

8. Engines

8.1 Introduction

The Engines module is used to display or introduce the characteristics of a given engine, i.e.:

- its geometrical characteristics
- its weight characteristics
- the characteristics of the various systems that are part of it (reduction gear, turbocharger, ...)
- its performances
- the 3-view drawings

The data can be downloaded from the PCA2000 website or inserted by the user via the PCA2000 interface.

Thereafter, in the PCA2000 analysis and design modules, mentioning merely the name of the engine will imply the knowledge of all its technical characteristics.

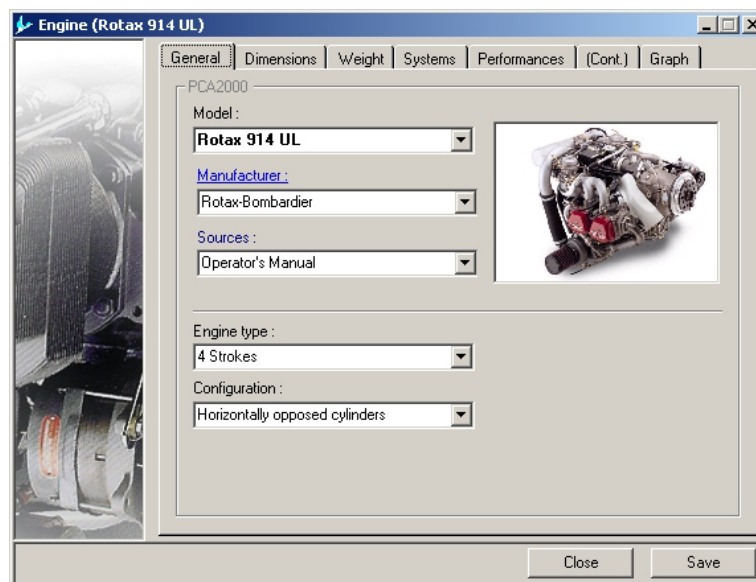



Figure 8.1 : Generalities

8.2 Table of content

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8.3 Engines

8.3.1 Description

To access the Engines module, **click** on **[Analysis]** then **[Engines]** of the menu bar of the main window. You can also reach it directly by clicking on  in the vertical toolbar.

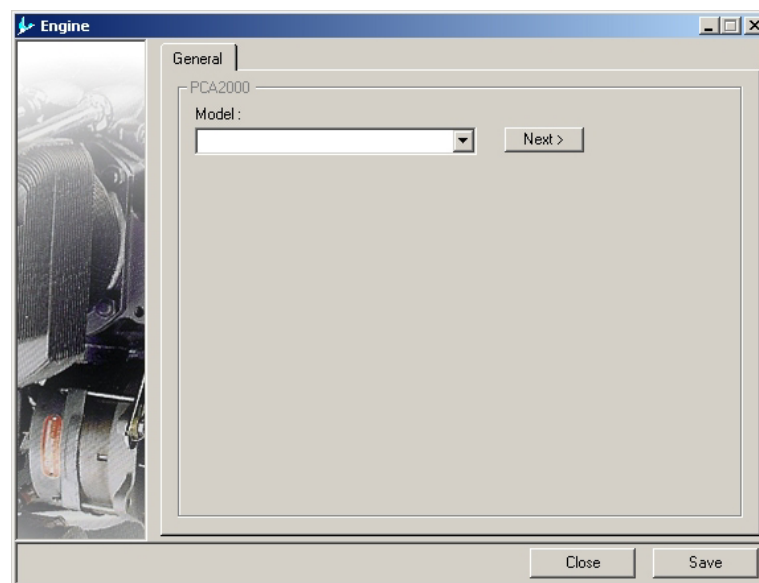


Figure 8.2 : Engines



You can press on the **F1** key at any time to reach the contextual help.



To navigate within the controls of a window, use the **tab key**.

8.3.2 To visualize the characteristics of a given engine

Once you open the **Engine** module, all the references related to data files of engines stored in the **Engines** directory of **PCA2000-Data** are automatically downloaded in the application.

To visualize the characteristics of a given engine, **click** on the engine reference that appears in the drop-down list under **Model**. All the tabs in the Engine window are now accessible.

8.3.2.1 Generalities

The first tab gathers general data related to the selected engine.

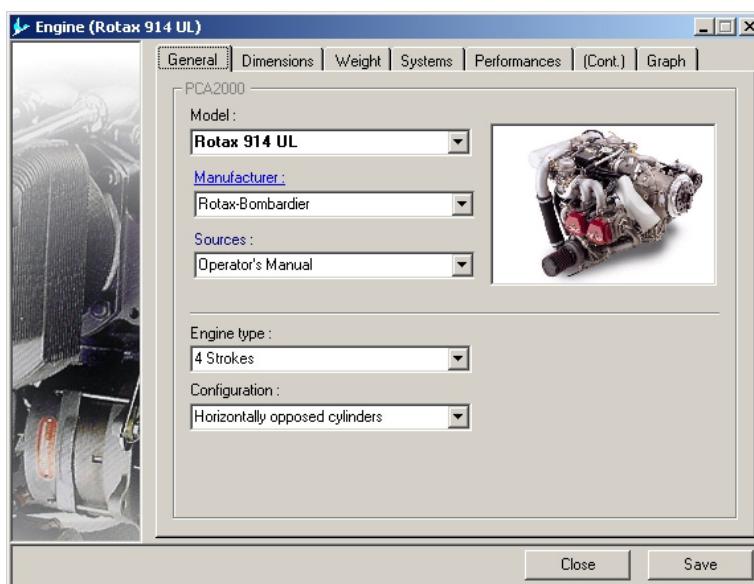
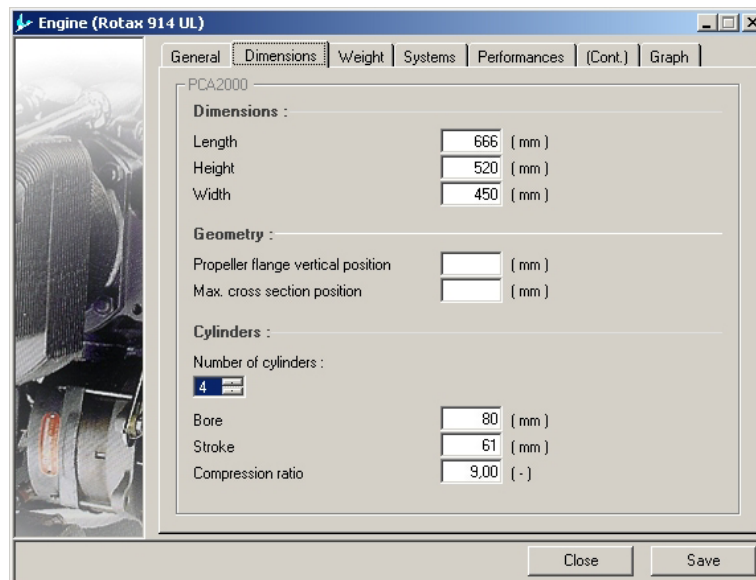


