9. Airfoils

9.1 Introduction

The **Airfoils** menu is used to display or introduce the characteristics of an airfoil, namely:

- its geometric characteristics
- its aerodynamic characteristics

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

After that, in the PCA2000 analysis and design modules, mentioning the name of the airfoil only will lead to the knowledge of all its geometric and aerodynamic characteristics.

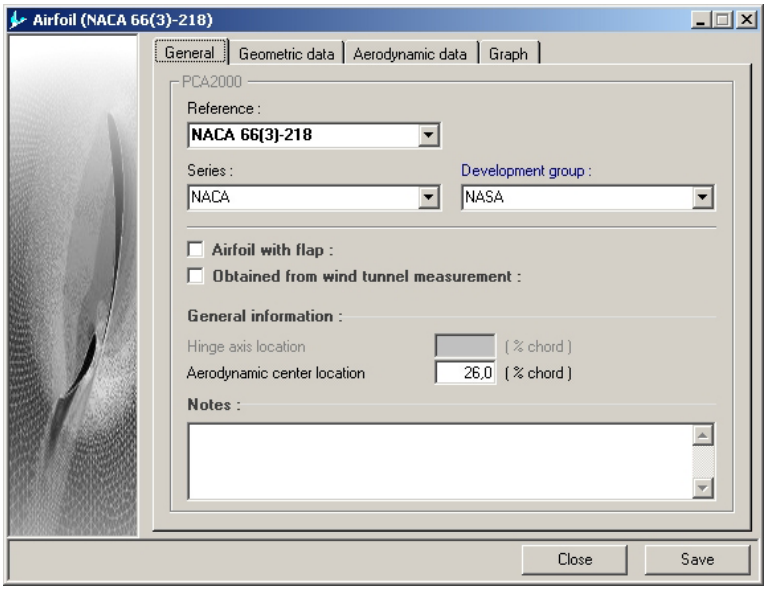


Figure 9.1 : Generalities

9.2 Table of content

9.3 Airfoils

9.3.1 Description

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

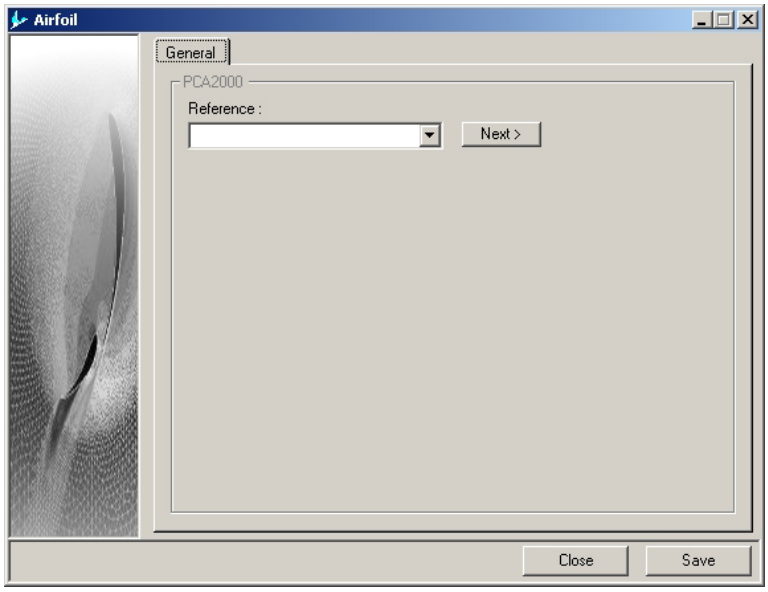


Figure 9.2 : Airfoils

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**.

9.3.2 Visualizing the characteristics of a given airfoil

When you open the **Airfoils** menu, all the references related to data files of airfoils stored in the folder **Airfoils** of **PCA2000-Data** are automatically downloaded in the application.

