

```

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AVL - B O O S T
Version : v2013.2.0.0.0
Build:   Nov 11 2013 16:58:06
System:  ia32-unknown-winnt_i11
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```

LICENSE

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Boost Main 2013.0@ License will expire in 240 days

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PROJECT

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Preprocessor Version : 2013.2
Calculation date    : 05.06.2014
File               : RCCI_new.bst
Case Set          : Case Set
Case              : Case

Project ID: ""
Run ID:      ""
Model date: "11. Dec 2013 10:12:07"

```

ELEMENTS

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Element Name      Number

PIPE              9
SYSTEMBOUNDARY    2
PLENUM            1
CYLINDER          1
RESTRICTION       4
FUELINJECTOR      1
MEASURINGPOINT    9
AIRCLEANER        1
ENGINE            1
PIPE_END          20
ASSEMBLED         1
ALL_PIPES         10
ALL_PLENUMS       3
ALL_BOUNDARIES    2
RESTRICTIONS      5
ALL_PIDS          1
PIPE_VAR_WALL_TEMP 10

```

GLOBAL DATA

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Engine Speed :      2000.0 rpm
Calculationmode:    BOOST Single
Cycle Duration:     720.00 degrees
Max. calc. period:  7200.00 degrees
Cycles calculated:   10 cycles
Calc. time steps:   1.00000 degrees (max)
                   1.00000 degrees
                   0.08333 ms
                   0.50000 degrees (short pipe)
                   0.04167 ms (short pipe)
Traces results step: 3.00000 degrees
Ref. pressure:     100000.00 Pa
Ref. temperature:  298.000 K
Gas properties:    Variable
General Species Transport Calculation
Number of Species: 13

```

ketqua_RCCI4.txt

Species No. 1 is: DIESEL
 Species No. 2 is: GASOLINE
 Species No. 3 is: O2
 Species No. 4 is: N2
 Species No. 5 is: H2
 Species No. 6 is: CO2
 Species No. 7 is: H2O
 Species No. 8 is: CO
 Species No. 9 is: O
 Species No. 10 is: NO
 Species No. 11 is: H
 Species No. 12 is: N
 Species No. 13 is: OH

Multiple Fuel Species:

Fuel Species No. 1 is: DIESEL

with ratio: 0.999

Fuel Species No. 2 is: GASOLINE

with ratio: 0.001

Lower calorific: 0.42803E+08 J/kg

Stoic. A/F-ratio: 15.169

Warnings: 4

Convergence errors: 0

PIPES

Total number of pipe cells: 11

Pipe Coeff. nr.	Cells Heat nr.	Cell size Factor [mm]	Volume [dm3]	W.Heat [kJ]	Wall T [K]	Fric. coeff. [-]	Lam. Fric.
1	1	110.0	0.000	298.00	0.019000		
64.000000	1.000000	1.460055					
2	1	120.0	0.000	302.15	0.019000		
64.000000	1.000000	0.887626					
3	1	100.0	0.000	302.15	0.019000		
64.000000	1.000000	0.145299					
4	1	75.0	0.000	302.15	0.019000		
64.000000	1.000000	0.103908					
5	1	75.0	0.000	298.00	0.019000		
64.000000	1.000000	0.103908					
6	1	75.0	0.001	360.00	0.019000		
64.000000	1.000000	0.086001					
7	1	55.0	-0.003	500.00	0.019000		
64.000000	1.000000	0.051426					
8	2	90.0	-0.009	500.00	0.019000		
64.000000	1.000000	0.173180					
9	2	85.0	-0.012	450.00	0.019000		
64.000000	1.000000	0.163559					
10	1	65.0	0.000	300.00	15.950260		
521528.892305	0.000000	0.100000	FILTER_PIPE	1			