Figure 8.3 : Generalities

Engines

8.3.2.2 Specifications

The second tab displays the geometric characteristics of the selected engine as well as its weights.

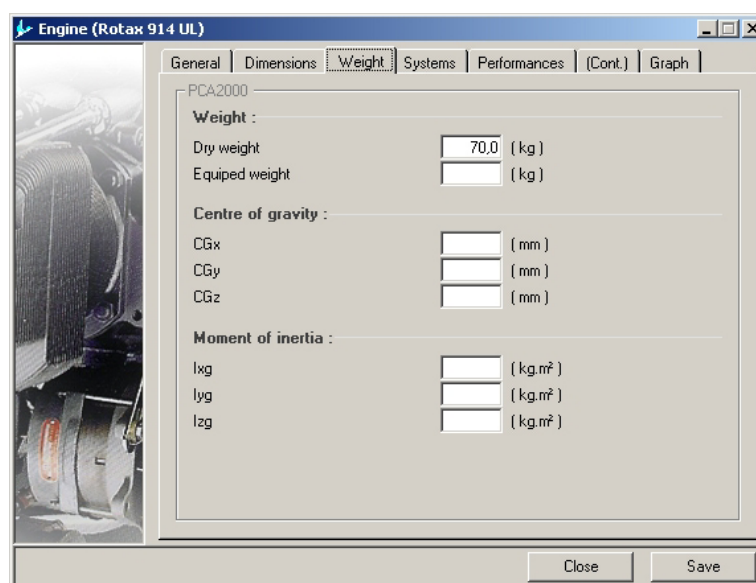


Parameter	Value	Unit
Length	666	mm
Height	520	mm
Width	450	mm
Geometry :		
Propeller flange vertical position		mm
Max. cross section position		mm
Cylinders :		
Number of cylinders :	4	
Bore	80	mm
Stroke	61	mm
Compression ratio	9.00	-

Figure 8.4 : Specifications

8.3.2.3 Weight

The third tab displays the weight characteristics of the selected engine as well as its centre of gravity position and its moment of inertia.



Parameter	Value	Unit
Dry weight	70.0	kg
Equiped weight		kg
Centre of gravity :		
CGx		mm
CGy		mm
CGz		mm
Moment of inertia :		
Ixx		kg.m²
Iyy		kg.m²
Izz		kg.m²

Figure 8.5 : Weight

8.3.2.4 Systems

The fourth tab displays the data related to the various systems that are part of the selected engine. **Click** on one of the option buttons to display the information about the corresponding system.



Once the mouse pointer leaves the drawer, the drawer closes itself.
To reopen it, move again the mouse pointer on it.

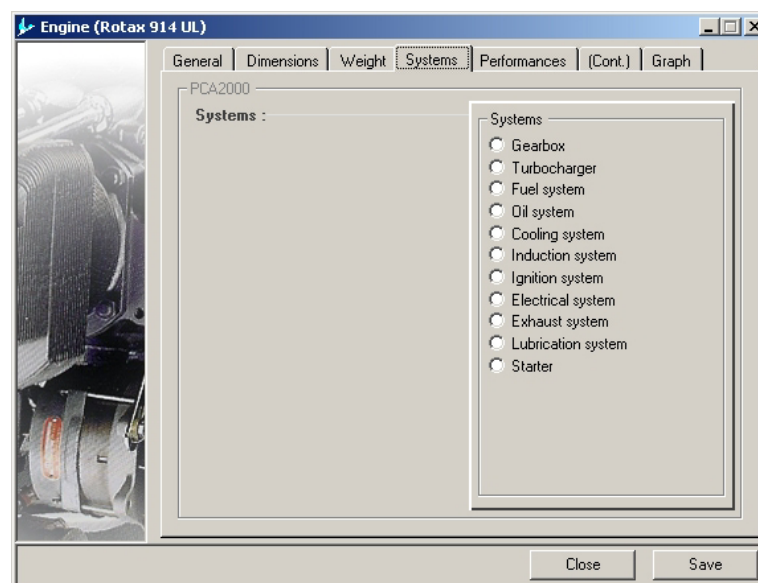


Figure 8.6 : Systems

8.3.2.5 Gearbox

Engine (Rotax 914 UL)

General | Dimensions | Weight | **Systems** | Performances | (Cont.) | Graph

PCA2000

Gearbox :

☒ Gearbox

Type : Model : Manufacturer :

Reduction ratio (-)

Weight (kg)

Notes :

Close Save

Figure 8.7 : Data related to the gearbox

If the engine is equipped with a gearbox:

1. **Check** the check box **Gearbox**,
2. **Insert** its various characteristics from which at least, the **gearbox ratio**.