To visualize the characteristics of a given airfoil, **click** on the airfoil's reference that appears in the drop-down list under **References**. All the tabs of the Airfoils window are now accessible.

9.3.2.1 Generalities

The first tab contains the general information related to the selected airfoil.

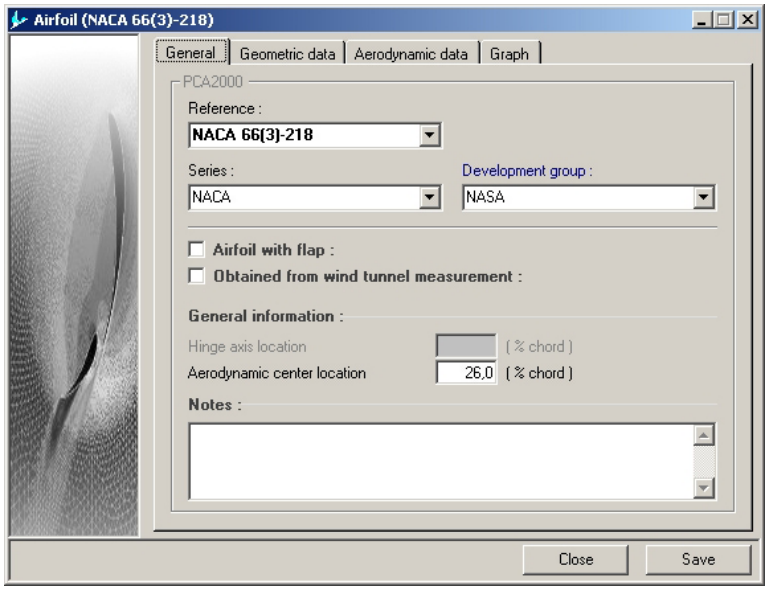
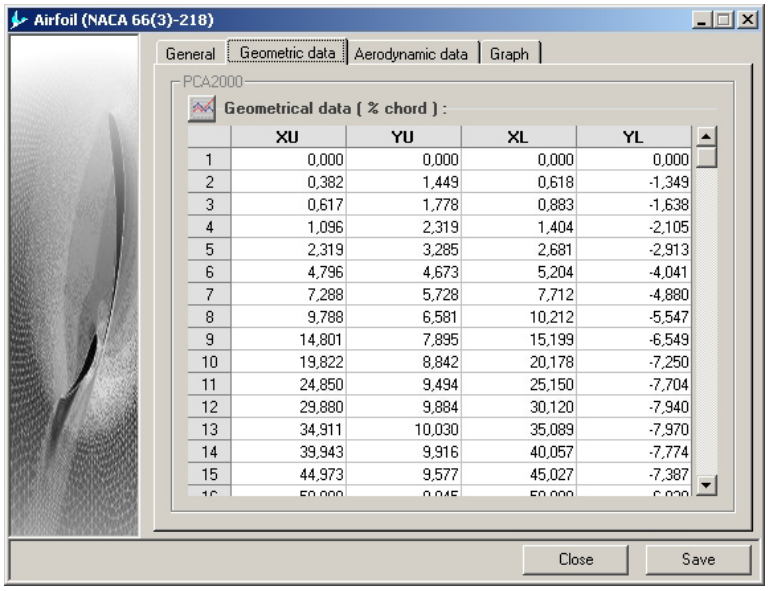


Figure 9.3 : Generalities

9.3.2.2 Geometric data

The second tab contains the geometric information related to the selected airfoil, namely the coordinates of the lower surface and the upper surface.



