.007822
Reference Values at SHP:					

Pressure at SHP[bar]	1.0397	1.0397	1.0397	1.0397	1.0397
Temperature [K]	363.87	363.87	363.87	363.87	363.87
Air Massfl. [g/s]	29.389684	7.347433	7.347436	7.347407	7.347407
Fuel Massfl. [g/s]	0.839167	0.209792	0.209792	0.209792	0.209792
Trapp. Eff. Air [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Trapp. Eff.Fuel [-]	1.0000	1.0000	1.0000	1.0000	1.0000
A/F-Ratio (Cmb.) [-]	36.14	36.14	36.14	36.14	36.14
Excess Air Ratio [-]	2.8545	2.8545	2.8545	2.8545	2.8545
Residual Gas:					

Res.gas content [-]	0.0621	0.0621	0.0621	0.0621	0.0621
Com.Prod.Mass. at EO [g]	1.994186	0.498547	0.498547	0.498547	0.498547
Res.gas mass at SHP [g]	0.122815	0.030703	0.030703	0.030704	0.030704
Res.gas aspirated IN [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Res.gas from intake [g]	0.000993	0.000497	0.000496	0.000000	0.000000
Rel. to Total [-]	0.0081	0.0162	0.0162	0.0000	0.0000
Res.gas flow EX [g]	1.868902	0.467225	0.467226	0.467225	0.467225
Res.gas from exhaust [g]	0.000000	0.000000	0.000000	0.000000	0.000000
Rel. to Total [-]	0.0000	0.0000	0.0000	0.0000	0.0000
Gas Exchange:					

Volumetric Eff. [-]	0.8375	0.8375	0.8375	0.8375	0.8375
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8520	0.8520	0.8520	0.8520	0.8520
Total Mass at SHP[g]	1.9790	0.4948	0.4948	0.4948	0.4948
Mass Delivered [g]	1.85593	0.46398	0.46398	0.46398	0.46398
Mass Delivered [g/s]	29.38558	7.34640	7.34640	7.34640	7.34637

Delivery Ratio [-]	0.8374	0.8374	0.8374	0.8374	0.8374
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8519	0.8519	0.8519	0.8519	0.8519
Av.Airmass at SHP[g]	1.9319	0.4830	0.4830	0.4830	0.4830
Air Delivered [g]	1.85619	0.46405	0.46405	0.46405	0.46405
Air Delivered [g/s]	29.38968	7.34743	7.34744	7.34741	7.34741
Airdeliveryratio [-]	0.8375	0.8375	0.8375	0.8375	0.8375
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Rel. To PL 1 [-]	0.8520	0.8520	0.8520	0.8520	0.8520
Airmass Trapped [g]	1.85619	0.46405	0.46405	0.46405	0.46405
Airmass Trapped [g/s]	29.38968	7.34743	7.34744	7.34741	7.34741
Trapp. Eff. Air [-]	1.0000	1.0000	1.0000	1.0000	1.0000
Rel. to Ave. [-]		1.0000	1.0000	1.0000	1.0000
Airpurity [-]	0.9762	0.9762	0.9762	0.9762	0.9762
Dyn. Swirl [-]	1.9606	1.9606	1.9606	1.9606	1.9606
Dyn. Tumble [-]	0.0000	0.0000	0.0000	0.0000	0.0000

Wall Heatlosses:

Piston [kJ]	-0.1504	-0.0376	-0.0376	-0.0376	-0.0376
Cylinderhead [kJ]	-0.12293	-0.03073	-0.03073	-0.03073	-0.03073
Cylinderliner [kJ]	-0.09516	-0.02379	-0.02379	-0.02379	-0.02379
Sum of Wallheat [kJ]	-0.36847	-0.09212	-0.09212	-0.09212	-0.09212
Wall Heatlosses in High Pressure Phase:					
Piston HP [kJ]	-0.16069	-0.04017	-0.04017	-0.04017	-0.04017
Cylinderhead HP [kJ]	-0.12865	-0.03216	-0.03216	-0.03216	-0.03216
Cylinderliner HP [kJ]	-0.07788	-0.01947	-0.01947	-0.01947	-0.01947
Sum of Wallheat HP [kJ]	-0.36722	-0.09181	-0.09181	-0.09181	-0.09181
Wall Heatlosses Related to Heatinput:					
Piston [-]	-0.0767	-0.0767	-0.0767	-0.0767	-0.0767
Cylinderhead [-]	-0.0627	-0.0627	-0.0627	-0.0627	-0.0627
Cylinderliner [-]	-0.0485	-0.0485	-0.0485	-0.0485	-0.0485
Sum of Wallheat [-]	-0.1879	-0.1879	-0.1879	-0.1879	-0.1879
M. Eff. HTC [W/m2/K]	289.62	289.62	289.62	289.62	289.62
M. Eff. Temp. [K]	917.68	917.68	917.68	917.68	917.68