8.3.2.6 Turbocharger

Figure 8.8 : Data related to the turbocharger

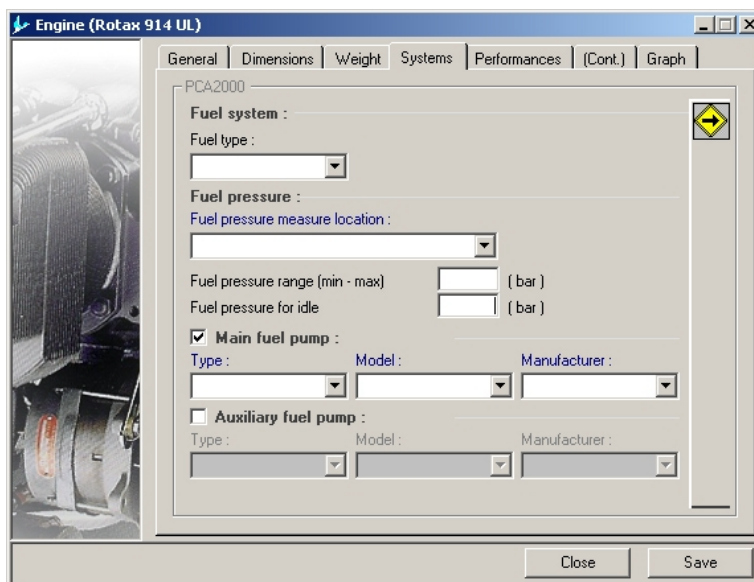
If the engine is equipped with a turbocharger:

1. **Check** the check box **Turbocharger**,
2. **Insert** its various characteristics from which at least the **critical altitude**.

Engines

8.3.2.7 Fuel system

Give at least the fuel used .



Engine (Rotax 914 UL)

General | Dimensions | Weight | **Systems** | Performances | (Cont.) | Graph

PCA2000

Fuel system :

Fuel type :

Fuel pressure :

Fuel pressure measure location :

Fuel pressure range (min - max) (bar)

Fuel pressure for idle (bar)

☒ **Main fuel pump :**

Type : Model : Manufacturer :

☐ **Auxiliary fuel pump :**

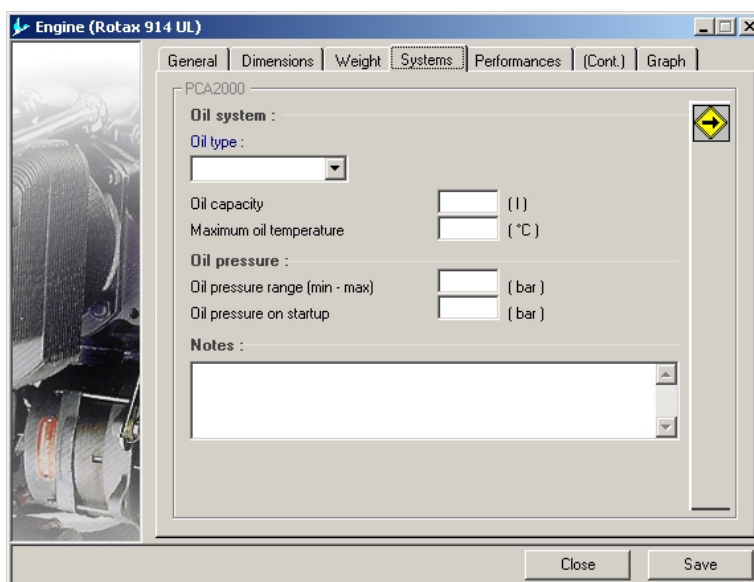
Type : Model : Manufacturer :

Notes :

Close Save

Figure 8.9 : Data related to the fuel system

8.3.2.8 Oil system.



Engine (Rotax 914 UL)

General | Dimensions | Weight | **Systems** | Performances | (Cont.) | Graph

PCA2000

Oil system :

Oil type :

Oil capacity (l)

Maximum oil temperature (°C)

Oil pressure :

Oil pressure range (min - max) (bar)

Oil pressure on startup (bar)

Notes :

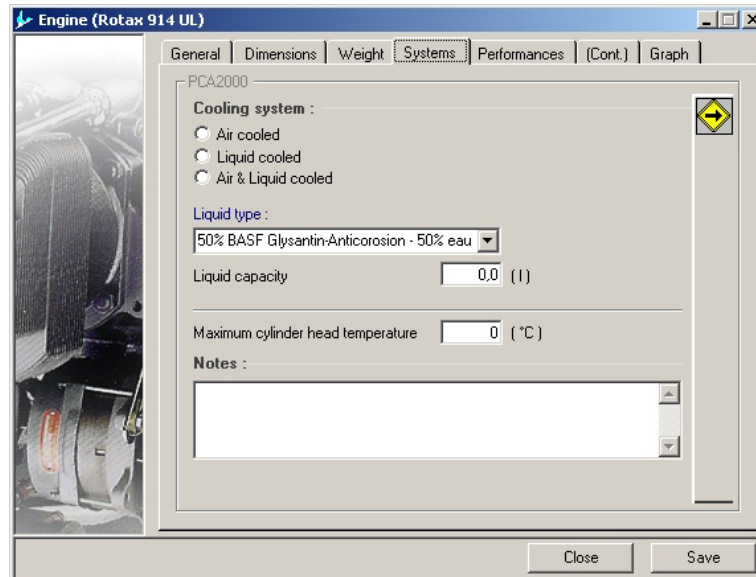
Close Save

Figure 8.10 : Data related to the oil system

Engines

8.3.2.9 Cooling system.

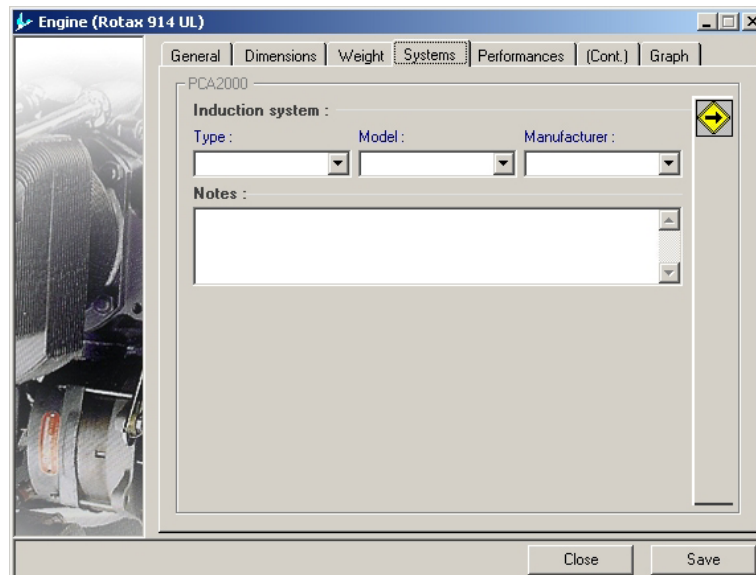
Give at least the cooling system used.