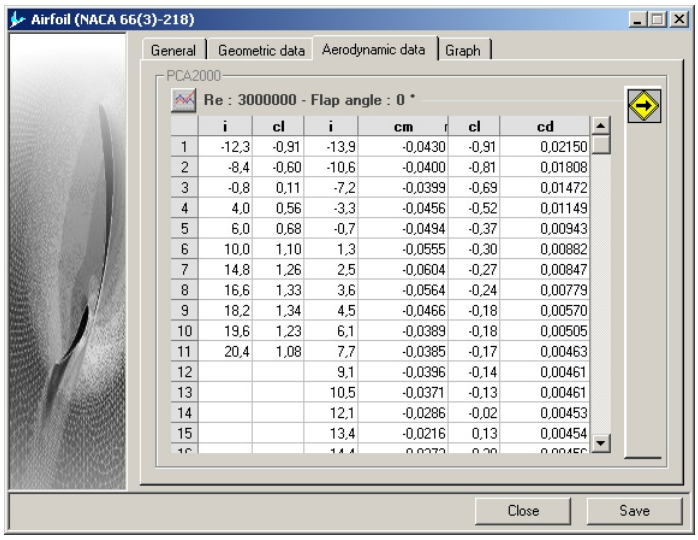
	XU	YU	XL	YL
1	0,000	0,000	0,000	0,000
2	0,382	1,449	0,618	-1,349
3	0,617	1,778	0,883	-1,638
4	1,096	2,319	1,404	-2,105
5	2,319	3,285	2,681	-2,913
6	4,796	4,673	5,204	-4,041
7	7,288	5,728	7,712	-4,880
8	9,788	6,581	10,212	-5,547
9	14,801	7,895	15,199	-6,549
10	19,822	8,842	20,178	-7,250
11	24,850	9,494	25,150	-7,704
12	29,880	9,884	30,120	-7,940
13	34,911	10,030	35,089	-7,970
14	39,943	9,916	40,057	-7,774
15	44,973	9,577	45,027	-7,387

Figure 9.4 : Geometric data

9.3.2.3 Aerodynamic data

The third tab contains the aerodynamic information of the selected data set. Each data set corresponds to the combination of a Reynolds number and a trailing edge flap angle position (if the profile is equipped with one).

In order to visualize in a graphic the information contained in a table, **click** directly on the [**Graphic**] tab or **click** on the button placed in the upper left corner in the table.



	i	cl	i	cm	cl	cd
1	-12,3	-0,91	-13,9	-0,0430	-0,91	0,02150
2	-8,4	-0,60	-10,6	-0,0400	-0,81	0,01808
3	-0,8	0,11	-7,2	-0,0399	-0,69	0,01472
4	4,0	0,56	-3,3	-0,0456	-0,52	0,01149
5	6,0	0,68	-0,7	-0,0494	-0,37	0,00943
6	10,0	1,10	1,3	-0,0555	-0,30	0,00882
7	14,8	1,26	2,5	-0,0604	-0,27	0,00847
8	16,6	1,33	3,6	-0,0564	-0,24	0,00779
9	18,2	1,34	4,5	-0,0466	-0,18	0,00570
10	19,6	1,23	6,1	-0,0389	-0,18	0,00505
11	20,4	1,08	7,7	-0,0385	-0,17	0,00463
12			9,1	-0,0396	-0,14	0,00461
13			10,5	-0,0371	-0,13	0,00461
14			12,1	-0,0286	-0,02	0,00453
15			13,4	-0,0216	0,13	0,00454

Figure 9.5 : Aerodynamic data

By default, the graphic displayed corresponds to the lift coefficient curve of the selected data set.

