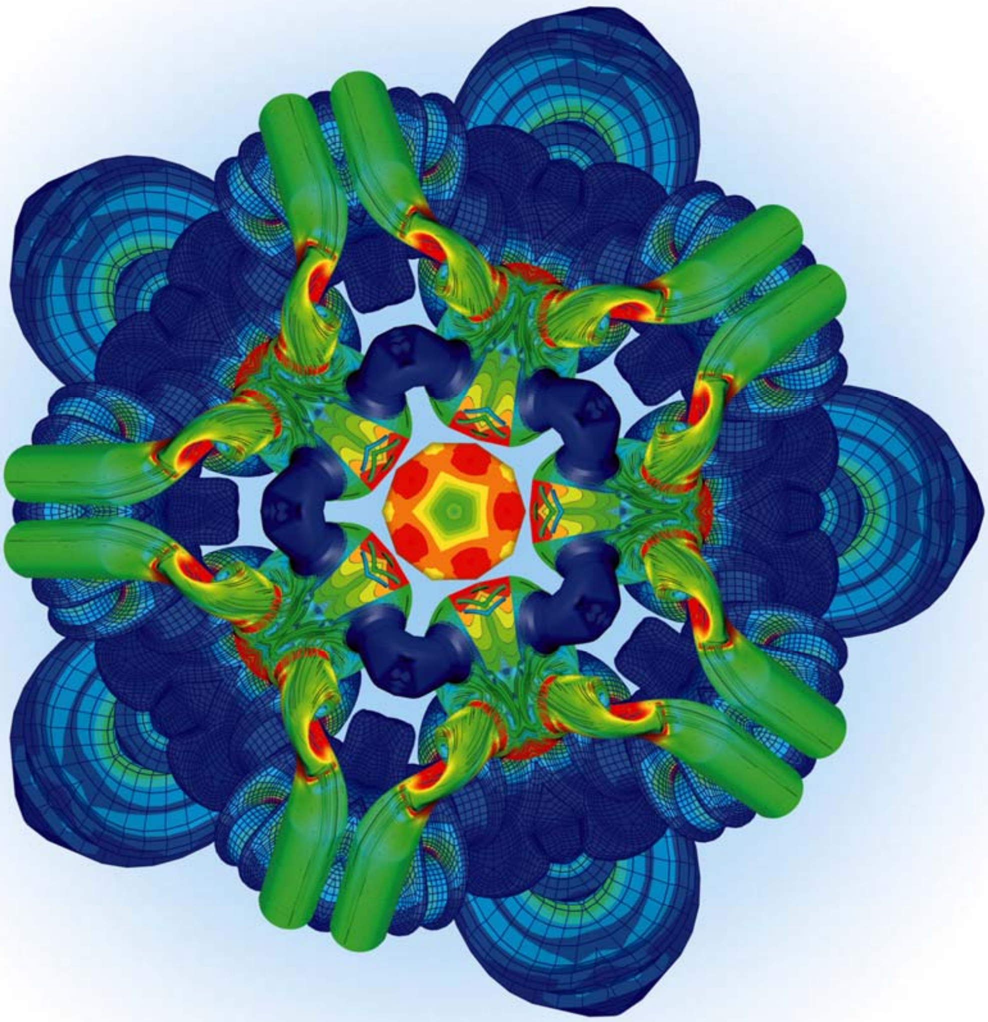
Edition 10/2010

Primer

AVL BOOST
VERSION 2010



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Revision	Date	Description	Document No.
A	17-Jul-2009	BOOST v2009 – Primer	01.0103.2009
B	19-Nov-2010	BOOST v2010 – Primer	01.0103.2010

This document describes how to run the BOOST software. It does not attempt to discuss all the concepts of 1D gas dynamics required to obtain successful solutions. It is the user's responsibility to determine if he/she has sufficient knowledge and understanding of gas dynamics to apply this software appropriately.

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1. INTRODUCTION

This manual describes how to use BOOST to model a single cylinder four stroke engine. Its purpose is to demonstrate concepts and methods through example investigations.

1.1. Scope

This manual describes an example of using BOOST to create an engine model. It does not attempt to discuss all the concepts of gas dynamics required to obtain successful solutions. It is the user's responsibility to determine if he/she has sufficient knowledge and understanding of fluid dynamics to apply this software appropriately.

1.2. User Qualifications

This document is a basic qualification for using BOOST and users are recommended to continue with basic and advanced training courses.

1.3. Symbols

The following symbols are used throughout this manual. Safety warnings must be strictly observed during operation and service of the system or its components.

⚠ **Caution:** Cautions describe conditions, practices or procedures which could result in damage to, or destruction of data if not strictly observed or remedied.

☞ **Note:** Notes provide important supplementary information.

Convention	Meaning
Italics	For emphasis, to introduce a new term or for manual titles.
`monospace`	To indicate a command, a program or a file name, messages, input / output on a screen, file contents or object names.
MenuOpt	A **MenuOpt** font is used for the names of menu options, submenus and screen buttons.

1.4. Configurations

Software configurations described in this manual were in effect on the publication date. It is the user's responsibility to verify the configuration of the equipment before applying procedures.

1.5. Documentation

BOOST documentation is available in PDF format and consists of the following:

BOOST
Release Notes
Users Guide
Primer
Examples
Theory
Aftertreatment
Aftertreatment Primer
Linear Acoustics
1D-3D Coupling
Interfaces
Validation
BOOST Hydsim
Release Notes
Users Guide
Primer
BOOST Real-Time (RT)
Release Notes
Users Guide
BOOST Thermal Network Generator (TNG)
Users Guide
Primer
AVL Workspace (AWS)
Release Notes
GUI Users Guide
Python Scripting
DoE and Optimization
Installation Guide
Licensing Users Guide
System Requirements and Supported Platforms

Known Issues are available on the AST Service World – Knowledge Base:

Link to AWS Known Software Issues

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Your comments and suggestions help us to improve the quality and practical relevance of our documentation.

If you have any suggestions for improvement, please send them to:
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We look forward to hearing from you.

2. SINGLE CYLINDER ENGINE

This chapter describes how to create and run the model of a single cylinder four stroke gasoline engine. The `4t1calc.bwf` file is used in this example.

The `4t1calc_species.bwf` example is available using the **General Species Transport** option. The setup is identical to the `4t1calc.bwf` except that the general species transport option is used. This is described in section 2.7.

It is recommended to refer to the BOOST Users Guide for more detailed information.

2.1. Pre-processing Project Structure

For post-processing and in particular for the support of case sets and cases in IMPRESS Chart, result files must be loaded from a specific project structure (lower case).

First create a project directory, then the client directory where the model is stored. The results directories and files are created automatically.

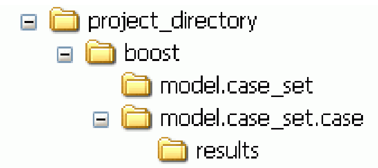

Figure 2-1: Project Structure

2.2. Design the Model

The model can be designed by placing the elements in the working area first and then connecting them with the pipes. Alternatively elements can be placed in the required order.

The model consists of the following elements:

- 1 Engine E
- 1 Cylinder C
- 1 Air Cleaner CL
- 1 Catalyst CAT
- 1 Injector I
- 2 System Boundaries SB
- 3 Plenums PL
- 3 Restrictions R
- 10 Measuring Points MP
- 12 Pipes Numbers

The following figure displays the created model:

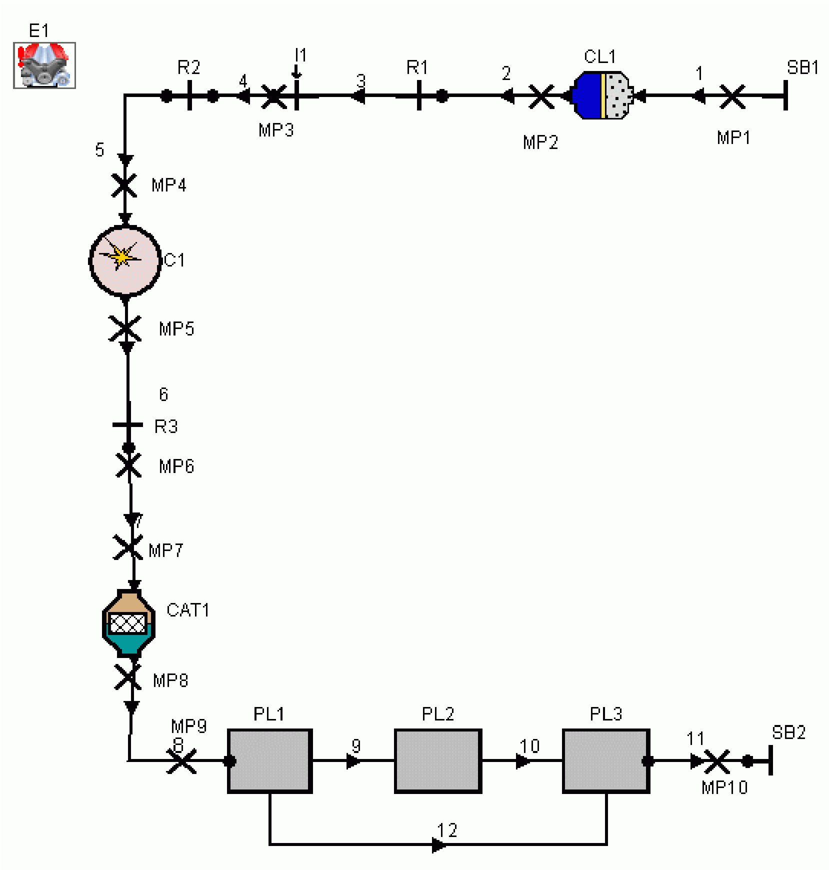

Figure 2-2: Single Cylinder Model

Double-click the required element in the Element tree with the left mouse button to display it in the working area. Move the displayed element to the desired location with the left mouse button. Select  to insert a pipe and attach it to the required elements by clicking on the activated circles (triangles for the cylinder).

2.3. General Input Data

BOOST requires the specification of the general input data prior to the input of any element.

The global input data must be defined first. Select **Simulation | Control** to open the following window.