MEASURINGPOINTS: Average Values

Mp. To.Ent.f. nr.	Pipe nr.	Location To.Ent.f. [mm]	Diameter Mach. [mm]	Pressure Wtemp. [bar]	Temp. Converg. [K]	Ms.Temp. [K]	Velo. [m/s]	Massflow [g/s]	Massflow [g/cycle]
1	1	110.0000	130.0000	1.0300	298.0	298.0	0.5	8.5211	0.5113
-0.001		-0.0001	0.00	298.0	0.134E-05				
2	2	120.0000	44.0000	1.0186	301.1	297.7	4.9	8.5260	0.5116
-0.002		-0.0001	0.01	302.2	0.739E-05				

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3	3	100.0000	42.0000	1.0184	301.2	297.5	5.4	8.5248	0.5115
-0.003	-0.0002	0.02	302.2	0.689E-05					
4	4	75.0000	42.0000	1.0183	301.2	297.5	5.4	8.5220	0.5113
-0.002	-0.0001	0.02	302.2	0.761E-05					
5	5	75.0000	42.0000	1.0183	303.1	297.5	5.4	8.5420	0.5125
-0.028	-0.0017	0.02	298.0	0.147E-04					
6	6	75.0000	34.0000	1.0171	309.2	297.9	8.3	8.5326	0.5120
-0.029	-0.0017	0.02	360.0	0.670E-06					
7	7	55.0000	35.0000	1.0104	689.3	784.3	20.1	9.0127	0.5408
-17.046	-1.0228	0.04	500.0	0.385E-05					
8	8	180.0000	35.0000	1.0106	733.7	771.9	19.7	9.0173	0.5410
-17.169	-1.0302	0.04	500.0	0.809E-06					
9	9	170.0000	35.0000	1.0041	766.1	752.4	19.9	9.0175	0.5411
-17.303	-1.0382	0.04	450.0	0.375E-06					

SYSTEMBOUNDARIES Attachments

Type	Nr.	Pipe Nr.	Mass flow [g/cycle]
SYSTEMBOUNDARY	1	1	0.5113
SYSTEMBOUNDARY	2	9	0.5411

PLENUMS: Average Values

	Pl. nr.	Pressure [bar]	Temp. [K]	Mass [g]	Wallheat [kJ]	
PLENUM	1	1.0101	760.96	0.823	0.000	
				Attached pipe 8:		0.5411 g/cycle
AIRCLEANER	1	1.0300	298.13	2.157	0.000	0.5411 g/cycle
				Attached pipe 1:		0.5113 g/cycle
AIRCLEANER	1	1.0193	301.15	1.409	0.000	0.5113 g/cycle
				Attached pipe 2:		0.5116 g/cycle
				Attached pipe 10:		0.5113 g/cycle

PLENUMS Attachments

Type	Nr.	Pipe Nr.	Mass flow [g/cycle]
PLENUM	1	8	0.5411
PLENUM	1	9	0.5411
AIRCLEANER	1	1	0.5113
AIRCLEANER	1	10	0.5113
AIRCLEANER	1	2	0.5116
AIRCLEANER	1	10	0.5113

CYLINDERS: Average Values

	Total Engine	Cyl. 1
Firing TDC [deg]		0.00
Bore [mm]		85.00
Stroke [mm]		90.00
Conrod1. [mm]		148.00
Piston pin offset [mm]		0.01
Swept Vol. [l]	0.5107	0.5107
Compression ratio [-]		16.10
Dyn. Comp. ratio [-]		14.74

Combustion Data:

ketqua_RCCI4.txt

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-----
Combustion Char.                               AVL-MCC
Comb.start [deg]                               -28.00
Comb.dur.1 [deg]                               156.00
Peak Fir.Pres. [bar]                           95.13      95.13
at Crankangle [deg]                           8.00      8.00
Peak Pres.Rise [bar/deg]                       8.07      8.07
at Crankangle [deg]                           2.00      2.00
Peak Fir. Temp. [K]                           2268.07    2268.07
at Crankangle [deg]                           12.50     12.50
Peak T_burned [K]                             2724.39    2724.39
at Crankangle [deg]                           4.50      4.50
Res. Gascompr. [bar]                           1.06      1.06
at Crankangle [deg]                           311.50    311.50

```

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).