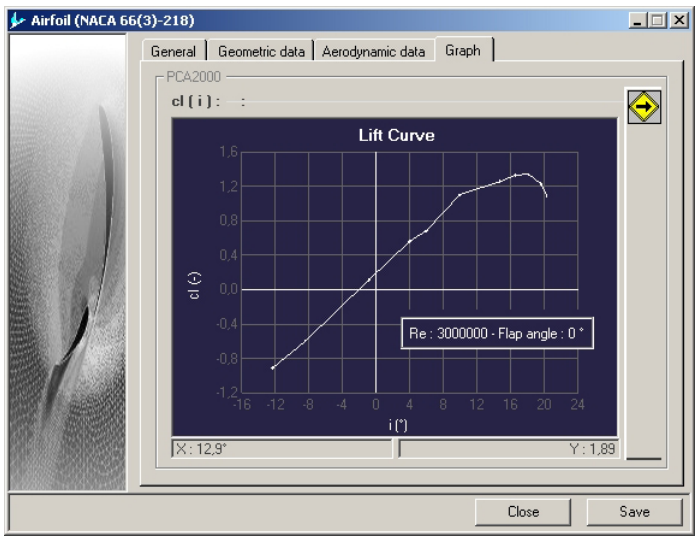


Figure 9.6 : Graphic visualization

To select another data set:

1. **Open** the drawer control by placing the mouse pointer on it
2. **Choose** the information that you wish to visualize.

To visualize the aerodynamic data:

1. **Select** one or several data set that you wish to see displayed (maximum 5 at a time),
2. **Choose** the information that you wish to visualize:

cl(i)	Evolution of the lift coefficient in relation with the incidence angle
cm(i)	Evolution of the moment coefficient measured at the aerodynamic center position in relation with the incidence angle
cmh(i)	Evolution of the moment coefficient measured at the control surface axis position (if the profile is equipped with one) in relation with the incidence angle
cd(cl)	Evolution of the drag coefficient in relation with the lift coefficient

3. The display is done automatically.

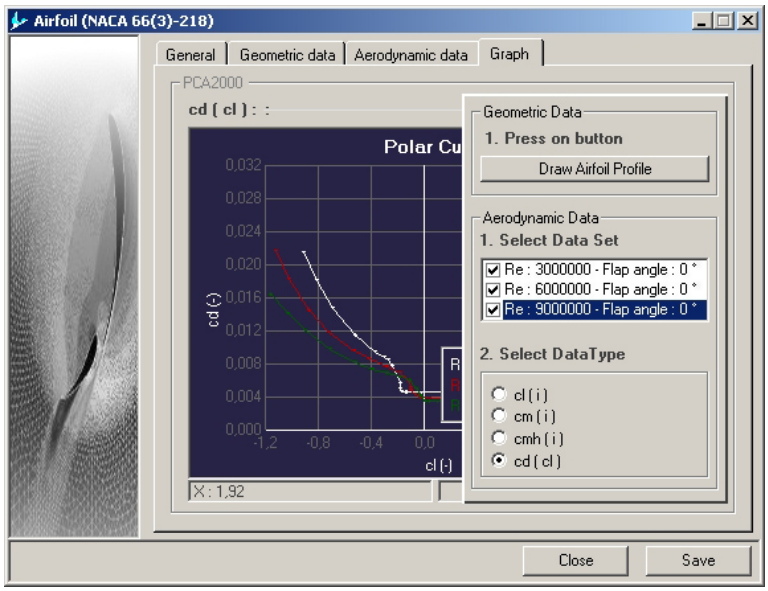


Figure 9.7 : Visualization of the aerodynamic data

The drawer control closes automatically once you move the mouse pointer away.

Once you move the mouse pointer over the graphic, the coordinates of the pointer's position are displayed in the two areas located at the bottom of the graphic.

The graphic legend can be moved around thanks to the mouse (left button) by clicking on it and by keeping the button pressed until the desired place is reached.