1. **SIMULATION TASKS**

   Click on the **Simulation Tasks** sub-group folder in the tree and select **Cycle Simulation**.

2. CYCLE SIMULATION

Click on the **Cycle Simulation** sub-group folder in the tree to access the following window:

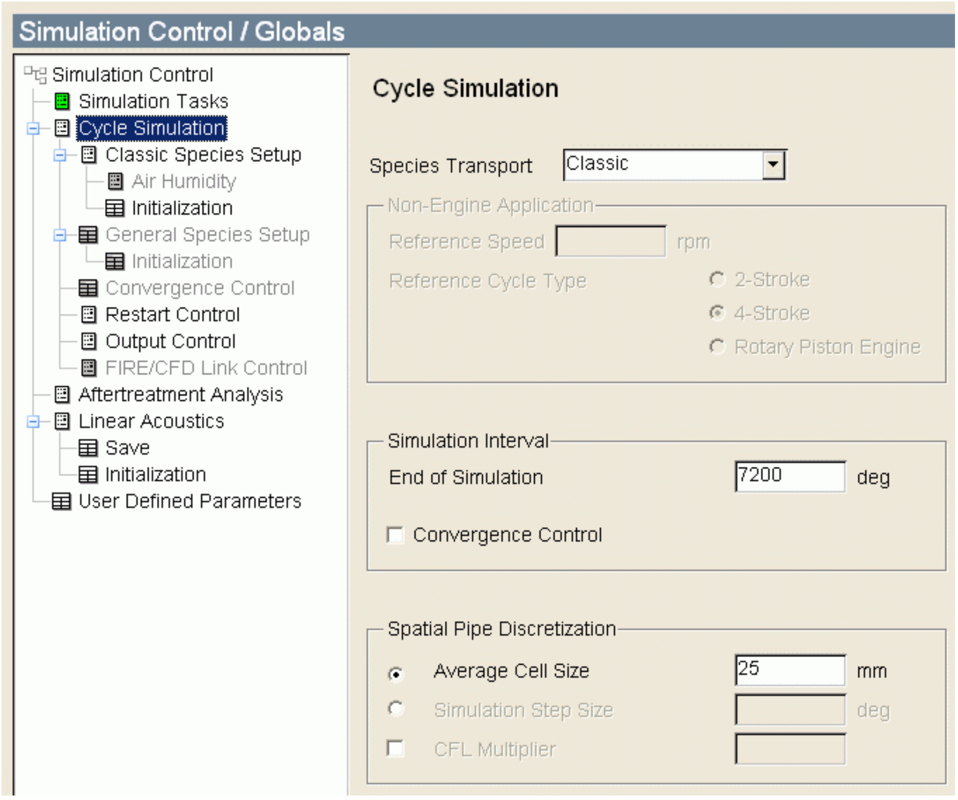

Figure 2-3: Simulation Control / Cycle Simulation Window

Enter the following data:

Species Transport: Classic (default)

Simulation Interval

End of Simulation 7200 deg

Spatial Pipe Discretization

Average Cell Size 25 mm

Note: Non-Engine Application is deactivated when the Engine element is introduced.

3. CLASSIC SPECIES SETUP

Click on the **Classic Species Setup** sub-group folder to access the following window. The input values used are default.

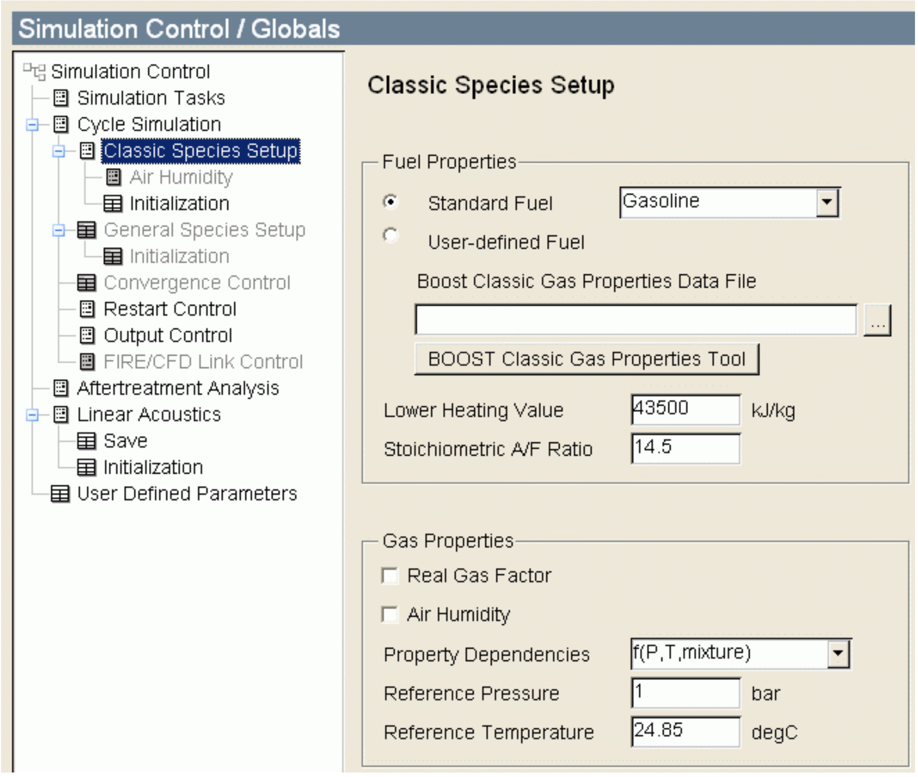

Figure 2-4: Classic Species Setup Window

4. INITIALIZATION

Click on the **Initialization** sub-group folder to access the Initialization window.

Select **A/F-Ratio** from the **Ratio** pull-down menu.

Select **Add Set** and enter the data in the input fields for each set.

Set	Pressure (bar)	Temp (degC)	Fuel Vapour	Combustion Products	A/F Ratio
1	0.97	24.85	0	0	10000
2	0.95	24.85	0.074	0	10000
3	1.1	826.85	0	1	13.54
4	1.05	626.85	0	1	13.54

5. **RESTART CONTROL**

Click on the **Restart Control** sub-group folder to access the following window.

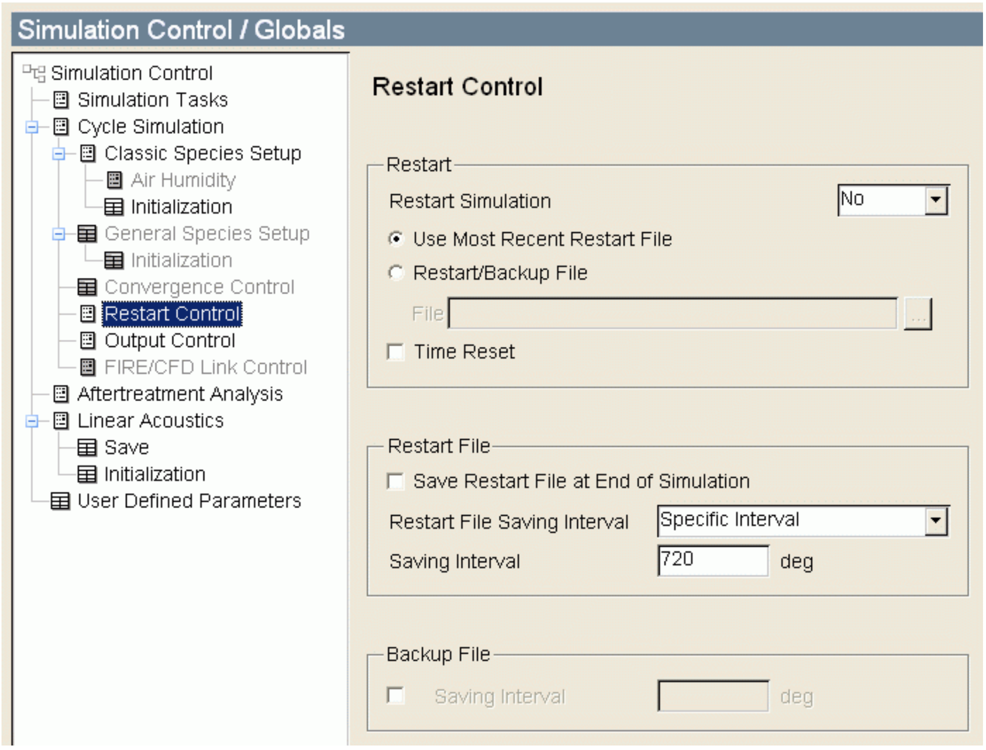

Figure 2-5: Restart Control Window

Select **Specific Interval** from the **Restart File Saving Interval** pull-down menu and enter `720` deg for **Saving Interval**.

6. **OUTPUT CONTROL**

Click on the **Output Control** sub-group folder and enter `3` deg for **Saving Interval**.

Click **OK**.

2.4. Element Input Data

Select the displayed element with the right mouse button and select **Properties** from the submenu to open the relevant data input window. Alternatively double click on the element with the right mouse button.

Data can be copied from the selected source element(s) to the target element(s) by selecting **Element|Copy Data**.

