Pi Aero

USER GUIDE

Pi Aero User Guide

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Contents

Introduction

PiAero provides the following basic functions:

- takes data on-line from Pi's wind tunnel instrumentation and stores it in a database
- allows you to develop an inventory of parts, used to describe the model configuration for each run
- places result and model configuration data in an Excel spreadsheet

Excel is intended to be the primary means for displaying the data, for generating reports and printouts. The Excel spreadsheet is linked 'live' to PiAero, so that data appears the moment it becomes available from the instrumentation. PiAero can also trigger macros in Excel upon receipt of data, so that printouts and other function calls can be run automatically.

The tables injected into the spreadsheet by PiAero can be used as sources of data for Excel charts and pivot tables. By spending a little time customising the Excel spreadsheet, you can create any number of reports, summary sheets, trend graphs etc... Once this has been done, it becomes a trivial task to select and load in data for the runs that you want to view.

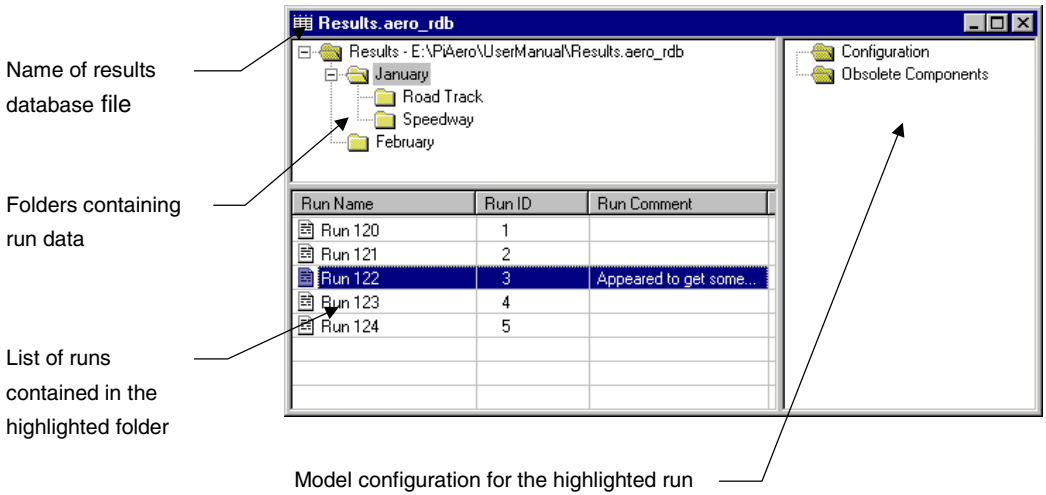
There are four types of data files used by PiAero. The distinction between them helps to explain the structure of the program.

Results Database (*.aero_rdb files)

A Results Database stores data generated by the wind tunnel instrumentation (forces, pressures etc...) run by run, together with the model configuration for each run.

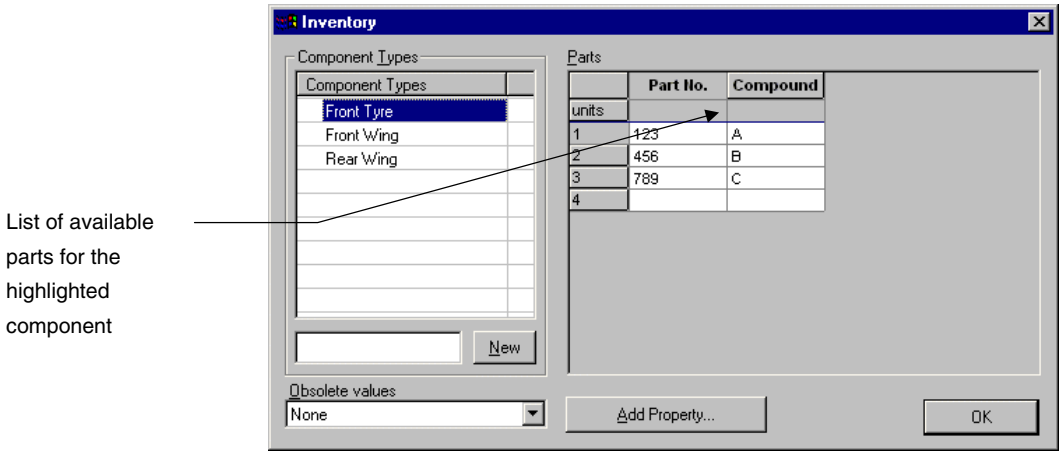
You can create any number of results databases, which could be used to separate out data for different projects, different cars, or perhaps each wind tunnel session.

A results database is displayed in PiAero as shown overleaf:



Inventory database (*.aero_idb files)

An Inventory Database stores all the details of the model parts.



When you define the model configuration for a particular run, you are associating the run with various parts in the inventory. However, the details of the parts actually remain in the Inventory database.

Note: If you delete a part from an inventory, then the information about it will be lost from every run that used that part

Although it is possible to create a number of inventory databases, this should only be done if you have distinct projects with no commonality of parts. The best strategy is to maintain a single inventory database that is carefully controlled - e.g. only one user should update the inventory at a time.