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

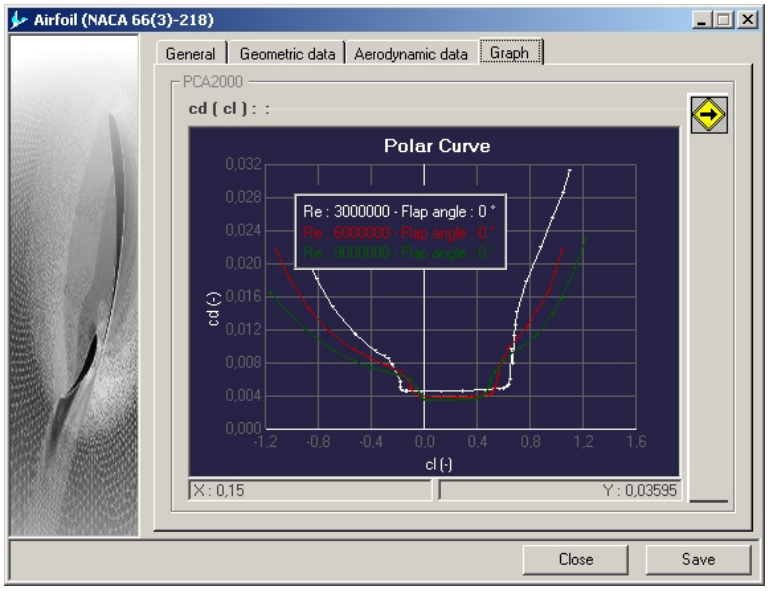


Figure 9.8 : Visualization of the aerodynamic data

In order to visualize other information:

1. **Open** the drawer control,
2. **Choose** the information that you wish to display
3. **Close** the box.

Visualizing the geometric data of the profile:

1. **Open** the drawer control,
2. **Click** on the button,
3. **Close** the drawer control.

Once you move the mouse pointer away, the drawer control closes automatically.

The graphic legend can be moved around thanks to the mouse (left button) by clicking on it and by keeping the button pressed until the desired place is reached.

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

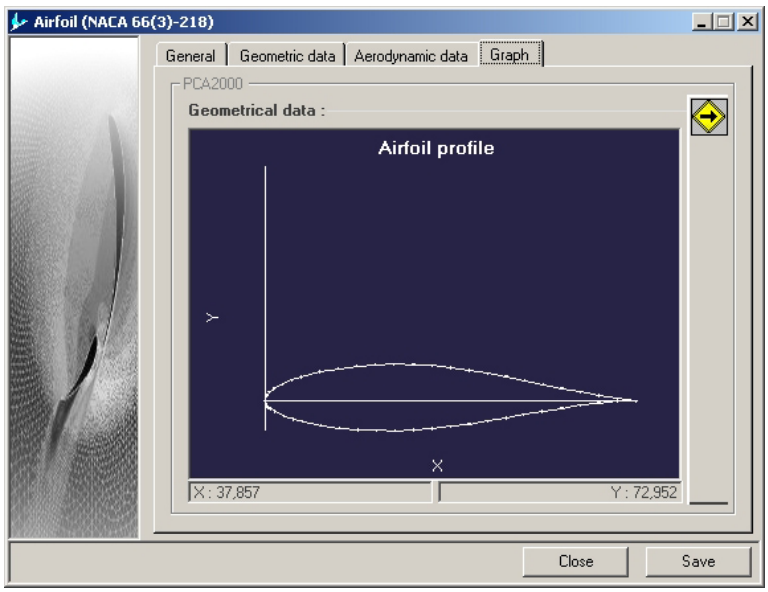


Figure 9.9 : Visualization of the geometric data

9.3.3 Inserting the characteristics of a new airfoil

In order to introduce the characteristics of a new airfoil in the database,

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

The Airfoils module is reset.

2. **Insert** the name of the new airfoil
3. **Click** on Next >.