```

General Species Transport: The emissions results displayed in this section are NOT based on the calculated species mass fractions in the cylinder(s).

```

NOX [g/kWh]      10.992232    10.992232
NOX [g/h]        80.275850    80.275850
NOX [ppm]        2362.04     2362.04
CO [g/kWh]       0.038356     0.038356
CO [g/h]         0.236995     0.236995
CO [ppm]         7.47        7.47
Soot [g/kWh]     1.403074     1.403074

```

Emissions (General Species Transport):

The emissions results displayed in this section are the calculated species mass/mole fractions in the cylinder(s) at End of High Pressure.

```

MassFrac DIESEL [-]      0.002583    0.002583
MassFrac GASOLINE [-]    0.000003    0.000003
MassFrac O2 [-]         0.035253    0.035253
MassFrac N2 [-]         0.726167    0.726167
MassFrac H2 [-]         0.000022    0.000022
MassFrac CO2 [-]        0.159460    0.159460
MassFrac H2O [-]        0.075531    0.075531
MassFrac CO [-]         0.001474    0.001474
MassFrac O [-]          0.000000    0.000000
MassFrac NO [-]         0.000000    0.000000
MassFrac H [-]          0.000001    0.000001
MassFrac N [-]          0.000000    0.000000
MassFrac OH [-]         0.000000    0.000000

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-----
MoleFrac DIESEL [-]      0.000738    0.000738
MoleFrac GASOLINE [-]    0.000001    0.000001
MoleFrac O2 [-]         0.031541    0.031541
MoleFrac N2 [-]         0.742125    0.742125
MoleFrac H2 [-]         0.000311    0.000311
MoleFrac CO2 [-]        0.103731    0.103731
MoleFrac H2O [-]        0.120030    0.120030
MoleFrac CO [-]         0.001506    0.001506
MoleFrac O [-]          0.000000    0.000000
MoleFrac NO [-]         0.000000    0.000000
MoleFrac H [-]          0.000017    0.000017
MoleFrac N [-]          0.000000    0.000000
MoleFrac OH [-]         0.000000    0.000000

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Performance:

IMEP [bar]	9.0959	9.0959
Rel. to Ave. [-]		1.0000
IMEP Exh. [bar]	-1.0470	-1.0470
IMEP Int. [bar]	0.9053	0.9053
IMEP Gasex. [bar]	-0.1417	-0.1417
IMEP HP [bar]	9.2377	9.2377
FMEP [bar]	1.8368	1.8368
BMEP [bar]	7.2591	7.2591
AMEP;SMEP [bar]	0.0000	0.0000
ISFC [g/kWh]	231.8264	231.8264
Rel. to Ave. [-]		1.0000
ISFC (tr.f.) [g/kWh]	231.8264	231.8264
BSFC [g/kWh]	290.4878	290.4878
Indicated Eff. [-]	0.3628	0.3628
Iso vol. comb. Eff [-]	0.9620	0.9620
Polytropic Coeff. [-]		1.3511

Fuel Mass Balance:

Inj. Fuelmass [g]	0.028450	0.028450
Asp.Trap. Fuelmass [g]	0.001464	0.001464
Fuelmassfl.(A+I) [g/s]	0.498570	0.498570
Fuelmass tot.trap. [g]	0.029914	0.029914
Trapped Fuelm.fl.[g/s]	0.498570	0.498570