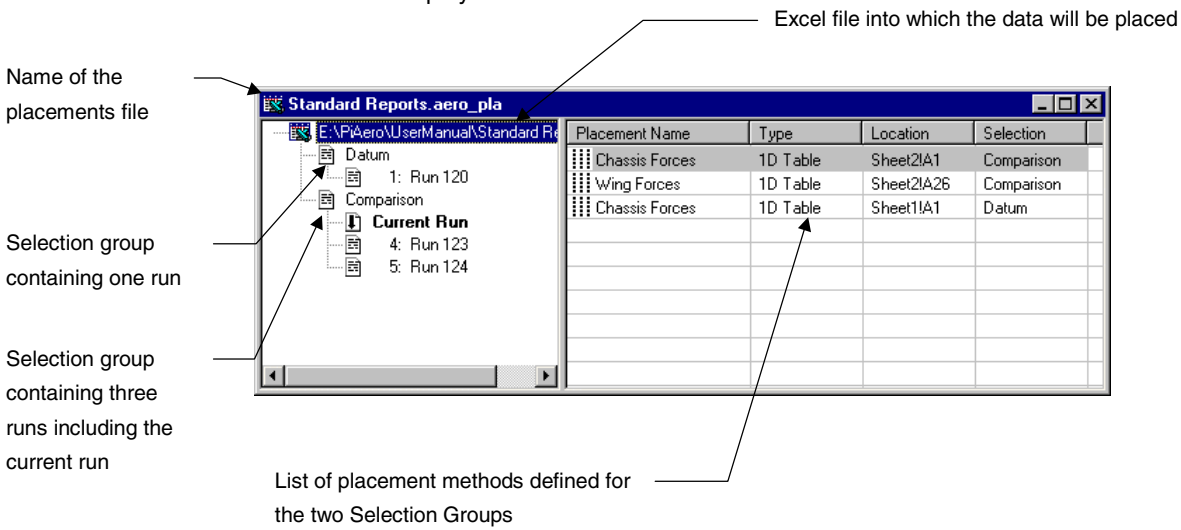
Placement files (*.aero_pla files)

A Placement file contains instructions for putting data into an Excel spreadsheet. It contains one or more Selection Groups, each of which contains the following:

- a source of data (i.e. one or more runs)
- a number of methods for placing data from that source into the spreadsheet

The spreadsheet will be populated with data whenever you change a data selection. If that includes the current run, then the spreadsheet will be change in real-time as results are generated.

A Placement file is displayed in PiAero as follows:



You will typically create a spreadsheet and a placement file as a matched pair: the formatting, charts and reports of the spreadsheet will correspond to the placement methods of the placement file.

Channel file (*.aero_cdb files)

PiAero maintains a channel file containing a record of all the channel names that PiAero has ever encountered. These are used when presenting the user with a list of channels from which to select.

It is possible to delete redundant channels from this file using PiAero Administrator - a separate program. If you delete a channel, but PiAero encounters it again (for example, when opening an old results database), then it will re-insert the channel name into the channel file.

More details are available on PiAero Administrator in a later section.

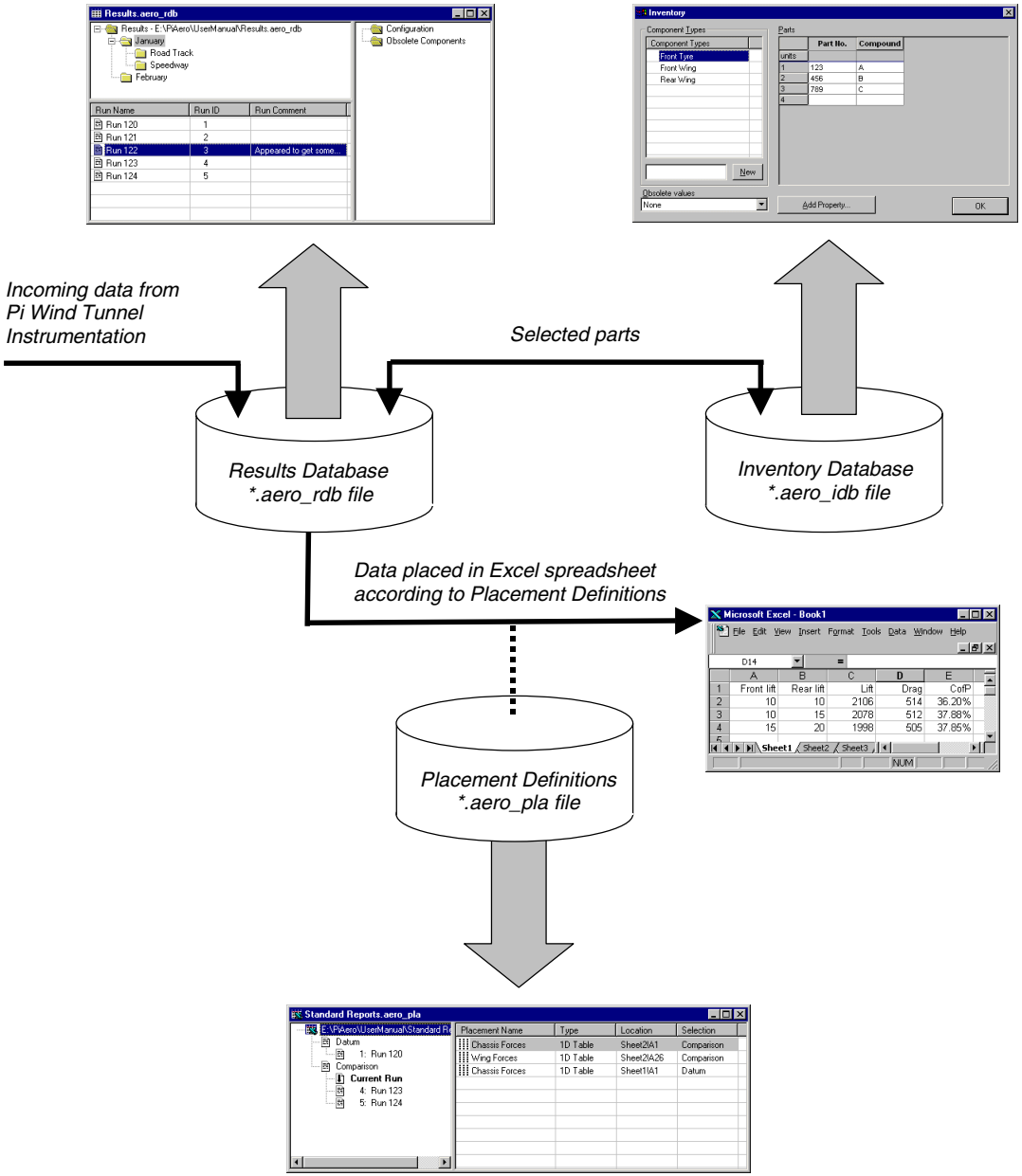
Workspaces (*.aero_wsp files)

The workspace is the collection of active windows such as Results, Configuration, and Placement. Having created a workspace it can be saved for future recall and use.