The screenshot shows the 'Engine (Rotax 914 UL)' software window with the 'Systems' tab selected. The 'Cooling system' section is active, showing three radio button options: 'Air cooled', 'Liquid cooled', and 'Air & Liquid cooled'. The 'Liquid type' dropdown menu is set to '50% BASF Glysantin-Anticorrosion - 50% eau'. The 'Liquid capacity' field is set to '0,0 (l)'. The 'Maximum cylinder head temperature' field is set to '0 (°C)'. There is a 'Notes' text area at the bottom. The window has a 'Close' button and a 'Save' button at the bottom right.

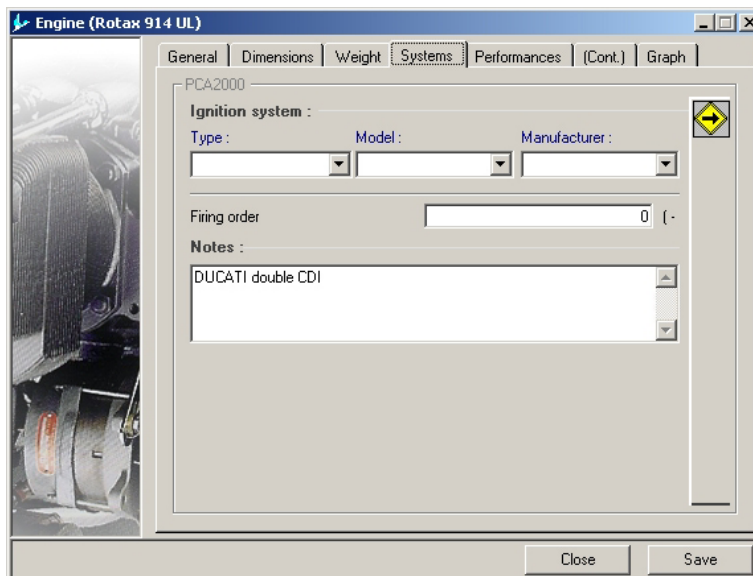
Figure 8.11 : Data related to the cooling system

8.3.2.10 Manifold system.



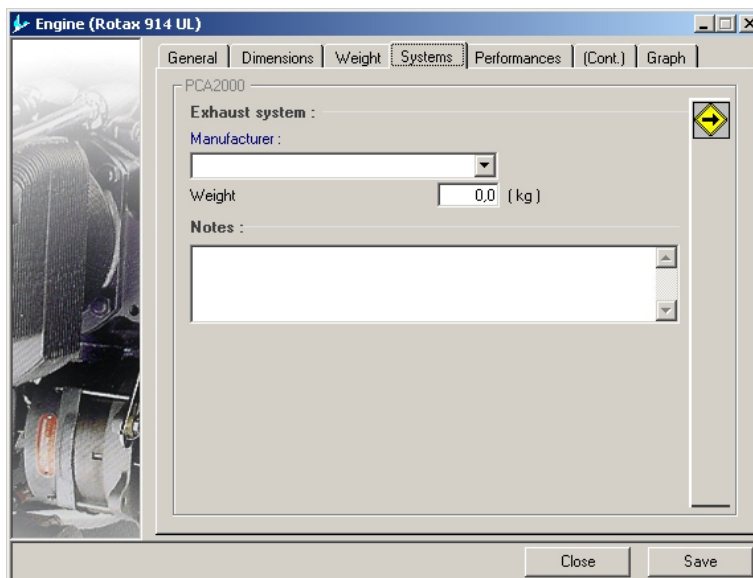
The screenshot shows the 'Engine (Rotax 914 UL)' software window with the 'Systems' tab selected. The 'Induction system' section is active, showing three dropdown menus for 'Type', 'Model', and 'Manufacturer'. There is a 'Notes' text area at the bottom. The window has a 'Close' button and a 'Save' button at the bottom right.

Figure 8.12 : Data related to the manifold system

8.3.2.11 Ignition system.

The screenshot shows the 'Engine (Rotax 914 UL)' window with the 'Systems' tab selected. The 'Ignition system' section includes fields for 'Type', 'Model', and 'Manufacturer', each with a dropdown menu. Below these is a 'Firing order' field with a value of '0' and a unit selector '(- '. A 'Notes' text area contains the text 'DUCATI double CDI'. The window has 'Close' and 'Save' buttons at the bottom right.

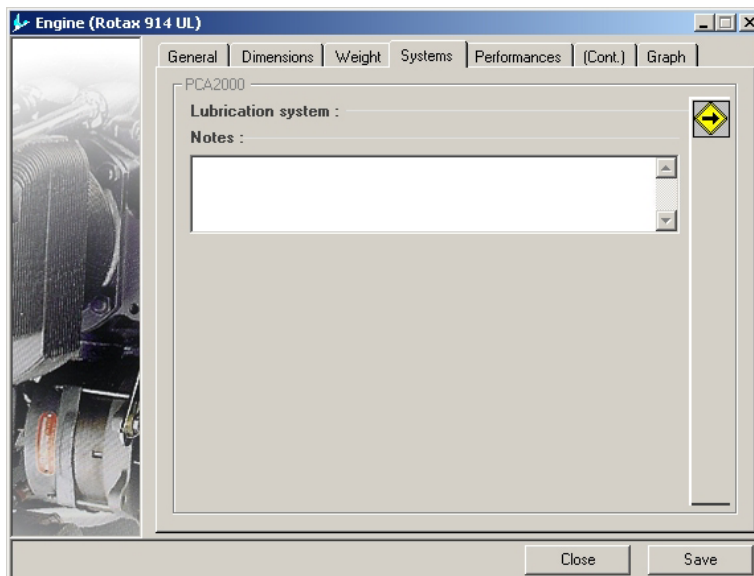
Figure 8.13 : Data related to the ignition system

8.3.2.12 Exhaust system

The screenshot shows the 'Engine (Rotax 914 UL)' window with the 'Systems' tab selected. The 'Exhaust system' section includes a 'Manufacturer' dropdown menu and a 'Weight' field with a value of '0.0' and a unit selector '(kg)'. A 'Notes' text area is also present. The window has 'Close' and 'Save' buttons at the bottom right.