Trapp. Eff. Fuel [-]	1.0000	1.0000

Energy Balance Cylinder:

Fuel Energy [kJ]	1.23416	1.28042
Released Energy [kJ]	1.23416	1.23416
-> Brake Power [%]	30.039	30.039
-> Loss: Friction [%]	7.601	7.601
-> Loss: Piston [%]	16.942	16.942
-> Loss: Head [%]	13.572	13.572
-> Loss: Liner [%]	5.285	5.285
-> Loss: Int. Port [%]	-0.212	-0.553
-> Loss: Exh. Port [%]	0.727	-6.524
-> Loss: Exh. Gas [%]	26.427	26.427
Eff. Rel. Energy [kJ]	1.23416	1.23416
Gross Rel. Energy [kJ]	1.23416	1.23416
Eff.Gross Rel.Ener.[kJ]	1.23416	1.23416
Energy Balance [-]	1.0079	0.9715
Eff. Energy Balance [-]	1.0000	0.9639

Blowby:

Blowbymass [g]	0.000000	0.000000
Blowbymassfl. [g/s]	0.000000	0.000000
Blowby Heat Flow [kJ]	0.000000	0.000000

Reference Values at SHP:

Pressure at SHP[bar]	1.1733	1.1733
Temperature [K]	366.56	366.56
Air Massfl. [g/s]	8.504233	8.504233
Fuel Massfl. [g/s]	0.498570	0.498570
Trapp. Eff. Air [-]	1.0025	1.0025
Trapp. Eff.Fuel [-]	1.0000	1.0000
A/F-Ratio (Cmb.) [-]	17.15	17.15
Excess Air Ratio [-]	1.1308	1.1308

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Residual Gas:

Res.gas content [-]	0.0317	0.0317
External EGR [-]	0.0006	0.0006
Internal EGR [-]	0.0311	0.0311
Com.Prod.Mass. at E0 [g]	0.524125	0.524125
Res.gas mass at SHP [g]	0.016786	0.016786
Res.gas aspirated IN [g]	0.000296	0.000296
Res.gas from intake [g]	0.000296	0.000296
Rel. to Total [-]	0.0177	0.0177
Res.gas flow EX [g]	0.507347	0.507347
Res.gas from exhaust [g]	0.000645	0.000645
Rel. to Total [-]	0.0384	0.0384

Gas Exchange:

Volumetric Eff. [-]	0.8677	0.8677
Rel. to Ave. [-]		1.0000
Rel. To MP 3 [-]	0.8612	0.8612
Total Mass at SHP [g]	0.5298	0.5298
Mass Delivered [g]	0.51197	0.51197
Mass Delivered [g/s]	8.53281	8.53281
Delivery Ratio [-]	0.8685	0.8685
Rel. to Ave. [-]		1.0000
Rel. To MP 3 [-]	0.8620	0.8620
Av.Airmass at SHP [g]	0.5131	0.5131
Air Delivered [g]	0.51025	0.51025
Air Delivered [g/s]	8.50423	8.50423
Airdeliveryratio [-]	0.8656	0.8656
Rel. to Ave. [-]		1.0000
Rel. To MP 3 [-]	0.8591	0.8591
Airmass Trapped [g]	0.51153	0.51153
Airmass Trapped [g/s]	8.52549	8.52549
Trapp. Eff. Air [-]	1.0025	1.0025
Rel. to Ave. [-]		1.0000
Airpurity [-]	0.9685	0.9685
Dyn. Swirl [-]	0.0000	0.0000
Dyn. Tumble [-]	0.0000	0.0000

Wall Heatlosses:

Piston [kJ]	-0.2091	-0.2091
Cylinderhead [kJ]	-0.16750	-0.16750
Cylinderliner [kJ]	-0.06522	-0.06522
Sum of Wallheat [kJ]	-0.44181	-0.44181
Wall Heatlosses in High Pressure Phase:		
Piston HP [kJ]	-0.20590	-0.20590
Cylinderhead HP [kJ]	-0.16303	-0.16303
Cylinderliner HP [kJ]	-0.04329	-0.04329
Sum of Wallheat HP [kJ]	-0.41222	-0.41222
Wall Heatlosses Related to Heatinput:		
Piston [-]	-0.1633	-0.1633