Saving a workspace saves the active windows in the position and size / configuration you defined when using them. See the section on Workspaces on page 15.

Operation

The interaction of data in PiAero is best shown by the diagram on the next page:


Results.aero_rdb
Results - E:\PiAero\UserManual\Results.aero_rdb
January
Road Track
Speedway
February
Configuration
Obsolete Components
Run Name
Run ID
Run Comment
Run 120
Run 121
Run 122
Appeared to get some...
Run 123
Run 124
Inventory
Component Types
Front Tyre
Front Wing
Rear Wing
New
Parts
Part No.
Compound
units
Obsolete values
None
Add Property...
OK
Incoming data from
Pi Wind Tunnel
Instrumentation
Selected parts
Results Database
*.aero_rdb file
Inventory Database
*.aero_idb file
Data placed in Excel spreadsheet
according to Placement Definitions
Microsoft Excel - Book1
File Edit View Insert Format Tools Data Window Help
Front lift
Rear lift
Lift
Drag
Placement Definitions
*.aero_pla file
Standard Reports.aero_pla
Datum
1: Run 120
Comparison
Current Run
4: Run 123
5: Run 124
Placement Name
Type
Location
Selection
Chassis Forces
1D Table
Sheet2!A1
Comparison
Wing Forces
Sheet2!A26
Chassis Forces
Sheet1!A1
Datum

Setting up

To set up PiAero for regular use, you should do the following:

- create a Results Database with suitable folders (e.g. February, March...)
- create an inventory of model parts
- create one or more placement files and corresponding spreadsheet templates

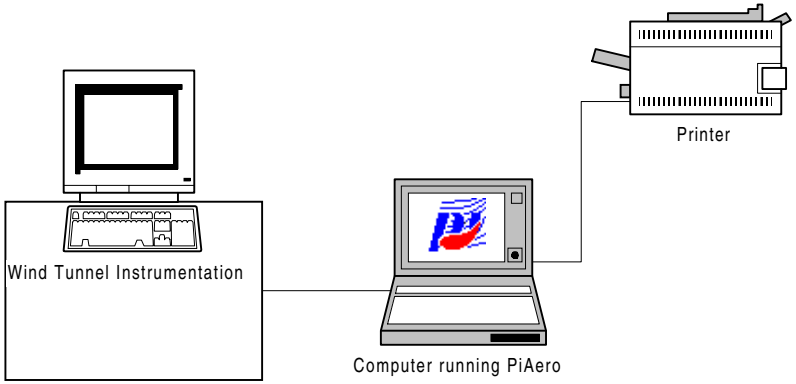
Regular operation

Once this is done, you will typically operate PiAero as follows:

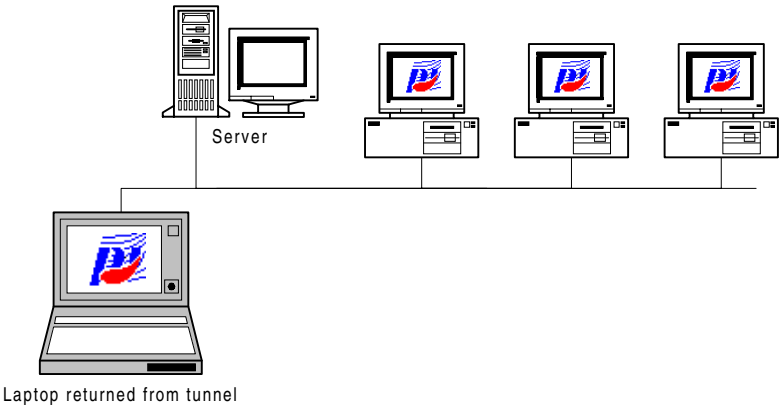
- From run to run... make sure the model configuration accurately describes the model being tested.
- When analysing data... generate spreadsheet reports by dragging runs from the Run Databases into Data Selections

Computer configuration

At the tunnel, PiAero needs to be running on a computer connected to the instrumentation by a serial communications link or on a network.



Away from the tunnel, it is likely that others will want access to the data, perhaps using a fileserver as a central repository.



If a computer (e.g. a laptop) is taken to the wind tunnel to collect results, then it is very important to maintain control over the "master" copies of the data files. If, for example, two

engineers are both editing different copies of the Inventory database, one on the tunnel laptop, one on the factory server, then you have lost control over the master copy.

It is not necessary to be strict about the control of Placement files and Excel templates, as these do not store unrecoverable information. It is likely that each user of PiAero will have their own Placement files and Excel templates to match their own requirements for viewing the data. You may, however, keep a library of these files on the fileserver for common access.

Setting up for networked usage

You can easily change the results and placement files that PiAero is using, simply by selecting Open or New from the File menu. With the correct network configuration, you can read and write to these files on remote computers as if they were on your own machine.

PiAero also needs an inventory and a channel file. To select which files PiAero uses, you need to start PiAero Administrator and change the choice of file. See the section towards the end of this manual.

Workspaces

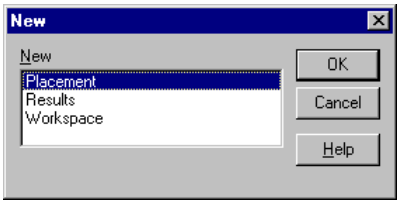
The workspace is the collection of active windows such as Results, Configuration, and Placement you have used during aerodynamic analysis. Saving a workspace saves these active windows in the position and size / configuration you defined when using them.

Once created the workspace is automatically saved when you close it, when you open another workspace or when you exit PiAero.