2.4.1. Engine

1. **GENERAL**

Click on the **Engine** element to open the following window:

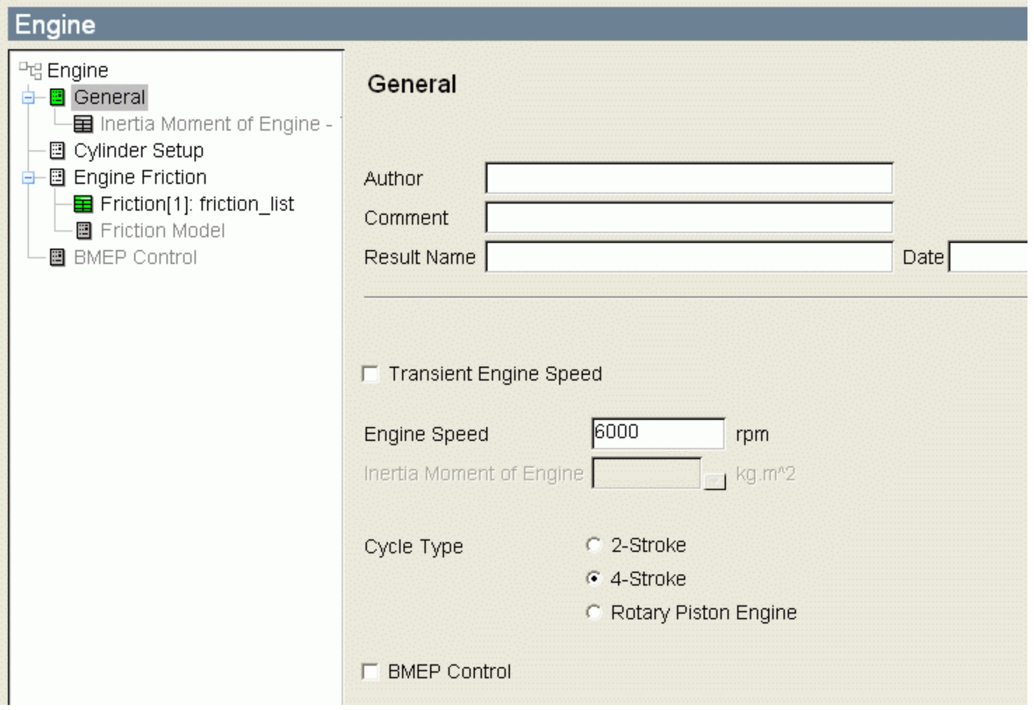

Figure 2-6: Engine - General Window

Enter 6000 rpm for **Engine Speed**.

2. **ENGINE FRICTION**

In the **Engine Friction** sub-group folder, **Table** is selected as default. Click on the **Engine Friction[1]: friction_list** sub-group folder to show the following window.

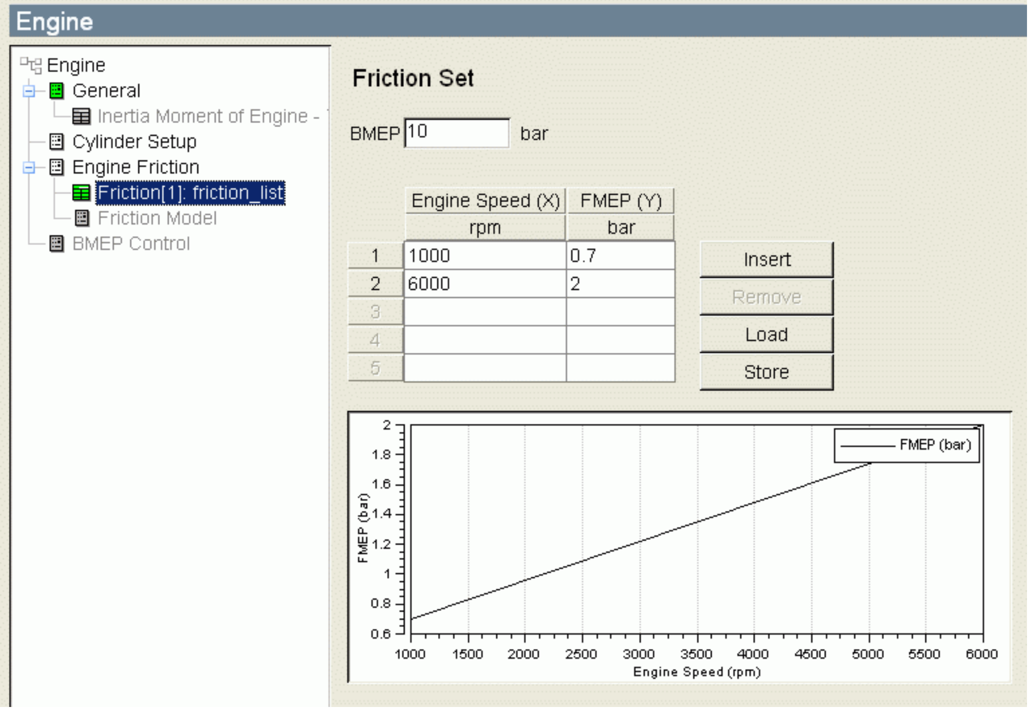

Figure 2-7: Engine - Friction Window

Enter the following data:

BMEP: 10 bar

Engine Speed (X) rpm	FMEP (Y) bar
1000	0.7
6000	2

Click **OK**.

2.4.2. Cylinder

1. **GENERAL**

Click on the **Cylinder** element to open the following window:

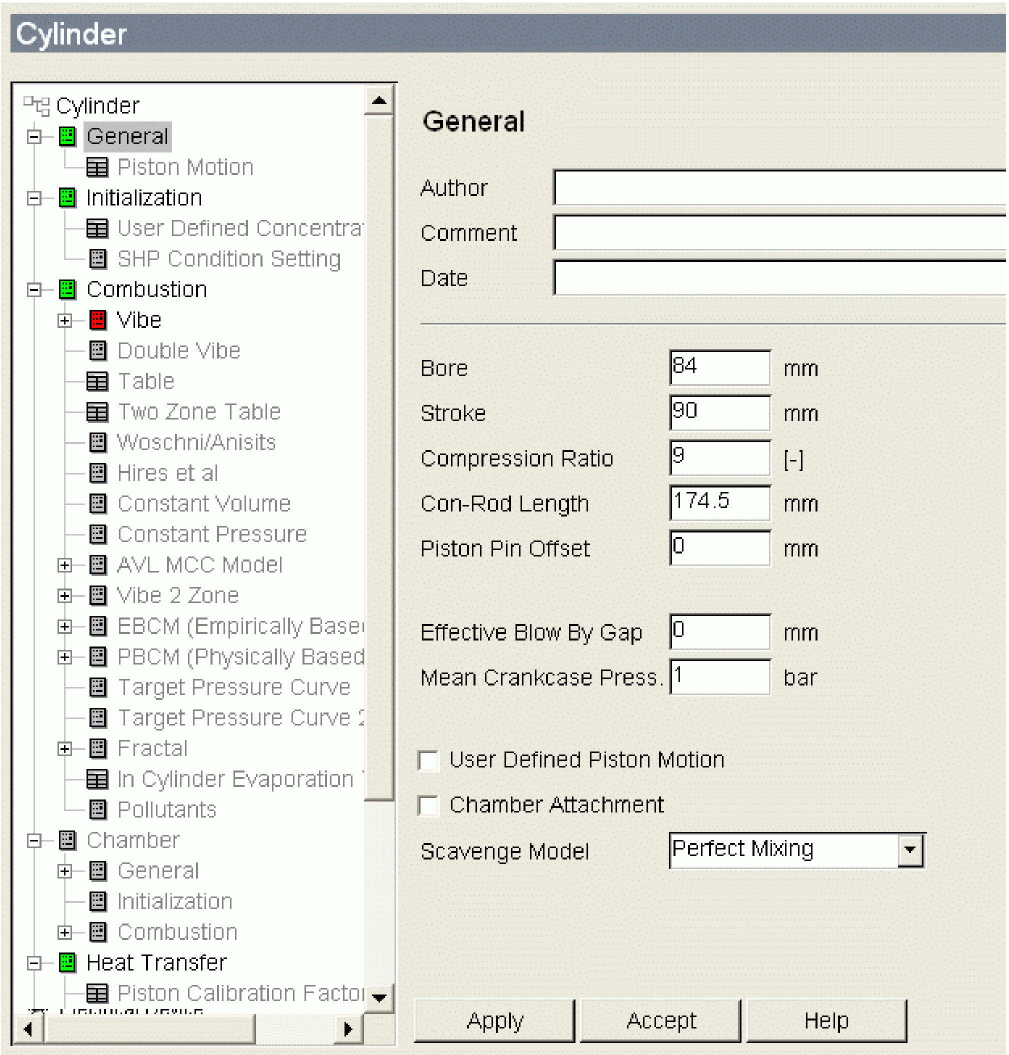

Figure 2-8: Cylinder General Window

Enter the following data:

Bore:	84 mm
Stroke:	90 mm
Compression Ratio:	9
Con-rod Length:	174.5 mm
Piston Pin Offset:	0 mm
Effective Blow by Gap:	0 mm
Mean Crankcase Press:	1 bar
Scavenge Model:	Perfect Mixing

2. **INITIALIZATION**

Click on the **Initialization** sub-group folder to show the following window:

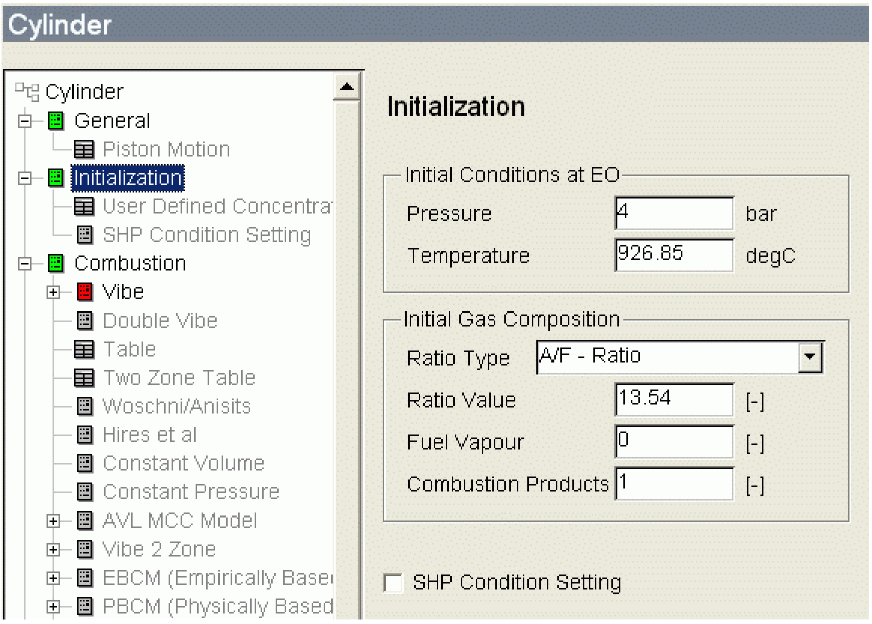

Figure 2-9: Cylinder Initialization Window

Enter the following data:

Initial Conditions at EO (Exhaust Valve Opening)

Pressure:	4 bar
Temperature:	926.85 degC

Initial Gas Composition

Ratio Type:	A/F Ratio
Ratio Value:	13.54
Fuel Vapour:	0
Combustion Products:	1

3. **COMBUSTION**

Click on the **Combustion** sub-group folder and select **Vibe** from the pull-down menu for Heat Release.