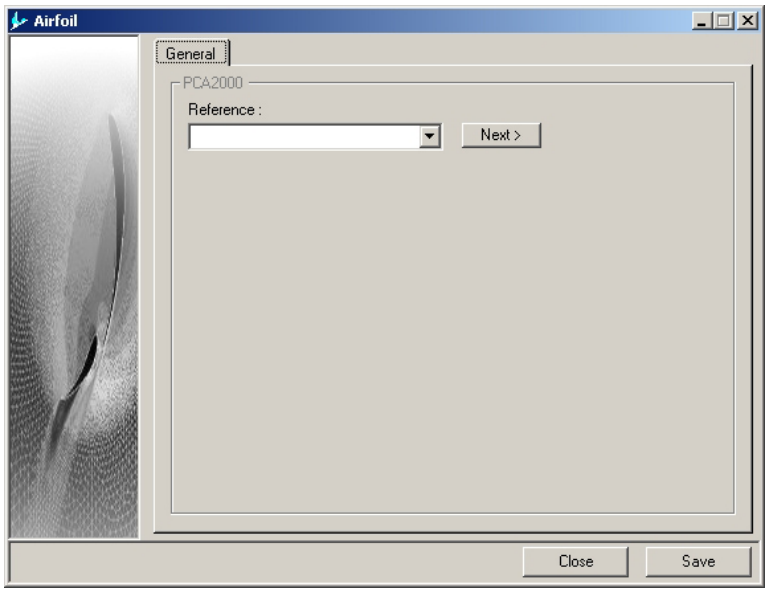


Figure 9.10 : Definition of the airfoil reference

9.3.3.1 Definition of the general information

Introduce the general information related to the new airfoil

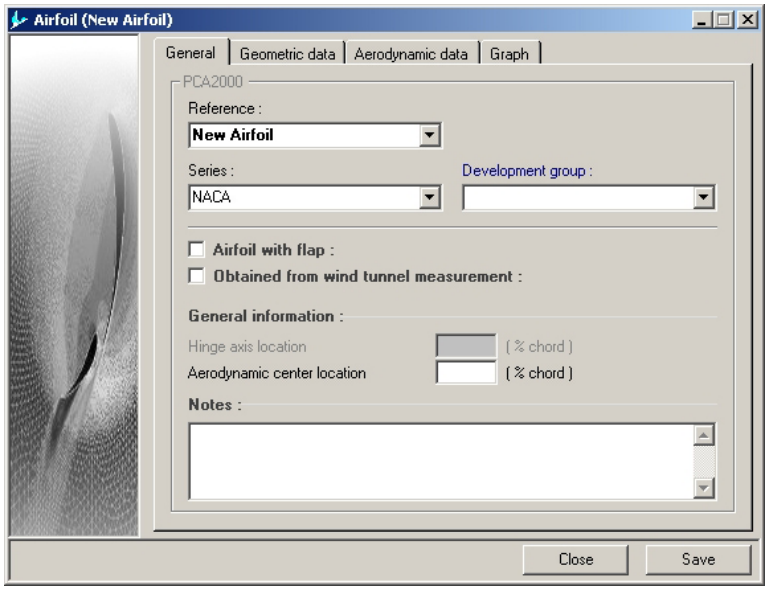


Figure 9.11 : Generalities

9.3.3.2 Definition of the geometric characteristics.

Insert its geometric characteristic.