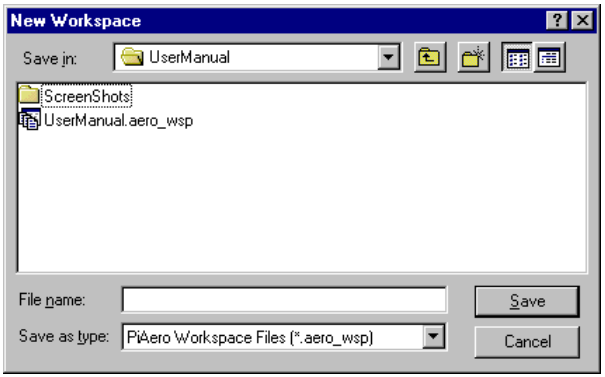
Saving a workspace

1. Select New from the File menu.

   This brings up the following dialog:



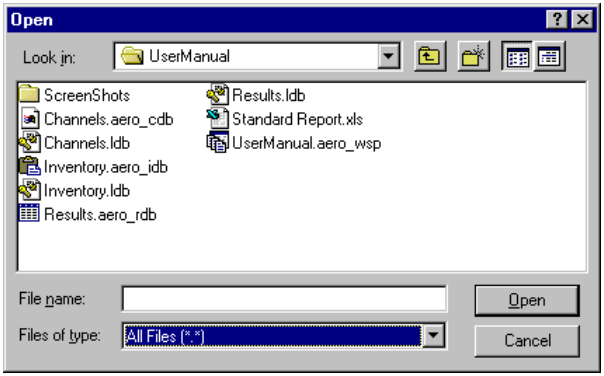
2. Select Workspace and click OK to bring up the following dialog:



3. Choose a Drive and Directory in which to save the workspace, enter the File name and click Save.

Opening a workspace

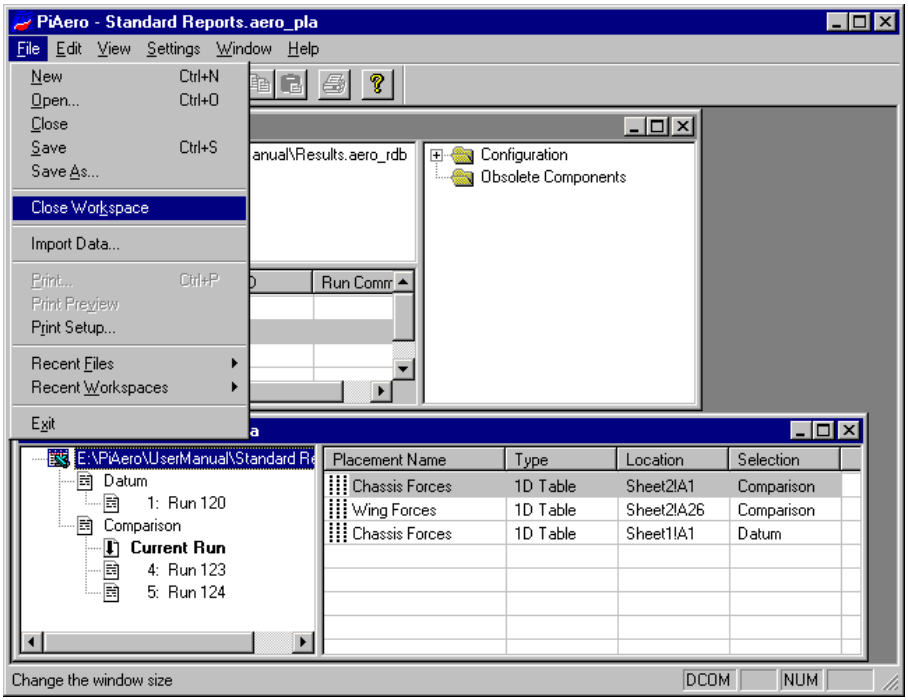
1. Select Open from the File menu.
   This brings up the following dialog:



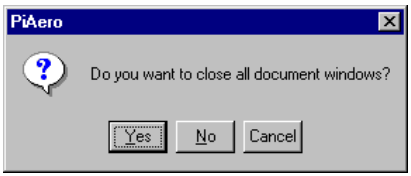
2. Select the Drive and Files of type .aero_wsp.
3. Select the file and click Open.

Closing a workspace

1. Select Close Workspace from the File menu.



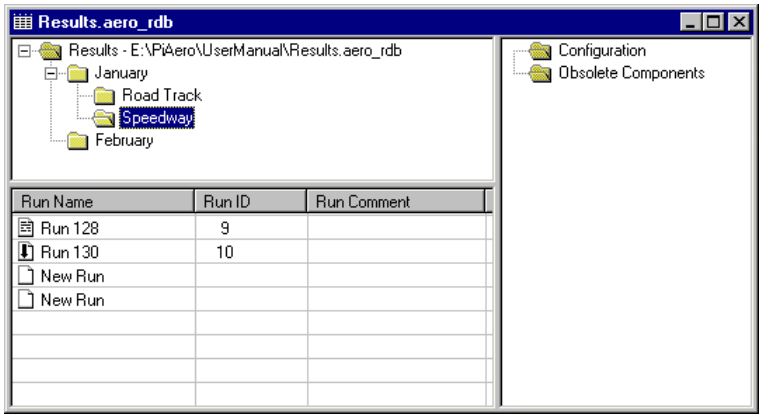
This brings up the following dialog:



2. Click Yes or No as appropriate.

Results storage

A Results Database stores data from one or more runs. These can be organised into folders - which might be used, for example, to segregate runs from different days, months, or major model changes. The folder structure is displayed in the top left pane of a results window, and the runs contained in the highlighted folder are shown as a list in the bottom left pane.



A run contains three types of data:

- wind tunnel data - generated by the instrumentation and imported into over a serial link / network
- model configuration data - entered by the user within PiAero
- run comments - entered by the user within PiAero by double-clicking on the run in the lower left-hand pane

Runs with and without wind tunnel data are distinguished as follows:


identifies a **past** run - i.e. one that has received data from the wind tunnel. It contains both model configuration data and wind tunnel data, and cannot be deleted from the database.