Click on the **Vibe** sub-group folder to show the following window:

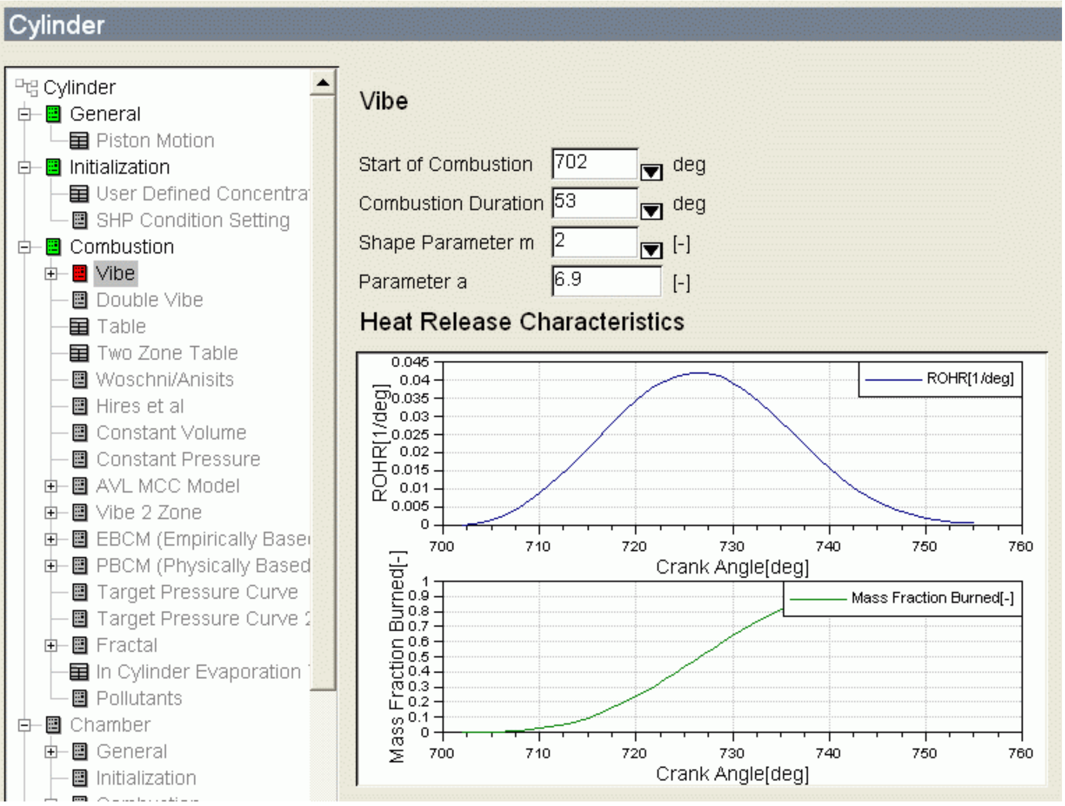

Figure 2-10: Cylinder - Vibe Window

Enter the following data:

Start of Combustion:	702 deg
Combustion Duration:	53 deg
Shaping Parameter m	2
Parameter a	6.9

4. HEAT TRANSFER

Click on the **Heat Transfer** sub-group folder to show the following window:

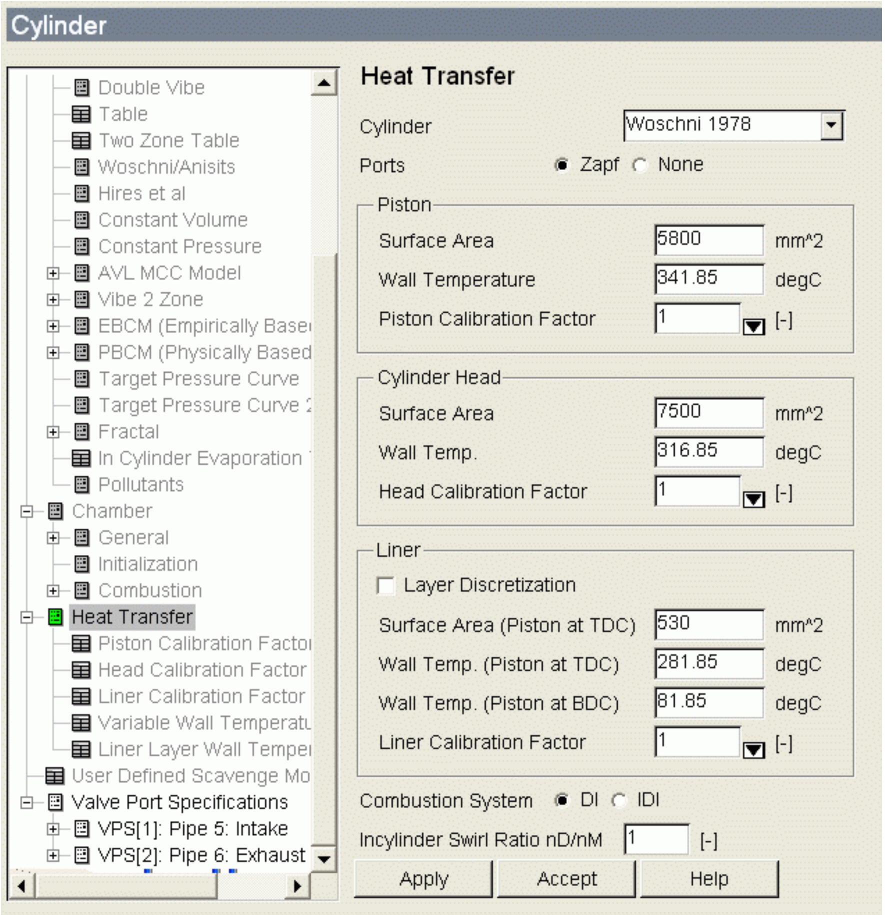

Figure 2-11: Cylinder Heat Transfer Window

Enter the following data:

Cylinder:	Woschni 1978	
Ports:	Zapf	
Piston:		
Surface Area:	5800 mm^2	
Wall Temperature:	341.85 degC	
Piston Calibration Factor:	1	
Cylinder Head:		
Surface Area:	7500 mm^2	
Wall Temperature:	316.85 degC	
Head Calibration Factor:	1	
Liner:		
Surface Area:	530 mm^2	(Piston at TDC)
Wall Temperature:	281.85 degC	(Piston at TDC)
Wall Temperature:	81.85 degC	(Piston at BDC)

Liner Calibration Factor: 1

Combustion System DI

Incylinder Swirl Ratio: 1

5. VALVE PORT SPECIFICATIONS

Click on the **Valve Port Specification** sub-group folder and enter the following data:

Controlled by		Port	
Pipe	**Control**	**Surface Area mm^2**	**Wall Temp degC**
5	Valve	15800	126.85
6	Valve	5840	306.85

Click on the **VPS [1]: Pipe 5: Intake** sub-group folder and then click on **Valve Controlled** to access the following input fields:

Inner Valve Seat (=Reference) Diameter 40 mm

Valve Clearance 0.2 mm

Scaling Factor for Eff. Flow Area 1.384

Click on **Lift Curve** to open the following window and enter the relevant data:

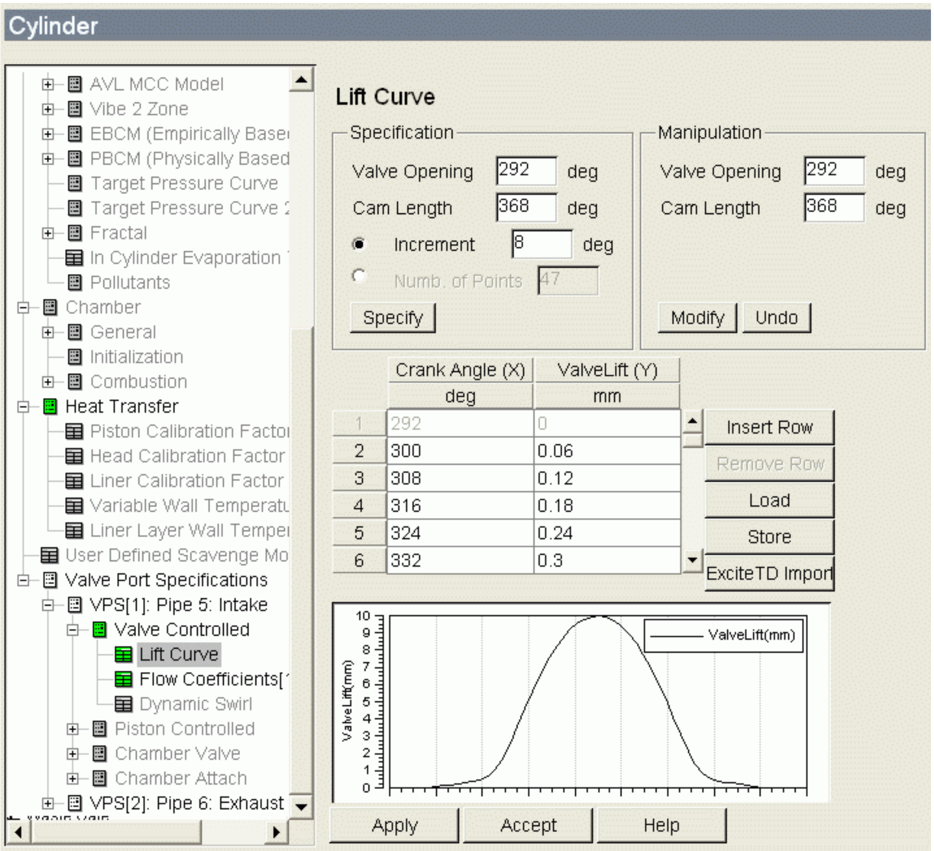

Figure 2-12: Lift Curve Window

Specification		Manipulation	
Valve Opening	292 deg	**Valve Opening**	292 deg
Cam Length	368 deg	**Cam Length**	368 deg
Increment	8 deg		

Refer to the Table on page 2-14 for **Crank Angle** and **Valve Lift** input data for Intake Pipe 5 Lift Curve.