Figure 8.14 : Data related to the exhaust system

8.3.2.13 Lubrication system.



Engine (Rotax 914 UL)

General | Dimensions | Weight | Systems | Performances | (Cont.) | Graph

PCA2000

Lubrication system :

Notes :

Close Save

Figure 8.15 : Data related to the lubrication system

8.3.2.14 Starter



Engine (Rotax 914 UL)

General | Dimensions | Weight | Systems | Performances | (Cont.) | Graph

PCA2000

Starter :

Type : Model : Manufacturer :

Battery voltage { V }

Pinion gear pitch { . }

Weight { kg }

Notes :

Close Save

Figure 8.16 : Data related to the starter

8.3.2.15 Performances

The fifth tab gathers the data related to the performances of the selected engine.

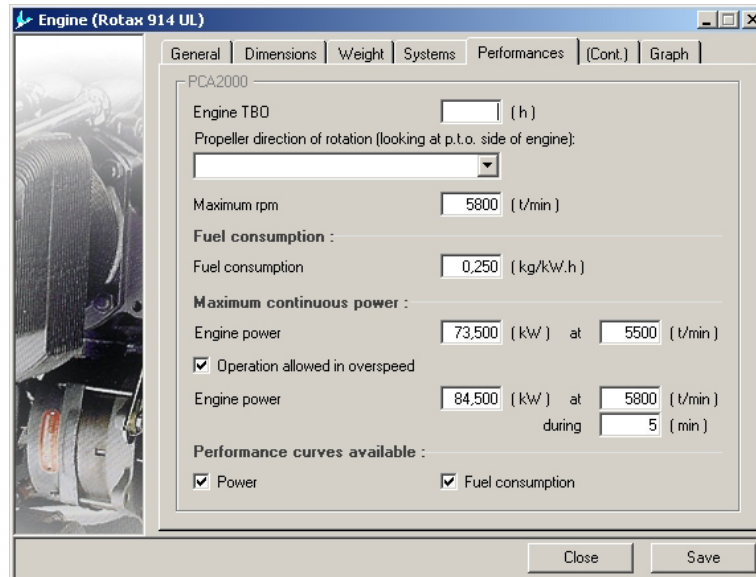


Figure 8.17 : Performances

If the engine can run in overspeed during a given period of time,

1. **Check** the check box **Operation allowed in overspeed.** ,
2. **Specify** the engine power, the corresponding engine rating as well as the maximum period of time allowed

If the power curves are available, **check** the check box **Power**.

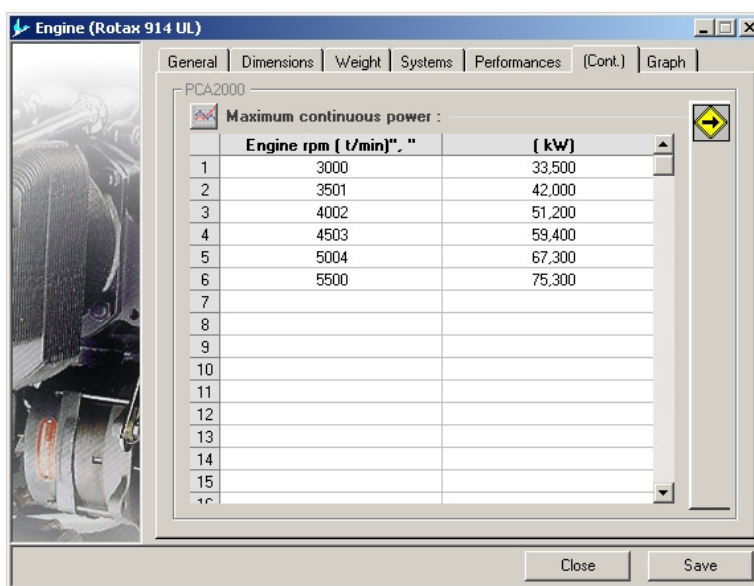
If the specific fuel consumption curves are available, **check** the check box **Fuel consumption**.

8.3.2.16 Performances curves

The sixth tab contains all the information related to the performance curves of the selected engine:


- Maximum continuous power.
- Maximum power at take-off.
- Specific fuel consumption.

The different curves are presented as points included in the table.



	Engine rpm (t/min)", "	(kW)
1	3000	33,500
2	3501	42,000
3	4002	51,200
4	4503	59,400
5	5004	67,300
6	5500	75,300
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Figure 8.18 : Performances

To visualize the table information in a graphic, **click** directly on the **[Graphic]** tab or click on the button  located in the upper left part in the table.



Click with the left button of the mouse on the column title or on the line number to select the entire column or the entire line.

Click with the right button of the mouse once it is on the table to activate the functions **[Cut]**, **[Copy]**, **[Paste]**.

Use those 2 functionalities to fill in the table with the values copied from other PCA2000 tables or spreadsheets such as Excel for example. While proceeding in that way, you speed up considerably the introduction of data and you avoid transcription errors.