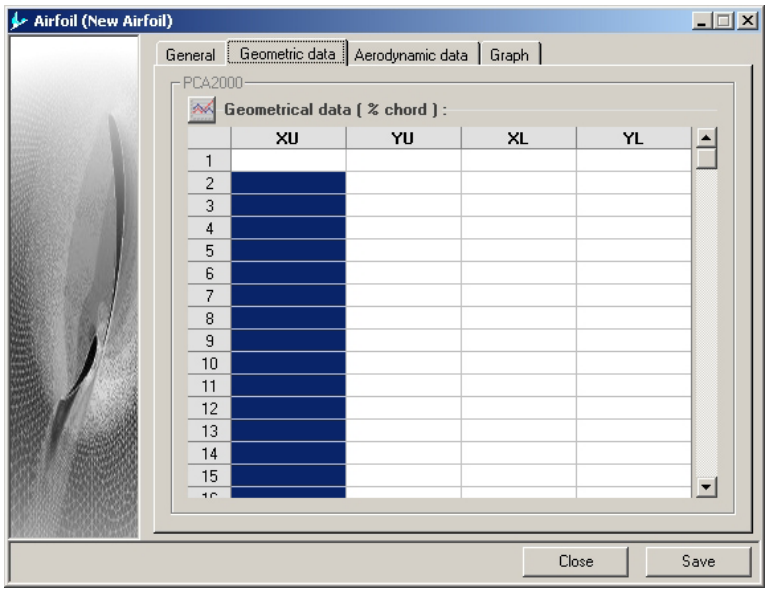


Figure 9.12 : Geometric information

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

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

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

9.3.3.3 Definition of the aerodynamic characteristics

In order to add a new data set:

1. **Click** on Create New.

The area located right at the bottom of the control button is now accessible.

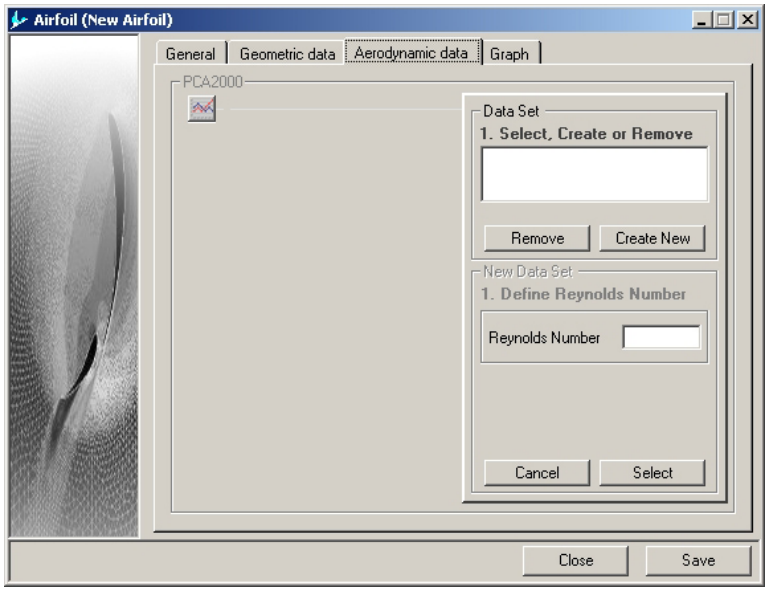


Figure 9.13 : Creation of a new data set

2. **Select** the Reynolds number that corresponds to the new data set and,
3. **Select** the trailing edge flap angle position if the airfoil is equipped with one. As a reminder, this characteristic is determined under the tab **Generalities**
4. **Click** on Select .

The new data set (empty) is displayed in the drop-down list.

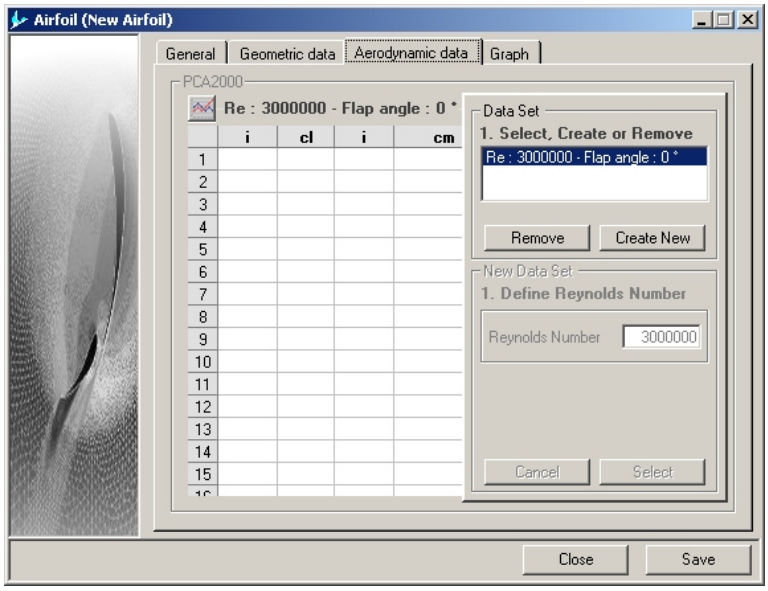


Figure 9.14 : Selection of the new data file

5. **Fill in** the table, cell by cell or use the [**copy**] [**paste**] functions taking information from other PCA2000 tables or spreadsheets such as Excel for example.