Click on **Flow Coefficient** to open the following window and enter the relevant data:

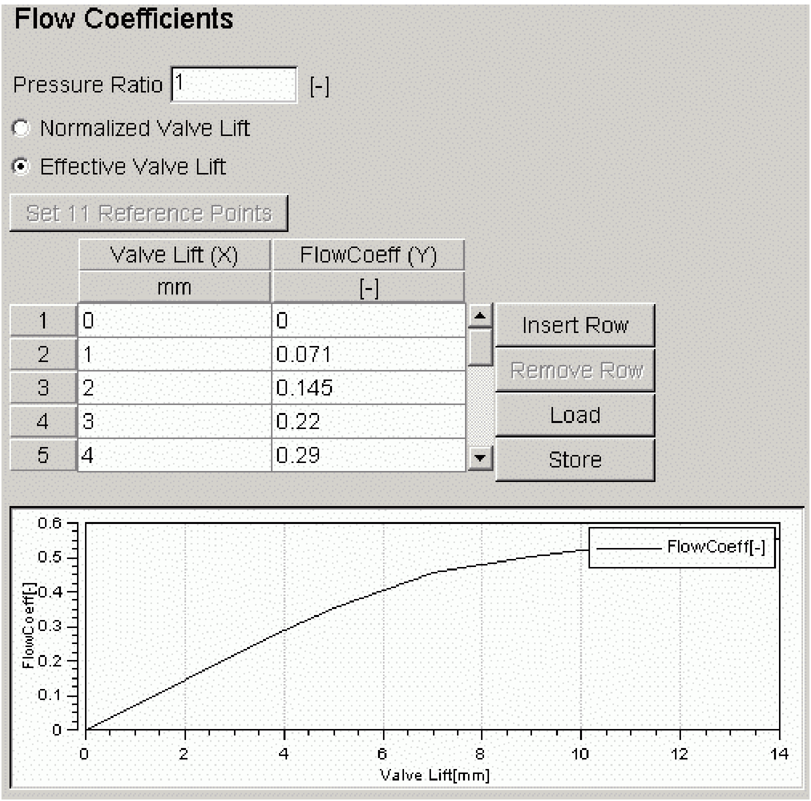

Figure 2-13: Flow Coefficient Window

Pressure Ratio	1
Effective Valve Lift	Activated

Refer to the following Table for **Valve Lift** and **Flow Coefficient** input data for Intake Pipe 5 Flow Coefficient.

Click on the **VPS [2]: Pipe 6 Exhaust** sub-group folder and then click on **Valve Controlled** to access the following input fields:

Inner Valve Seat (=Reference) Diameter	34.8 mm
Valve Clearance	0.3 mm
Scaling Factor for Eff. Flow Area	1.26

Click on **Lift Curve** and enter the relevant data:

Specification		**Manipulation**	
Valve Opening	66 deg	**Valve Opening**	66 deg
Cam Length	368 deg	**Cam Length**	368 deg
Increment	8 deg		

Refer to the following Table for **Crank Angle** and **Valve Lift** input data for Exhaust Pipe 6 Lift Curve.

Click on **Flow Coefficient** and enter the relevant data:

Pressure Ratio 1

Effective Valve Lift Activated

Refer to the following Table for **Valve Lift** and **Flow Coefficient** input data for Exhaust Pipe 6 Flow Coefficient.

Intake Pipe 5				Exhaust Pipe 6			
Lift Curve		Flow Coefficient		Lift Curve		Flow Coefficient	
Crank Angle (X) deg	Valve Lift (Y) mm	Valve Lift (X) mm	Flow Coeff (Y)	Crank Angle (X) deg	Valve Lift (Y) mm	Valve Lift (X) mm	Flow Coeff (Y)
292	0	0	0	66	0	0	0
300	0.06	1	0.071	74	0.06	1	0.093
308	0.12	2	0.145	82	0.12	2	0.18
316	0.18	3	0.22	90	0.18	3	0.262
324	0.24	4	0.29	98	0.24	4	0.341
332	0.3	5	0.355	106	0.3	5	0.405
340	0.36	6	0.405	114	0.36	6	0.458
348	0.44	7	0.455	122	0.44	7	0.501
356	0.65	8	0.48	130	0.65	8	0.526
364	1.04	9	0.501	138	1.04	9	0.542
372	1.69	10	0.52	146	1.69	10	0.551
380	2.57	11	0.532	154	2.57	11	0.559
388	3.59	12	0.54	162	3.59	12	0.56
396	4.63	13	0.546	170	4.63	13	0.56
404	5.61	14	0.552	178	5.61	14	0.56
412	6.53			186	6.53		
420	7.34			194	7.34		
428	8.05			202	8.05		
436	8.66			210	8.66		
444	9.16			218	9.16		

452	9.54			226	9.54		
460	9.8			234	9.8		
468	9.96			242	9.96		
476	9.98			250	9.98		
484	9.9			258	9.9		
492	9.69			266	9.69		
500	9.37			274	9.37		
508	8.92			282	8.92		
516	8.38			290	8.38		
524	7.71			298	7.71		
532	6.95			306	6.95		
540	6.08			314	6.08		
548	5.14			322	5.14		
556	4.11			330	4.11		
564	3.07			338	3.07		
572	2.11			346	2.11		
580	1.33			354	1.33		
588	0.81			362	0.81		
596	0.52			370	0.52		
604	0.4			378	0.4		
612	0.33			386	0.33		
620	0.27			394	0.27		
628	0.21			402	0.21		
636	0.15			410	0.15		
644	0.09			418	0.09		
652	0.03			426	0.03		
660	0			434	0		

2.4.3. Air Cleaner

The data for the air cleaner is listed in the following table. Click on the air cleaner number to access the input fields.

1. **GENERAL**

Click on the **General** sub-group folder and enter the following data:

Geometrical Properties

Total Air Cleaner Volume:	3.1 (l)
Inlet Collector Volume:	1.8 (l)
Outlet Collector Volume:	1.2 (l)
Length of Filter Element:	65 mm

Friction Specification

Target Pressure Drop	Activate

Target Pressure Drop

Mass Flow	0.021 kg/s
Target Pressure Drop	0.02 bar
Inlet Pressure	0.9785 bar
Inlet Air Temperature	24.85 degC

2. **FLOW COEFFICIENTS**

Click on the **Flow Coefficients** sub-group folder and enter the following data:

Pipe 1 Inflow	0.95	**Pipe 1 Outflow**	0.95
Pipe 2 Inflow	0.95	**Pipe 2 Outflow**	0.95

2.4.4. Catalyst

The data for the catalyst is listed in the following table. Click on the catalyst icon to access the input fields.

1. **GENERAL**

Click on the **General** sub-group folder and enter the following data:

Chemical Reactions	disabled
Monolith Volume:	0.3 (l)
Length of Monolith:	115 mm
Inlet Collector Volume:	0.1 (l)
Outlet Collector Volume:	0.1 (l)

2. **TYPE SPECIFICATION**

Click on the **Type Specification** sub-group folder and enter the following data:

Catalyst Type Specification

General Catalyst	Activate

General Catalyst

Open Frontal Area (OFA)	1
Hydraulic Unit	Diameter
Hydraulic Diameter	57.63240 mm
Geometrical Surface Area (GSA)	0 1/m

3. **FRICTION**

Click on the **Friction** sub-group folder and enter the following data:

Friction Specification

Target Pressure Drop	Activate

Target Pressure Drop

Inlet Massflow	0.02356 kg/s
Inlet Temperature	806.85 degC
Inlet Pressure	1.08 bar
Target Pressure Drop	0.1 bar

4. **FLOW COEFFICIENTS**

Click on the **Flow Coefficients** sub-group folder and enter the following data:

Pipe 7 Inflow	1	**Pipe 7 Outflow**	1
Pipe 8 Inflow	1	**Pipe 8 Outflow**	1

2.4.5. Injector

The data for the injector is listed in the following table. Click on the injector number to access the input fields.

1. **GENERAL**

Click on the **General** sub-group folder and enter the following data:

Injection Method: Continuous

2. **MASS FLOW**

Click on the **Mass Flow** sub-group folder and enter the following data:

Air Fuel Ratio: 14

Injector Model: Injection Nozzle (Continuous Injection)

Air Flow taken from Measuring Point: Measuring Point 1

The Inject Covers 100% of the Total Air Flow

3. **FLOW COEFFICIENTS**

Click on the **Flow Coefficients** sub-group folder and enter the following data:

Injector 1	**from Pipe 3 to Pipe 4**	1
	from Pipe 4 to Pipe 3	1

2.4.6. System Boundary

The data for each system boundary is listed in the following table. Data can be copied from one system boundary to others by selecting **Element|Copy Data**. Click on the system boundary number to access the input fields.

1. **GENERAL**

Click on the **General** sub-group folder and select **Standard** for the **Boundary Type**.

2. **BOUNDARY CONDITIONS**

Click on the **Boundary Conditions** sub-group folder and enter the following data:

Select **Local Boundary Conditons** and **Set 1** from the **Preference** pull-down menu (defined in section 2.3 – Initialization)

	Pressure (bar)	Gas Temp (degC)	Fuel Vapour	Combustion Products	Ratio Type	Ratio Value
SB 1	1	24.85	0	0	A/F Ratio	10000
SB 2	1	126.85	0	1	A/F Ratio	14

3. **FLOW COEFFICIENTS**

Click on the **Flow Coefficients** sub-group folder and enter the following data:

SB 1	**Pipe 1 Inflow**	1	**Pipe 1 Outflow**	1
SB 2	**Pipe 11 Inflow**	0.98	**Pipe 11 Outflow**	0.98

2.4.7. Plenum

The data for the plenums is listed in the following table. Data can be copied from one plenum to others by selecting **Element|Copy Data**. Click on the relevant plenum number to access the input fields.

1. **GENERAL**

   Click on the **General** sub-group folder and enter `1.8` for the **Volume** for each Plenum.

2. **INITIALIZATION**

   Click on the **Initialization** sub-group folder and select **Global Initialization** for each Plenum. Select **Set 1** from the **Preference** pull-down menu.