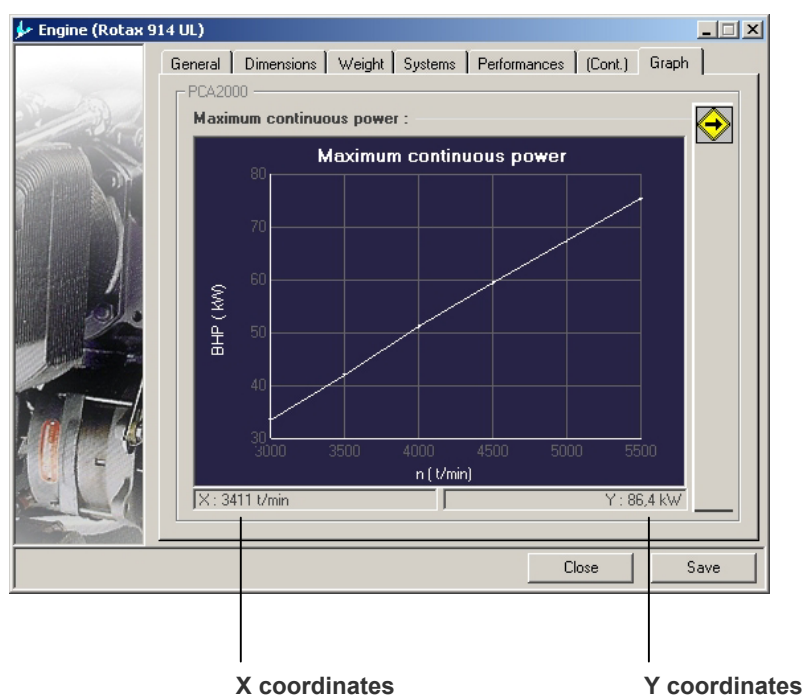


Figure 8.19 : Performances curves

To display other information:

1. **Open** the drawer by moving the pointer of the mouse on it
2. **Chose** the information that you wish to visualize. The display is done automatically.

The drawer closes itself automatically once you move the mouse pointer away from it. Once you move the mouse pointer on the graphic, the coordinates of the mouse pointer are displayed in the 2 areas located under the graphic.



Use the **arrows** ← → ↑ ↓ of the keyboard to move precisely the mouse pointer.

Engines

It is also possible to display the 3 views drawings of the engine:

- Front view.
- Side view.
- Top view.

In order to do that:

1. **Move** the mouse pointer on the drawer to open it
2. **Select** then the view that you wish to see displayed.



The files associated with the data file have to be named in the following way:

- Front view : NameOfTheDataFile-FR.jpg
- Side view : NameOfTheDataFile-SD.jpg
- Top view : NameOfTheDataFile-TP.jpg

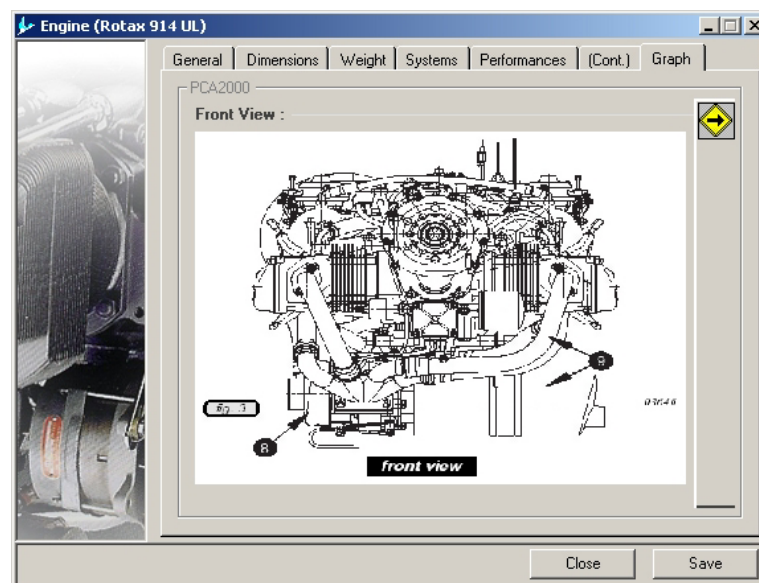


Figure 8.20 : 3-view drawings

8.3.3 Introduce the characteristics of a new engine

To introduce in the database the characteristics of a new engine,

1. **Click** on **[File]** then **[New]** of the menu bar of the main window.

The Engines module is initialized.

2. **Introduce** the name of the new engine

3. **Click** on .

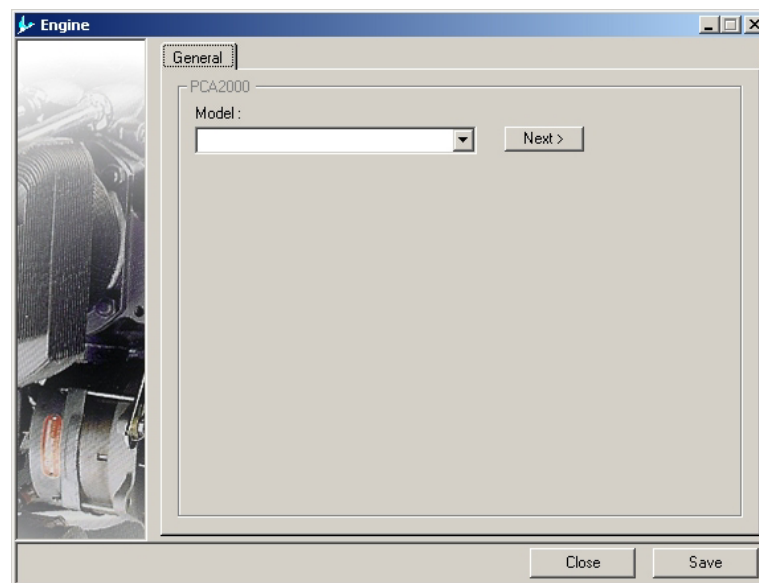


Figure 8.21 : Definition of the model

8.3.3.1 Definition of the general information

Introduce the general information in relation with the new engine

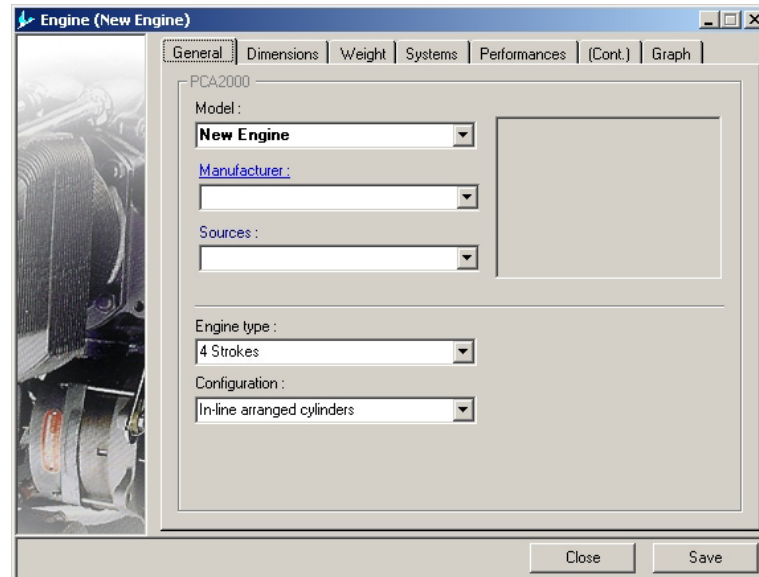


Figure 8.22 : Generalities

8.3.3.2 Definition of the geometrical information

Introduce the information in relation with the engine geometry.