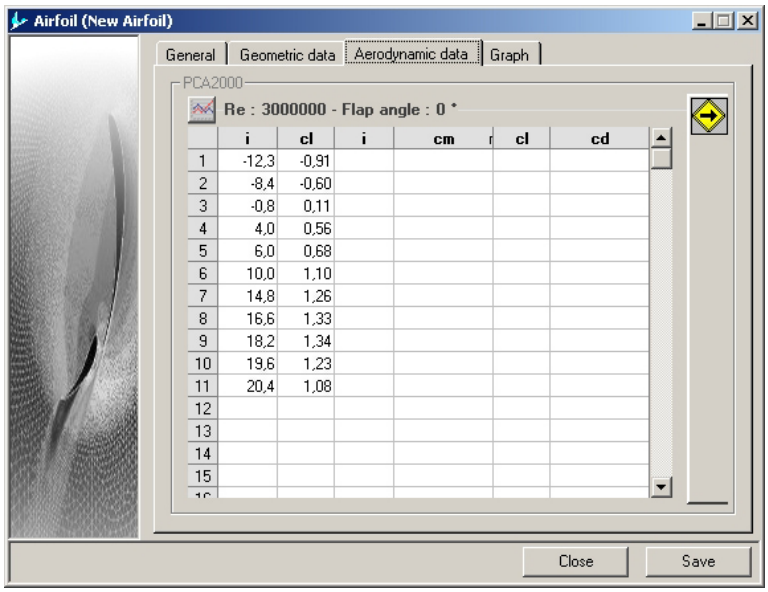


Figure 9.15 : Definition of the new data set

9.3.4 Save the data file of a new profile

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

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

The name of the profile will be NameOfTheProfile.arf

The file will be saved automatically in a specific folder according to its series:

- **NACA** : PCA2000-Data\Airfoils\NACA\NameOfTheProfile
- **Eppler** : PCA2000-Data\Airfoils\Eppler\NameOfTheProfile
- **Wortmann** : PCA2000-Data\Airfoils\Wortmann\NameOfTheProfile

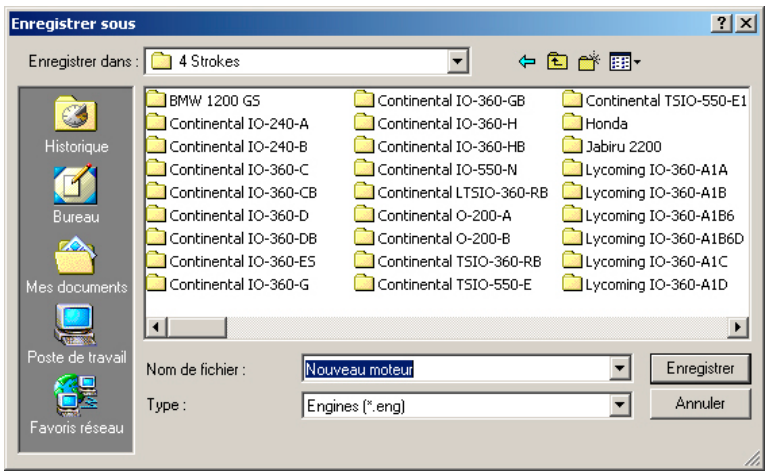


Figure 9.16 : Save the data file