3. **FLOW COEFFICIENTS**

   Click on the **Flow Coefficients** sub-group folder and enter the following data:

Plenum 1	**Pipe 8 Inflow**	0.98	**Pipe 8 Outflow**	0.98
	Pipe 9 Inflow	0.98	**Pipe 9 Outflow**	0.98
	Pipe 12 Inflow	0.98	**Pipe 12 Outflow**	0.98
Plenum 2	**Pipe 9 Inflow**	0.98	**Pipe 9 Outflow**	0.98
	Pipe 10 Inflow	0.98	**Pipe 10 Outflow**	0.98
Plenum 3	**Pipe 10 Inflow**	0.98	**Pipe 10 Outflow**	0.98
	Pipe 11 Inflow	0.5	**Pipe 11 Outflow**	0.5
	Pipe 12 Inflow	0.98	**Pipe 12 Outflow**	0.98

2.4.8. Restrictions

The data for the restrictions is listed in the following table. Data can be copied from one restriction to others by selecting **Element|Copy Data**. Click on the relevant restriction number to access the input fields.

1. **FLOW COEFFICIENTS**

   Click on the **Flow Coefficients** sub-group folder and enter the following data:

Restriction 1	**from Pipe 2 to Pipe 3**	0.98
	from Pipe 3 to Pipe 2	0.98
Restriction 2	**from Pipe 4 to Pipe 5**	0.98
	from Pipe 5 to Pipe 4	0.98
Restriction 3	**from Pipe 6 to Pipe 7**	0.98
	from Pipe 7 to Pipe 6	0.98

2.4.9. Pipes

The data for each pipe is listed in the following tables. Data can be copied from one pipe to others by selecting **Element|Copy Data**. Click on the relevant pipe number to access the input fields. Enter the following General and Initialization data for each pipe.

1. **GENERAL**

Click on the **General** sub-group folder to show the following window.

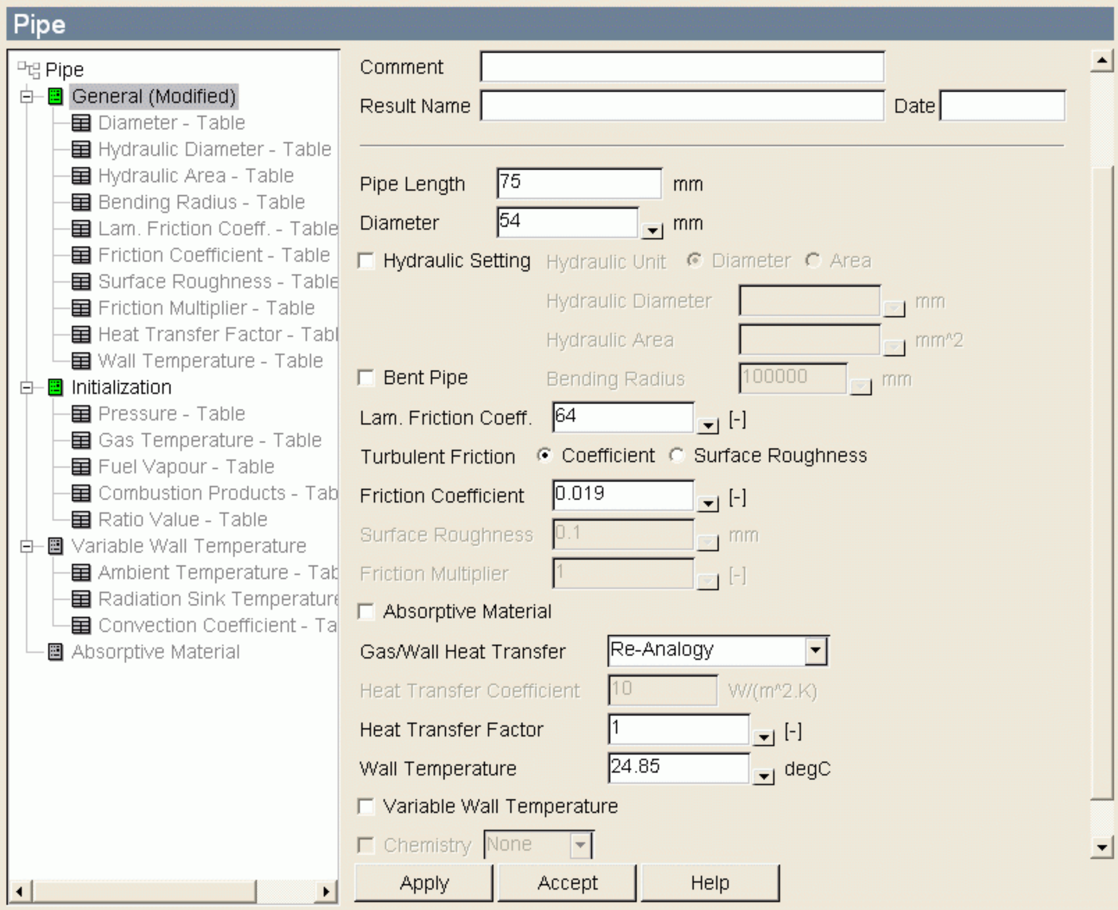

Figure 2-14: Pipe General Window

Enter the data in the following table for each pipe. The default **Bending Radius** (100000 mm) is used.

In the **Initialization** sub-group, select the required **Global** set from the **Preference** pull-down menu.

	Pipe Length (mm)	Diameter (mm)	Friction Coeff	Heat Transfer Factor	Wall Temp (degC)	Global Initial.
Pipe 1	75	54	0.019	1	24.85	Set 1
Pipe 2	48	47	0.019	1	24.85	Set 1
Pipe 3	32	34	0.019	1	24.85	Set 1
Pipe 4	72	34	0.019	1	24.85	Set 2
Pipe 5	140	34	0.019	1	24.85	Set 2
Pipe 6	60	31	0.019	1	526.85	Set 3
Pipe 7	380	TABLE	0.019	1	526.85	Set 3
Pipe 8	400	TABLE	0.019	1	426.85	Set 4
Pipe 9	280	40	0.019	1	261.85	Set 4
Pipe 10	100	37	0.019	1	261.85	Set 4
Pipe 11	150	48	0.019	1	91.85	Set 4
Pipe 12	250	10	0.019	1	261.85	Set 4

The diameter data for pipes 7 and 8 is listed in the following table. Click on ▼ and then select the **Table** button which appears on the input field to open the input window. Select **Insert Row** to activate the input fields.

Diameter Table		
	Location X (mm)	**Diameter Y (mm)**
Pipe 7	0	31
	70	35
	380	35
Pipe 8	0	35
	70	31
	400	31

2.4.10. Measuring Point

The data for the measuring points is listed in the following table. Data can be copied from one measuring point to others by selecting **Element|Copy Data**. Click on the relevant measuring point number to access the input fields.

1. **GENERAL**

   Click on the **General** sub-group folder and enter the following data:

	Location of Measuring Point from Upstream Pipe End (mm)	Output Extent
Measuring Point 1	75	Standard
Measuring Point 2	0	Standard
Measuring Point 3	0	Standard
Measuring Point 4	140	Standard
Measuring Point 5	0	Standard
Measuring Point 6	0	Standard
Measuring Point 7	120	Extended
Measuring Point 8	300	Standard
Measuring Point 9	400	Standard
Measuring Point 10	0	Standard

2.4.11. Reference Point for Volumetric Efficiency

Select **Simulation | Volumetric Efficiency** to open the following window. In this example select **Measuring Point 2** as the reference element.

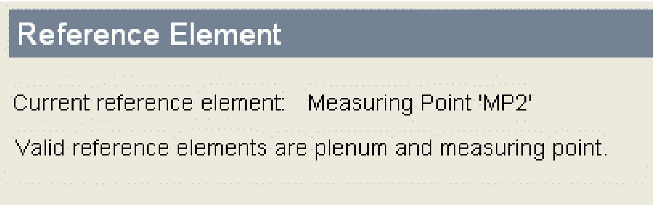

Figure 2-15: Reference Point for Volumetric Efficiency

2.5. Run Simulation

Select **Simulation**|**Run** to open the following window.

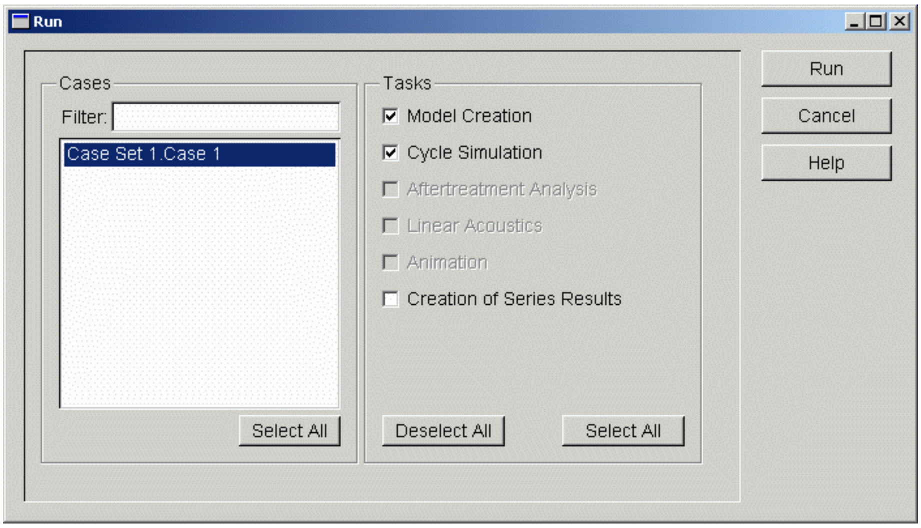

Figure 2-16: Run Simulation Window

Cases: Select the required case(s) to be run. **Select All** allows all the cases to be activated.

Tasks: Select **Model Creation** to create a calculation kernel input file (`.bst` file) in the case sub-directory.

Select **Cycle Simulation** to run the simulation and pass the input file (`.bst` file) to the calculation kernel. **Deselect All** and **Select All** allow all defined tasks to be deactivated or activated.