Reference Values at EO:

Pressure [bar]	2.27	2.27	2.27	2.27	2.27
Temperature [K]	766.28	766.28	766.28	766.28	766.28
A/F-Ratio [-]	34.62	34.62	34.62	34.62	34.62
Com.Prod.Conc. [-]	0.99853	0.99853	0.99853	0.99853	0.99853
Fuel Concentr. [-]	0.000000	0.000000	0.000000	0.000000	0.000000

Average Values of Pipeattachements:

Attached Pipe	5	6	7	8
Vlv/Prt.Op.Clr.0mm[deg]	344.00	344.00	344.00	344.00
Vlv/Prt.Op.Eff.0mm[deg]	377.55	377.55	377.55	377.55
Vlv/Prt.Op.Eff.1mm[deg]	394.00	394.00	394.00	394.00
Vlv/Prt.Op.Udef.mm[deg]	377.55	377.55	377.55	377.55
Vlv/Prt.Cl.Clr.0mm[deg]	584.00	584.00	584.00	584.00
Vlv/Prt.Cl.Eff.0mm[deg]	550.45	550.45	550.45	550.45
Vlv/Prt.Cl.Eff.1mm[deg]	534.00	534.00	534.00	534.00
Vlv/Prt.Cl.Udef.mm[deg]	550.45	550.45	550.45	550.45
Cam Phasing [deg]	0.00	0.00	0.00	0.00
Massflow [g/cycle]	0.463983	0.463983	0.463983	0.463982
Wallheat [kJ/cycle]	0.002960	0.002960	0.002960	0.002960
rel.to Heatinp.[-]	0.0060	0.0060	0.0060	0.0060
Swirl Entry [-]	2.0887	2.0887	2.0887	2.0887
Attached Pipe	9	10	11	12
Vlv/Prt.Op.Clr.0mm[deg]	135.00	135.00	135.00	135.00
Vlv/Prt.Op.Eff.0mm[deg]	155.00	155.00	155.00	155.00
Vlv/Prt.Op.Eff.1mm[deg]	183.33	183.33	183.33	183.33
Vlv/Prt.Op.Udef.mm[deg]	155.00	155.00	155.00	155.00
Vlv/Prt.Cl.Clr.0mm[deg]	375.00	375.00	375.00	375.00
Vlv/Prt.Cl.Eff.0mm[deg]	355.00	355.00	355.00	355.00
Vlv/Prt.Cl.Eff.1mm[deg]	326.67	326.67	326.67	326.67
Vlv/Prt.Cl.Udef.mm[deg]	355.00	355.00	355.00	355.00
Cam Phasing [deg]	0.00	0.00	0.00	0.00
Massflow [g/cycle]	0.467912	0.467912	0.467912	0.467912
Wallheat [kJ/cycle]	0.000000	0.000000	0.000000	0.000000
rel.to Heatinp.[-]	0.0000	0.0000	0.0000	0.0000
Swirl Entry [-]	0.0000	0.0000	0.0000	0.0000

ASSEMBLED: Average Values

```
 Type          Nr.  ----------Inlet-----------   ---------Outlet-----------    ----------------------
-Core----------------------
                   Pressure Temperat.   Mass    Pressure Temperat.   Mass     Rej.Heat   Rej.Heat
Fric. coeff.  Heat Factor
                    [bar]     [K]        [g]     [bar]      [K]       [g]       [kJ]       [kW]
[-]           [-]
 AIRCOOLER     1    0.9967   298.26     2.328    0.9891   298.90     2.305     0.0003     0.0047
0.416333    13.772989
 AIRCLEANER    1    0.9996   298.06     4.672    0.9976   298.25     4.078     0.0000     0.0000
2.219221     0.000000

ASSEMBLED
Attachments
-----------
 Type                 Nr.   Pipe       Mass flow
                            Nr.       [g/cycle]
 AIRCOOLER             1      3          1.8559
 AIRCOOLER             1      4          1.8559
 AIRCLEANER            1      1          1.8560
 AIRCLEANER            1      2          1.8560

OVERALL ENGINE PERFORMANCE:
===========================

Indicated Torque          :     71.77 Nm                    Indicated Specific Torque :     37.85
Nm/l
Indicated Power           :     14.28 kW,        19.42 PS   Indicated Specific Power  :      7.53
kW/l,      10.24 PS/l
Friction Torque           :     23.57 Nm                    Friction Power            :      4.69
kW
Effective Torque          :     48.20 Nm                    Effective Specific Torque :     25.42
Nm/l
Effective Power           :      9.59 kW,        13.04 PS   Effective Specific Power  :      5.06
kW/l,       6.88 PS/l

Required time for reading the inputfile and initialisation:       0.02 min
Required time for the calculation: ..........................     0.83 min
Required time for writing the outputfile: ..................      0.02 min
Required total time: .......................................      0.87 min
Required total CPU-time: ...................................     50.93 sec
```