Cylinderhead [-]	-0.1308	-0.1308
Cylinderliner [-]	-0.0509	-0.0509
Sum of Wallheat [-]	-0.3451	-0.3451
M. Eff. HTC [W/m ² /K]	369.89	369.89
M. Eff. Temp. [K]	1272.19	1272.19

Reference Values at E0:

Pressure [bar]	3.67	3.67
Temperature [K]	1069.19	1069.19
A/F-Ratio [-]	16.83	16.83

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Com.Prod.Conc. [-]	0.93834	0.93834
Fuel Concentr. [-]	0.002586	0.002586

Average Values of Pipeattachments:

Attached Pipe	6
Vlv/Prt.Op.Clr.0mm[deg]	298.88
Vlv/Prt.Op.Eff.0mm[deg]	345.26
Vlv/Prt.Op.Eff.1mm[deg]	370.20
Vlv/Prt.Op.Udef.mm[deg]	345.26
Vlv/Prt.Cl.Clr.0mm[deg]	626.12
Vlv/Prt.Cl.Eff.0mm[deg]	580.56
Vlv/Prt.Cl.Eff.1mm[deg]	554.64
Vlv/Prt.Cl.Udef.mm[deg]	580.56
Cam Phasing [deg]	0.00
Massflow [g/cycle]	0.511968
Wallheat [kJ/cycle]	0.002613
rel.to Heatinp.[-]	0.0020
Attached Pipe	7
Vlv/Prt.Op.Clr.0mm[deg]	80.00
Vlv/Prt.Op.Eff.0mm[deg]	128.00
Vlv/Prt.Op.Eff.1mm[deg]	153.77
Vlv/Prt.Op.Udef.mm[deg]	128.00
Vlv/Prt.Cl.Clr.0mm[deg]	425.00
Vlv/Prt.Cl.Eff.0mm[deg]	380.57
Vlv/Prt.Cl.Eff.1mm[deg]	352.79
Vlv/Prt.Cl.Udef.mm[deg]	380.57
Cam Phasing [deg]	0.00
Massflow [g/cycle]	0.540763
Wallheat [kJ/cycle]	-0.008973
rel.to Heatinp.[-]	-0.0070

FLOWRESTRICTIONS: Average Values

Flr. nr.	Att.Pi. number	Massflow [g/cycle]	Att.Pi. number	Massflow [g/cycle]
1	2	0.5118	3	0.5115
2	3	0.5116	4	0.5113
3	5	0.5126	6	0.5120
4	7	0.5410	8	0.5410

FUELINJECTORS: Average Values

Inj. nr.	Att.Pi. number	Massflow [g/cycle]	Att.Pi. number	Massflow [g/cycle]	Added Fuel [g/cycle]
1	4	0.5114	5	0.5125	0.0015

ASSEMBLED: Average Values

Type	Nr.	-----Inlet-----			-----Outlet-----			
-----Core-----								
Rej.Heat [kW]	Rej.Heat [kW]	Pressure [bar]	Temperat. [K]	Mass Heat Factor [g]	Pressure [bar]	Temperat. [K]	Mass [g]	
AIRCLEANER	1	1.0300	298.13	2.157	1.0193	301.15	1.409	
0.0000	0.0000	15.950260	0.000000					

ASSEMBLED Attachments

Type	Nr.	Pipe Nr.	Mass flow [g/cycle]
------	-----	----------	---------------------

ketqua_RCCI4.txt

AIRCLEANER	1	1	0.5113
AIRCLEANER	1	2	0.5116

OVERALL ENGINE PERFORMANCE:

=====

Indicated Torque	:	36.97 Nm		Indicated Specific
Torque :	72.38 Nm/l			
Indicated Power	:	7.74 kW,	10.53 PS	Indicated Specific Power
:	15.16 kW/l,	20.61 PS/l		
Friction Torque	:	7.47 Nm		Friction Power
:	1.56 kW			
Effective Torque	:	29.50 Nm		Effective Specific
Torque :	57.77 Nm/l			
Effective Power	:	6.18 kW,	8.40 PS	Effective Specific Power
:	12.10 kW/l,	16.45 PS/l		

Required time for reading the inputfile and initialisation:	0.00 min
Required time for the calculation:	0.68 min
Required time for writing the outputfile:	0.02 min
Required total time:	0.70 min
Required total CPU-time:	41.17 sec