Then select **Run** to start the simulation. The following window opens and provides an overview of the status of the simulation.

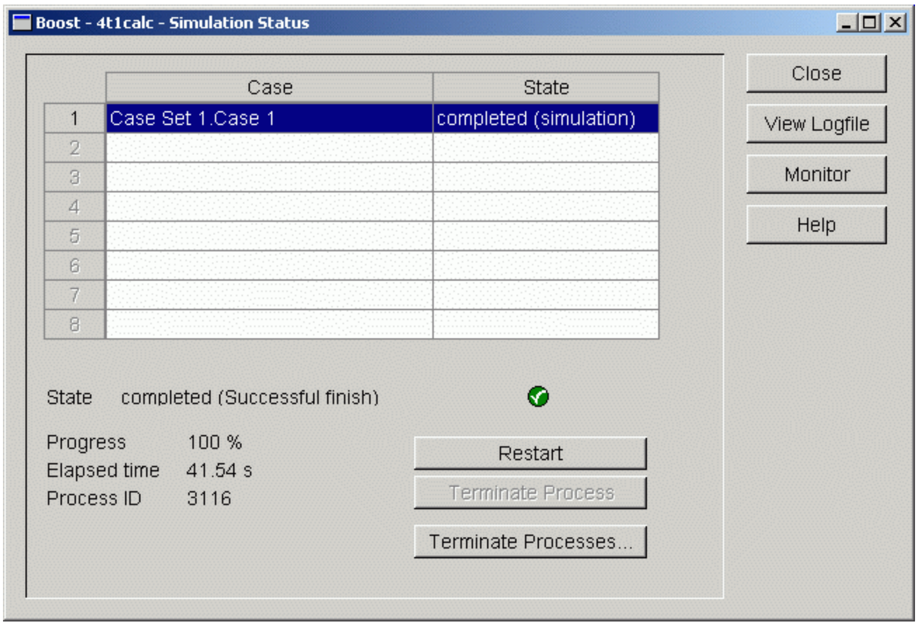

Figure 2-17: Simulation Status Window

Select **View Logfile** to view more detailed information on the simulation run produced by the simulation kernel. Select **Cycle Simulation** to show the information in the following window. Select **Model Creation** to show whether the model was created successfully.

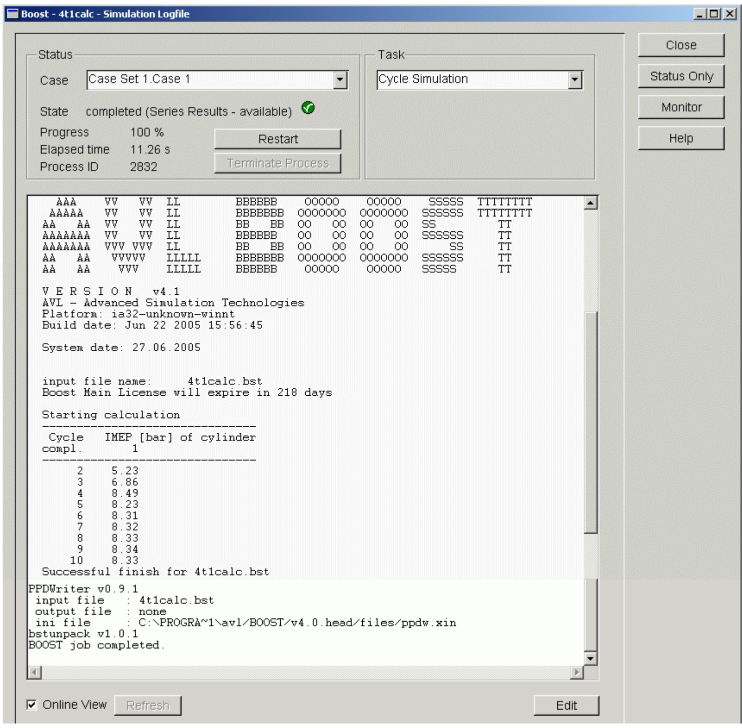

Figure 2-18: View Logfile Window; Classic Species Transport

Once the job is complete select **Close** to exit.

2.6. Post-processing

Refer to Chapter 4 of the BOOST Users Guide for more detailed information.

2.6.1. Messages

Select **Simulation**|**Show Messages**|**Cycle Simulation** to open the following window.

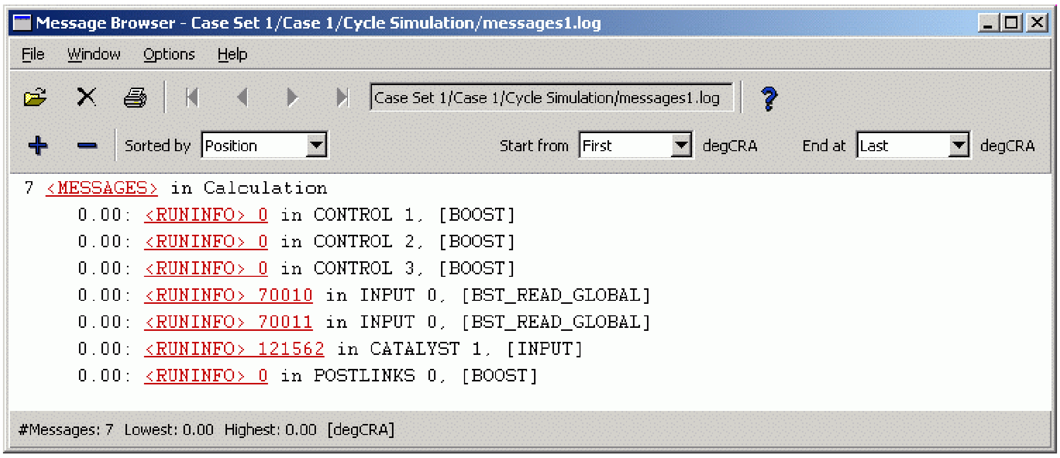

Figure 2-19: Message Browser Window

Check for Convergence Warnings and relevant information.

2.6.2. Summary

Select **Simulation** | **Show Summary** | **Cycle Simulation** to open the following window.

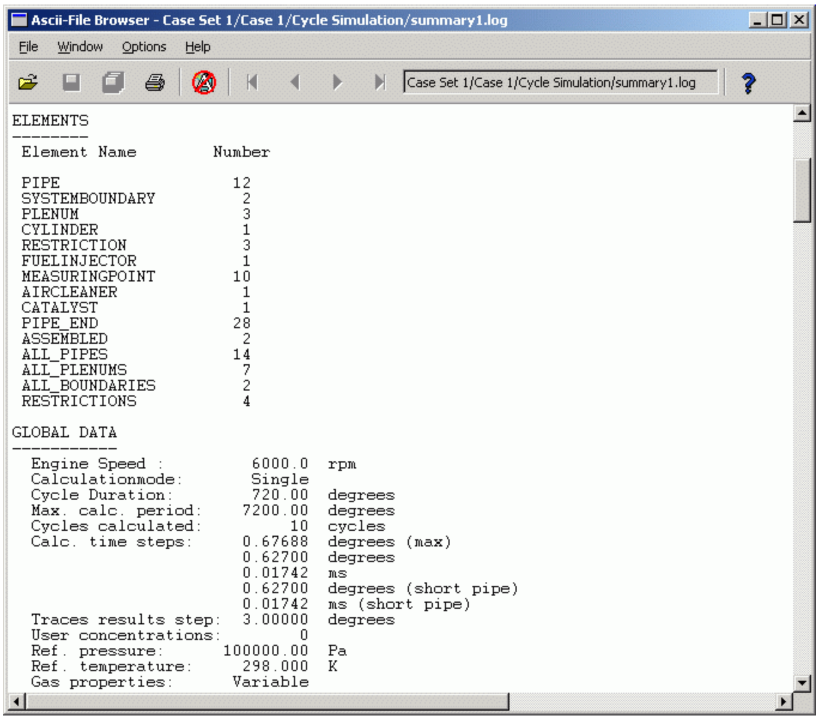

Figure 2-20: Summary Browser Window

Summary information about the simulation run is displayed, e.g. overall engine performance.

2.6.3. Results

Select **Simulation** | **Show Results** | **Cycle Simulation** to open **IMPRESS Chart**. Refer to the IMPRESS Chart Users Guide for further details.

1. Select the **Results** tab to display the tree as shown in the following window.
2. In the **4t1calc** case folder, double click `Case_Set_1.Case_1.simulation.dir` to load the Transients, Traces and Acoustic result folders.
3. Select the **Report** tab and insert a layer into the selected page. Then select the layer.
4. Select the **Results** tab and click on the required curve to load the results into the selected layer.

The example shows pressure at a measuring point both as Transient and Trace Plots.