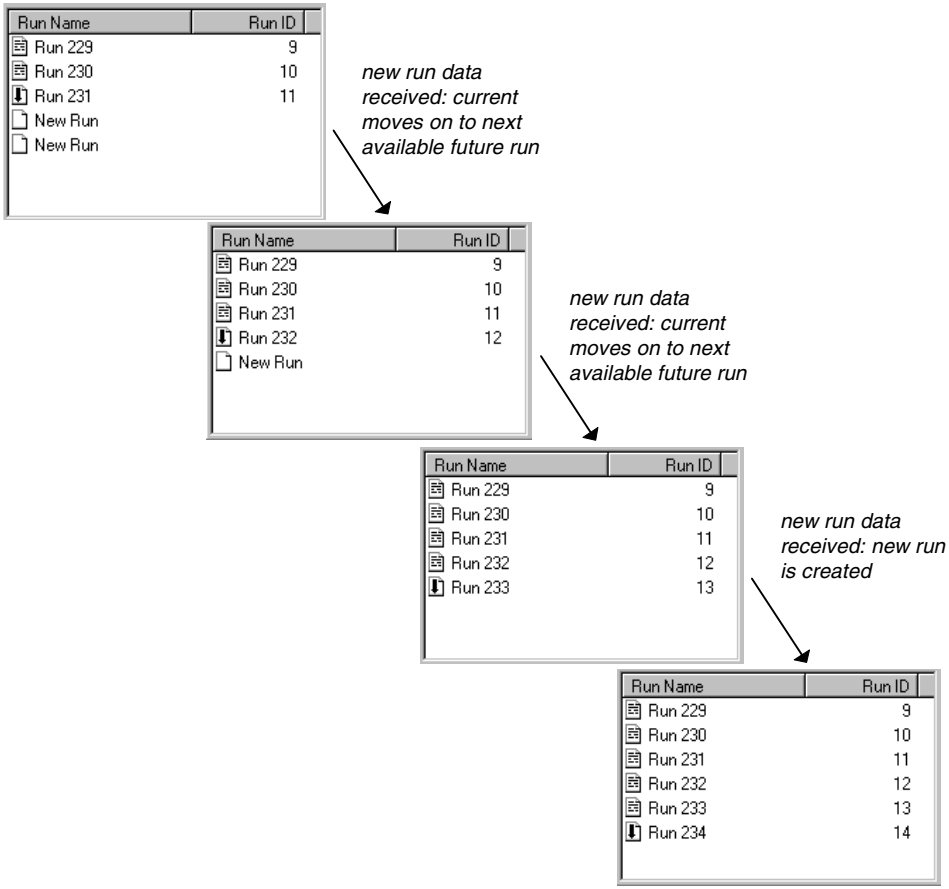

identifies a **future** run - i.e. one that has yet to receive data from the wind tunnel. It contains only model configuration data, and can be deleted from the database.

Each Results Database has one run designated as the **current** run. In turn, one Results Database is designated as **active**. Whenever PiAero receives data from the wind tunnel instrumentation, it assigns it to the current run in the active database.

 Identifies the current run in the active database.

 identifies the current run in a non-active Results Database

Since the runs are listed chronologically, a folder always contains firstly all the past runs, then (optionally) the current run, then all the future runs. When the instrumentation indicates that a new run is starting, the current run moves on to the next available future run. If one is not available, it creates one. This process is shown in the diagram below



By creating a number of future runs, you can set up a sequence of model configurations in advance of the wind tunnel test.

The minimum that you need to do to run PiAero is as follows:

- open or create a results database
- create a series of folders in which to store the runs
- set the active results database
- set the current run

You can optionally create a number of future runs.

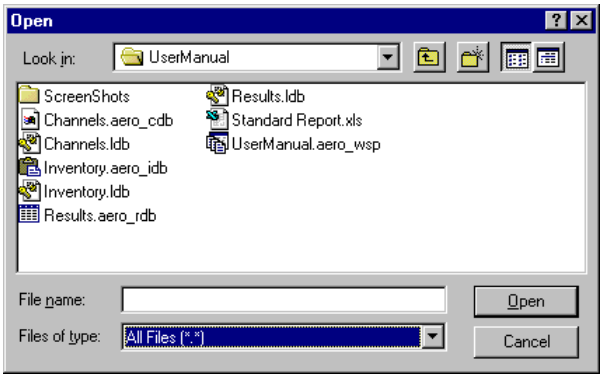
Opening and creating Results Databases

Opening a Results Database

3. There are three methods for opening a results database file:

either: select Open from the File menu
or: type Ctrl-O;
or: click on the Open file button 

This will bring up the following dialog:



4. Narrow down the selection to Results Database files using the file type filter at the bottom of the dialog. Results Database files have the file extension *.aero.rdb. and are identified by this icon. 

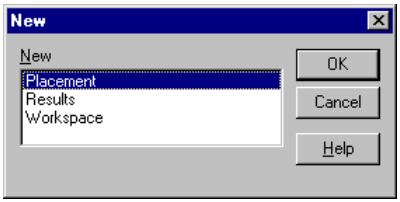
5. Select which file you want and press Open. If you can't find it in the current directory, use the browsing controls at the top of the dialog box to change directory.