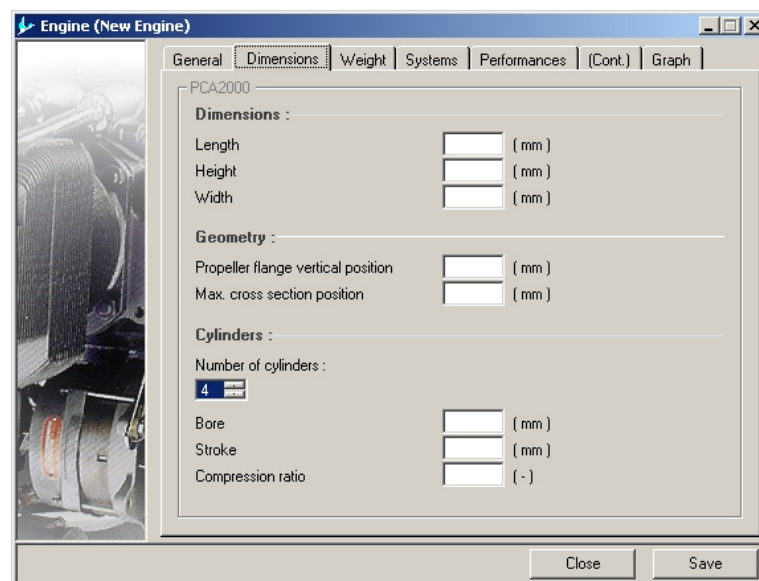
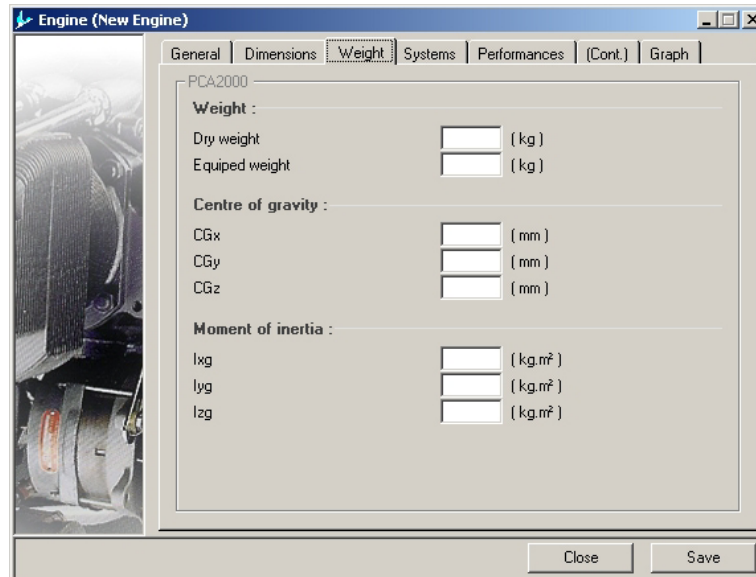


Figure 8.23 : Specifications

Engines

8.3.3.3 Definition of the geometrical and weight information

Introduce the information in relation with the engine weights.



Engine (New Engine)

General | Dimensions | **Weight** | Systems | Performances | (Cont.) | Graph

PCA2000

Weight :

Dry weight (kg)

Equiped weight (kg)

Centre of gravity :

CGx (mm)

CGy (mm)

CGz (mm)

Moment of inertia :

Ixx (kg.m²)

Iyy (kg.m²)

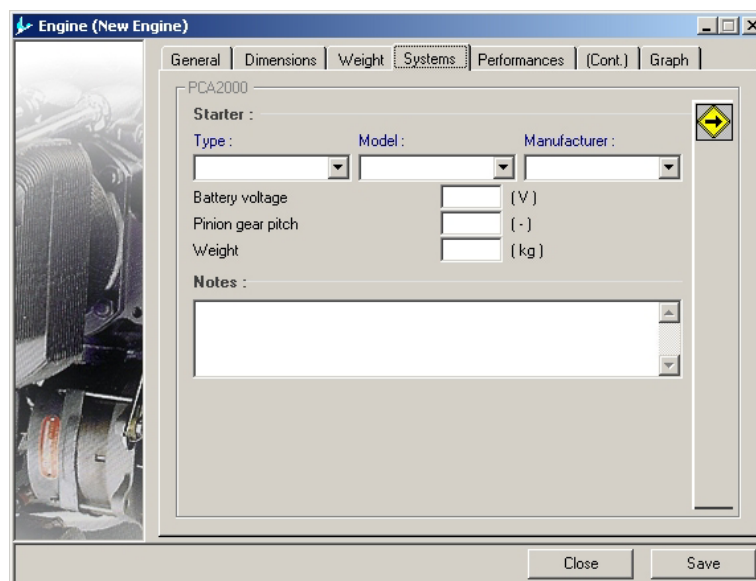
Izz (kg.m²)

Close Save

Figure 8.24 : Weight

8.3.3.4 Definition of the information in relation with the various systems

Introduce the information in relation with the various systems that equip the engine.