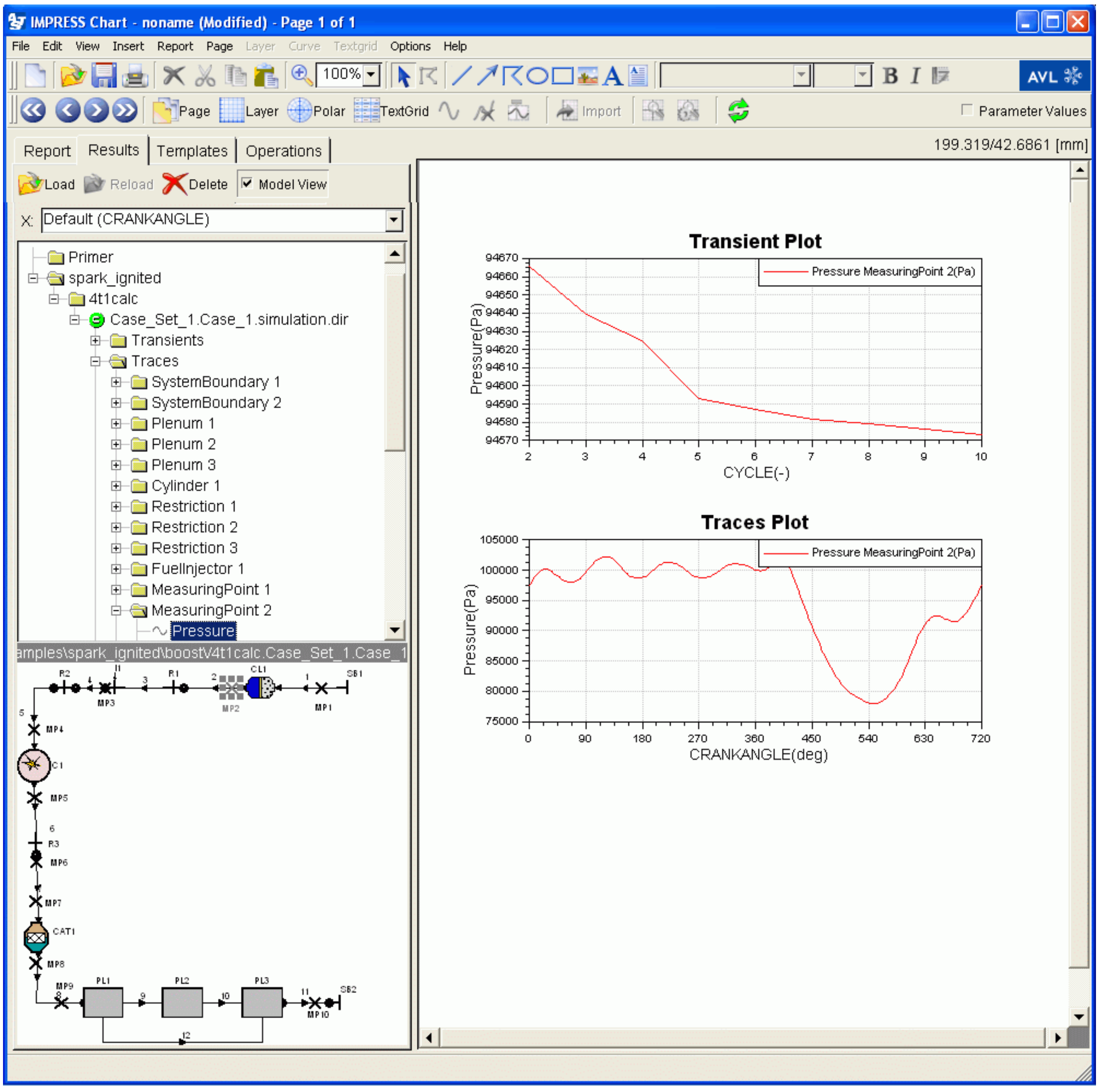

Figure 2-21: IMPRESS Chart - Results Window

Transients plot the variable versus the cycle number and **Traces** plot the variable versus the crankangle for the last complete cycle.

The following example shows the cylinder pressure and the species mass fractions as traces results in case of a general species transport calculation.

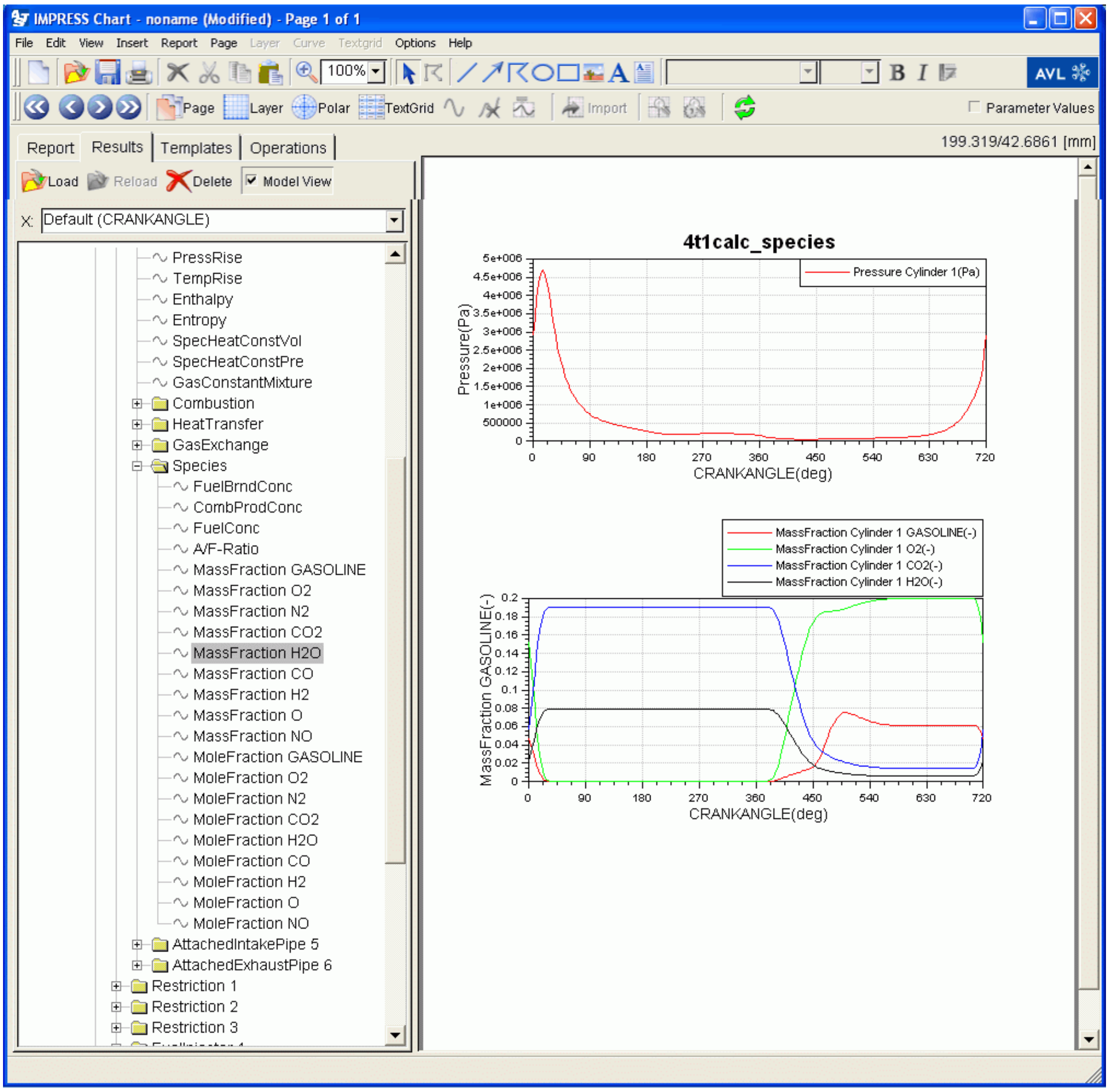

Figure 2-22: IMPRESS Chart - Results Window: Traces - General Species Transport Calculation

2.7. General Species Transport

The `4t1calc_species.bwf` example is available using the General Species Transport option. The setup is identical to the `4t1calc.bwf` except that the general species transport option is used.

1. In the **Simulation | Control – Cycle Simulation** window, select **General** for **Species Transport**. Then select **General Species Setup** sub-group folder in the tree to access the following window:

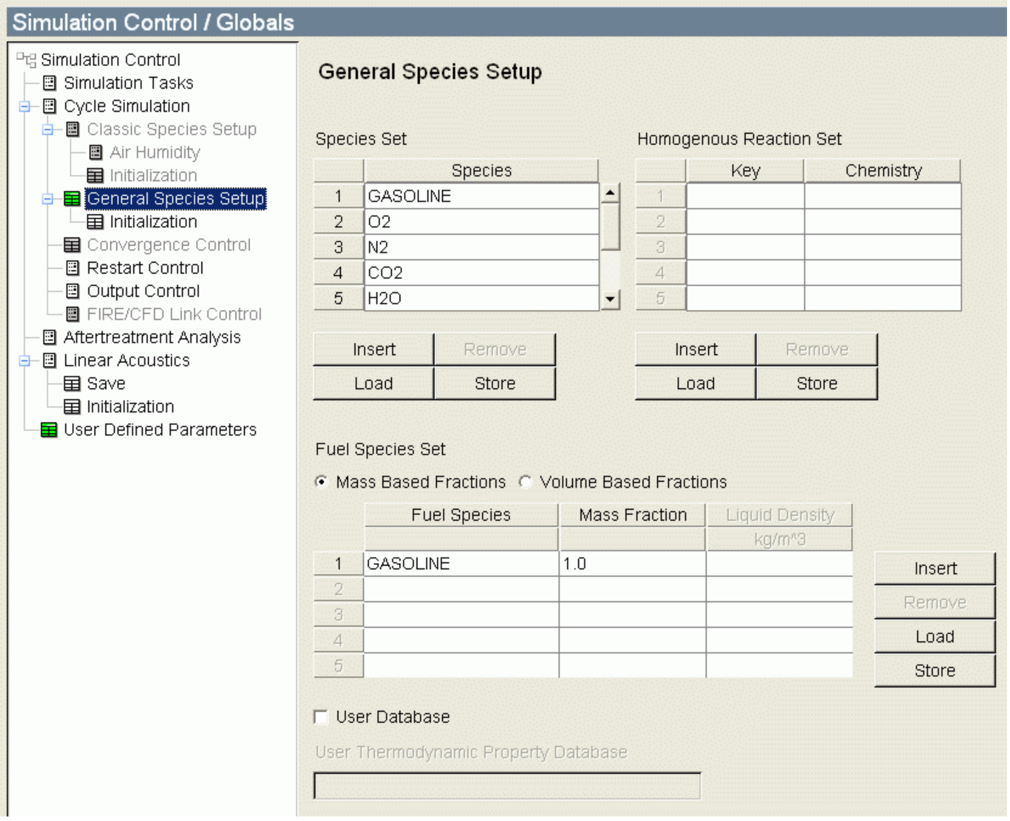

Figure 2-23: Simulation Control – General Species Setup Window

Enter the following data:

Species Set:	GASOLINE, O2, N2, CO2, H2O, CO, H2, O, NO
Fuel Species:	GASOLINE
Mass Fraction:	1.0

2. In the **Cylinder - Combustion** window, ensure the following options under **General Species** are disabled:

   Single Zone Chemistry

   Gas Exchange Phase Chemistry

   Solver absolute Tolerance

   Solver relative Tolerance

3. In the **Injector – Species Options** window, **Fuel** is activated and **Consider Heat of Evaporation** is deactivated as default.