Creating a new Results Database

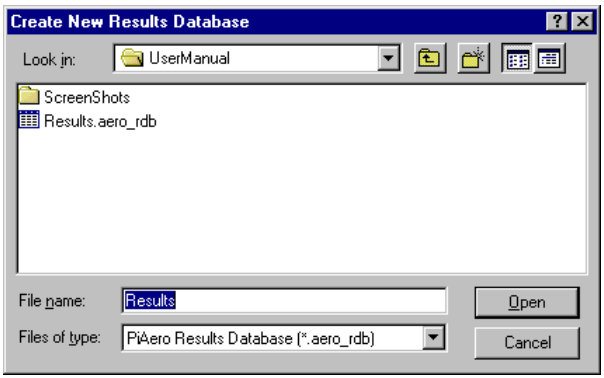
1. There are three methods for creating a new results database file:

   either: select New from the File menu
   or: type Ctrl-N
   or: click on the New Database button 

   This will bring up the following dialog:



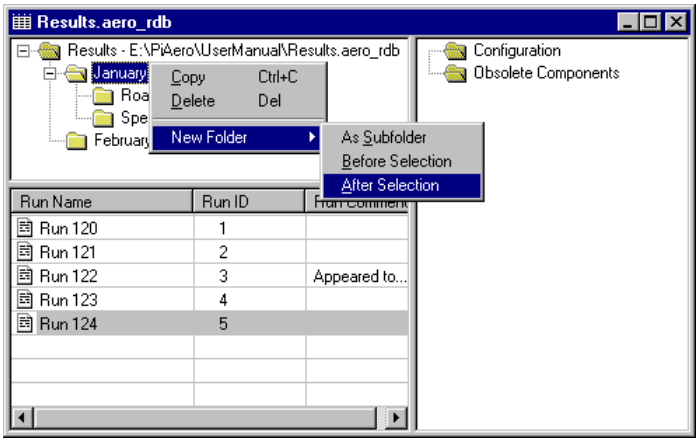
2. Click on Results and press OK to give the following dialog:



3. Choose a directory for storing the database and enter its name. Press Open to create and start the database.

Folders

You can change the folder structure by right-clicking on the part that you want to change.



You can add folders as siblings or children of existing folders, and you can also rename them by clicking on their names.

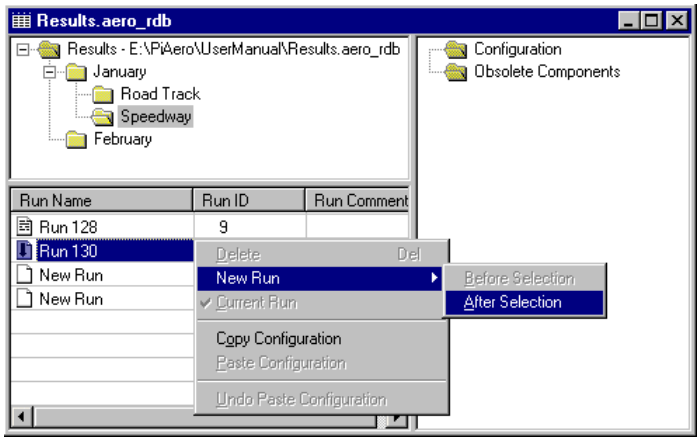
You can also delete folders, but only if they do not contain any runs.

Runs

Future runs

You can add a future run to a Results Database by right-clicking on the following parts of the run list pane:

- on the last past run
- or on an existing future run
- or (if the run list is empty) anywhere in the run list pane



The only restriction is that you cannot insert a new run between past runs.

Current run

In order to import data from the instrumentation, one run in the database must be selected as the current run. This must be the first future run in a folder.

1. If the folder doesn't contain any future runs, right-click on the last run and select New Run → After Selection.
2. Right-click on the first future run in the folder and select Current Run.

Deleting runs

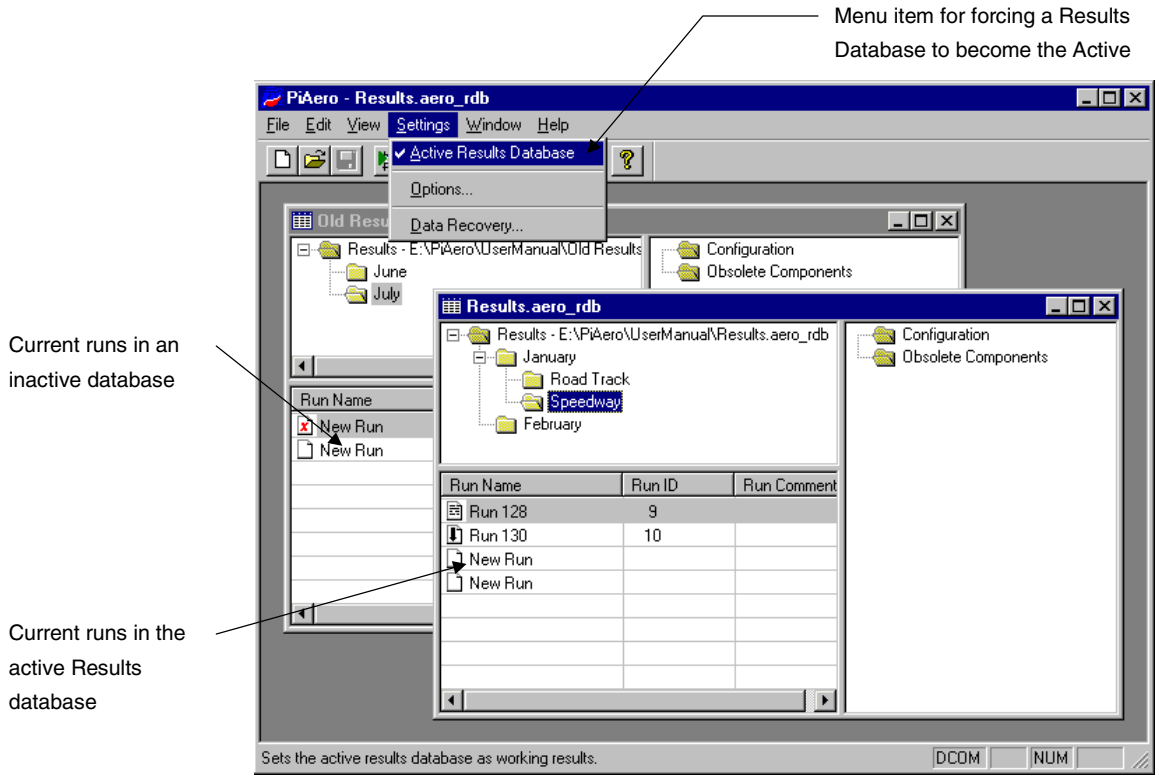
To delete a run, right-click on a run and either select Delete or press the Del key. You cannot delete the current run.