Engine (New Engine)

General | Dimensions | Weight | **Systems** | Performances | (Cont.) | Graph

PCA2000

Starter :

Type : Model : Manufacturer :

Battery voltage (V)

Pinion gear pitch (-)

Weight (kg)

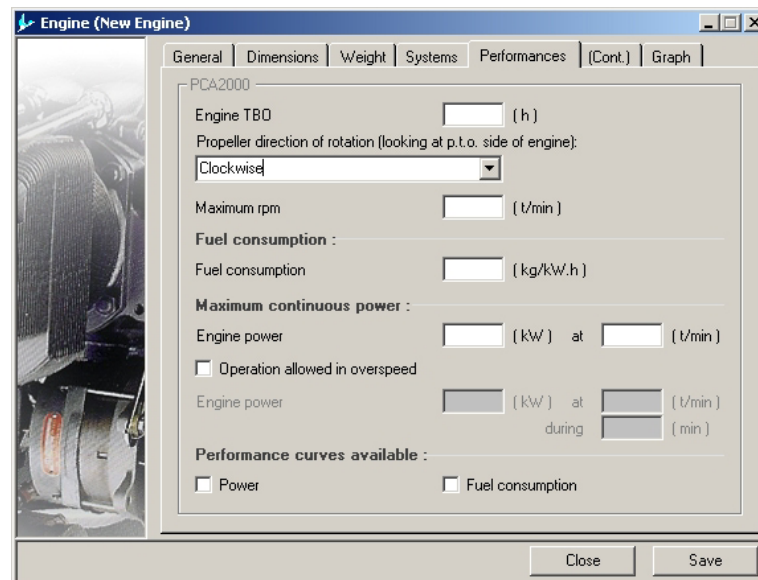
Notes :

Close Save

Figure 8.25 : Systems

8.3.3.5 Definition of the performances

Introduce the information in relation with the general performances.



Engine (New Engine)

General | Dimensions | Weight | Systems | **Performances** | (Cont.) | Graph

PCA2000

Engine TBO (h)

Propeller direction of rotation (looking at p.t.o. side of engine):

Maximum rpm (t/min)

Fuel consumption :

Fuel consumption (kg/kW.h)

Maximum continuous power :

Engine power (kW) at (t/min)

☐ Operation allowed in overspeed

Engine power (kW) at (t/min)
during (min)

Performance curves available :

☐ Power ☐ Fuel consumption

Close Save

Figure 8.26 : Performances

8.3.3.6 Performances curves

Introduce the information in relation with the power and specific fuel consumption curves.

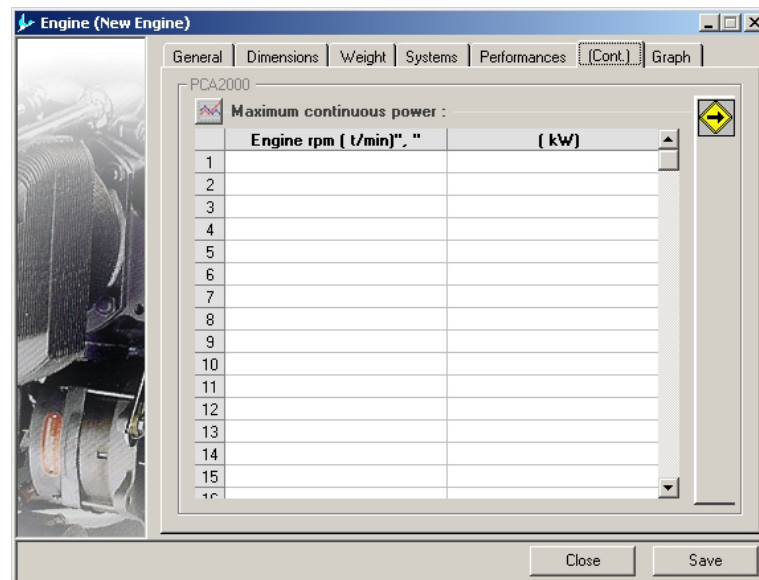


Figure 8.27 : Performances




Click with the left button of the mouse on the column title or on the line number to select the entire column or the entire line.

Click with the right button of the mouse once it is on the table to activate the functions **[Cut]**, **[Copy]**, **[Paste]**.

Use those 2 functionalities to fill in the table with the values copied from other PCA2000 tables or spreadsheets such as Excel for example. While proceeding in that way, you speed up considerably the introduction of data and you avoid transcription errors.

8.3.4 To save the data file related to the new engine

In order to save in a file the information related to a new engine, **click** on **[File]** then **[Save as]** in the menu bar in the main window. You can also do it by clicking on  in the toolbar.

The dialogue box **[Save as]** is displayed on the screen.



The name of the file will be NameOfTheEngine.eng

The file will be saved automatically in a specific folder according to the type of the engine :

- **2 Strokes**: PCA2000-Data\Engines\2 Strokes\NameOfTheEngine
- **2 Strokes Diesel**: PCA2000-Data\Engines\2 Strokes Diesel\ NameOfTheEngine
- **4 Strokes**: PCA2000-Data\Engines\4 Strokes\ NameOfTheEngine
- **4 Strokes Diesel**: PCA2000-Data\Engines\4 Strokes Diesel\ NameOfTheEngine
- **Rotary**: PCA2000-Data\Engines\Rotary\ NameOfTheEngine
- **Turboprop**: PCA2000-Data\Engines\Turbopropeller\ NameOfTheEngine.

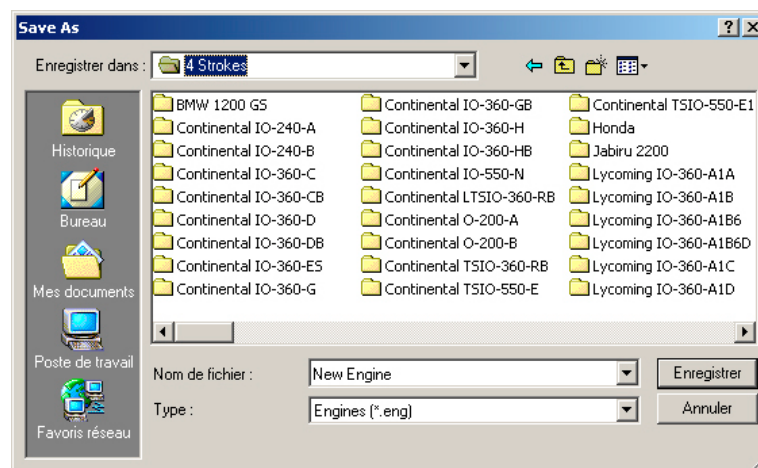


Figure 8.28 : Save the data file