Active database

Incoming wind tunnel data will get assigned to the current run in the active database. To make a database active:

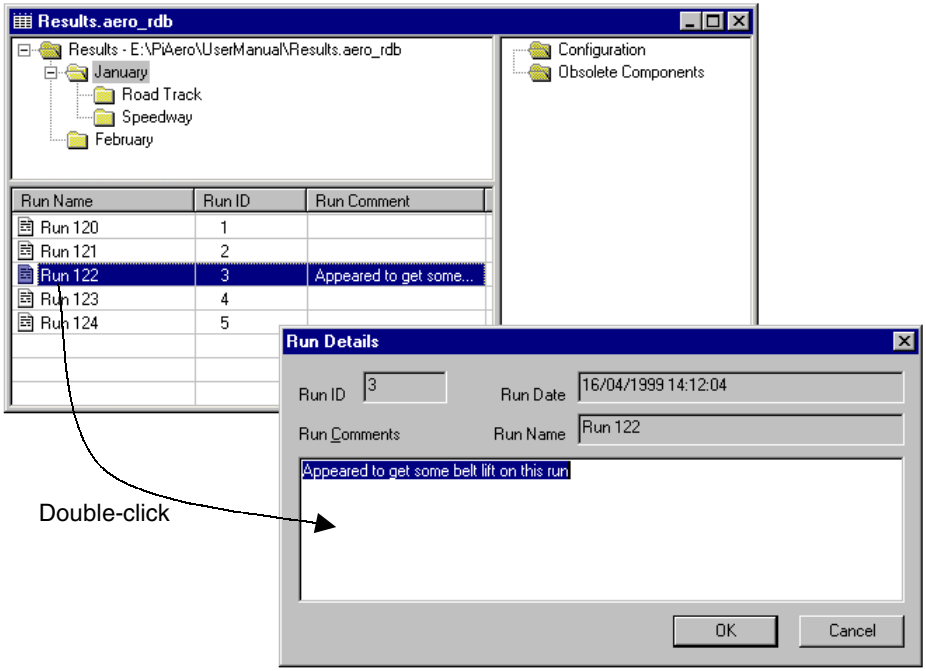
- make sure the Results Database is open
- select Active Results Database from the Settings menu.

A check sign (✓) appears next to the Active Results Database whenever the currently opened database is the active one.



Run comments

Run comments appear in the lower left-hand pane of the results window, and can be edited by double clicking on a run, as shown overleaf.


Results.aero_rdb
Results - E:\PiAero\UserManual\Results.aero_rdb
January
Road Track
Speedway
February
Configuration
Obsolete Components
Run Name
Run ID
Run Comment
Run 120
1
Run 121
2
Run 122
3
Appeared to get some...
Run 123
4
Run 124
5
Double-click
Run Details
Run ID
3
Run Date
16/04/1999 14:12:04
Run Comments
Run Name
Run 122
Appeared to get some belt lift on this run
OK
Cancel

Car configuration

The car consists of a set of **components** (e.g. front wing), and the car's configuration for a particular run is described in terms of the **parts** assigned to those components (e.g. 'part#123'). All the parts available for selection are stored in an **inventory**.

The inventory also defines **component types**: each component on the car and each part in the inventory is associated with a component type. The selection of parts for a component is restricted to those of the same component type. Typically, components that are repeated on the car (e.g. wheels) will share the same component type, so that they draw from the same list of parts in the inventory.

Each part has one or more user-defined **properties** (e.g. part number, size, angle etc...), which describe the part in detail. One of the properties is nominated to be shown in the **configuration layout**, which provides a quick view of all the parts on the car. All of the properties of all the parts can be displayed in an Excel placement.

If a property of a part represents a setting rather than a physical attribute - for example 'wing angle' - then you can change the value for that property locally for each run without creating any additional parts in the inventory.

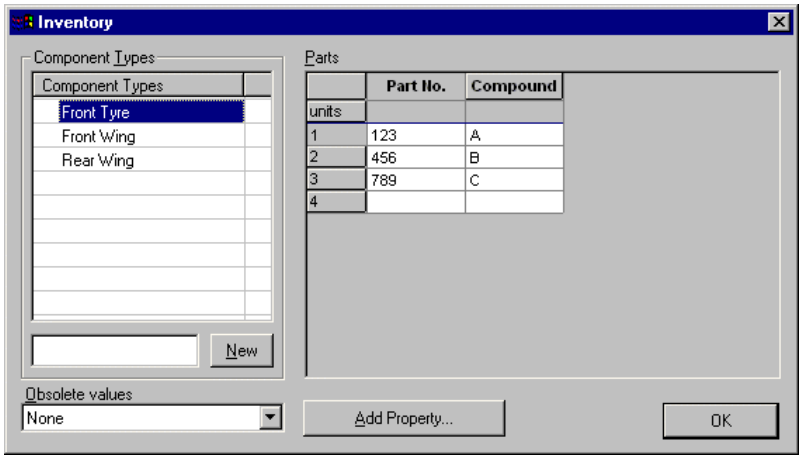
A useful thing to bear in mind is that once you have entered data into the inventory, it can never be removed entirely. PiAero offers various ways of hiding obsolete data, but it will still remain in the database and can be recovered at a later date.

The steps you need to follow when building an inventory for the first time are:

1. make a list of the components that make up your car, and decide how many component types describe them (most parts on a car are unique, and so you will probably have almost as many component types as there are components)
2. create a new component type
3. define any new properties that you'll need for parts of that type
4. create however many parts of that type that you want in the inventory
5. create the components of that type in the configuration layout

Component types

First, bring up the inventory from the View menu.



Creating a component type

On the left are the currently available component types. To create a new one, type its name into the box to the left of the New button and click New.

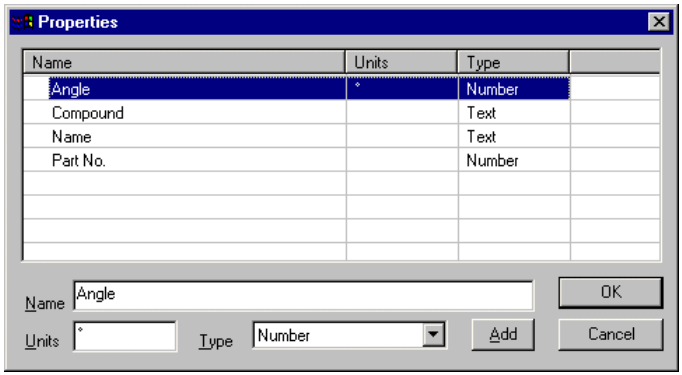
To start with, no parts or properties are defined in the right-hand pane for that type.

Deleting / recovering a component type

If you want to delete a component type, then right-click on it and select Delete. If you wish to recover it at a later date, then choose to show the obsolete 'Parts, Properties and Types' from the box at the bottom left - all the deleted component types will now appear, marked by a red cross. You may now right-click on a deleted type and select it to be 'Marked available'.

Properties

Click on the Add Property... button.



The properties shown are universal for the inventory, and can be re-used by many different component types.

Creating a new property

To create a new property, enter its name and units into the boxes at the bottom. Also select a 'type' - this affects how the property information is stored in the database and will restrict the values that you can enter. Click the Add button.

The new property appears in the list.

Note: To enter the units symbol for degrees °, hold down the Alt key on your keyboard, type 248 on the numeric keypad, then release the Alt key.

Editing a property

You can edit a property simply by clicking on it and changing the name, units or type down at the bottom of the window. Do not press the Add button, as this will create another property with your changed settings. When you click to another property, you will see your edited changes appear.

Deleting / restoring a property

To delete a property from the global list, click on it and press the Delete key. A red cross will appear against it.

Note: This will affect all parts that have this property, so proceed with care.

To restore it, click on it and press the Add button.

First, add the properties that you require to the component type.

1. click on the Add Property... button in the Inventory window.
2. click on the property you wish to add.
3. click on the OK button
4. go back to step (1) and repeat until you have all the properties you want.

Now enter as many parts as you want into the inventory.

1. enter values for the properties for a part. If the property is a setting (such as wing angle) that you will change for each run, then just leave it blank
2. press the tab key to move on and create a new row.

Changing the displayed property

The first property that is listed (i.e. the left-most column) is the property that will be displayed in the configuration layout. To change this, right-click on the top row of the property that you want to display and select 'Displayed property'. This property will now move to become the left-hand column.

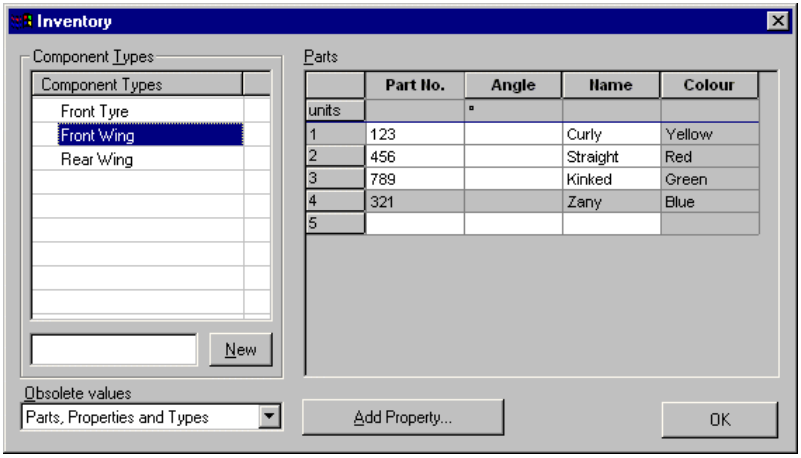
Removing / restoring properties

To remove a property, right-click on the top row of the property and select 'Marked Obsolete'. Unless 'Properties' are selected in the Obsolete values box at bottom left, its column will disappear. Otherwise, the column will remain, but greyed out. To restore it, right-click again and select 'Marked Available'.

Removing / restoring parts

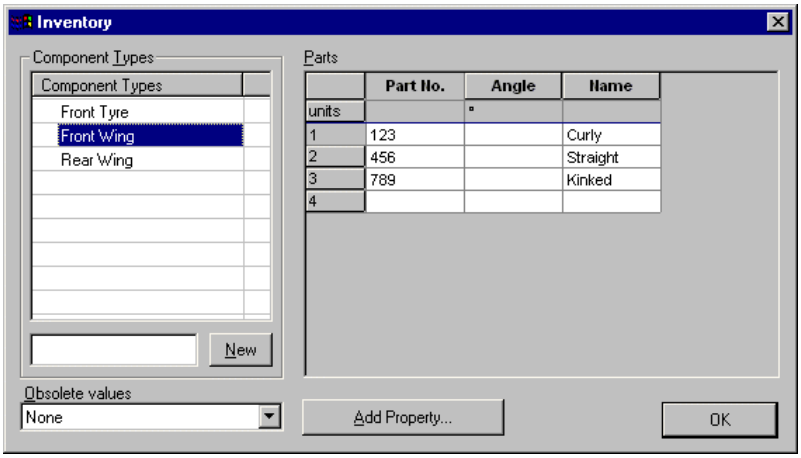
A similar technique is used to remove or restore parts from the inventory.

To remove a part, right-click on the left-hand cell of the part and select 'Marked Obsolete'. Unless 'Parts' are selected in the Obsolete values box at bottom left, its row will disappear. Otherwise, the row will remain, but greyed out. To restore it, right-click again and select 'Marked Available'.



In the example above, the component type has 4 parts available, and one ('Zany') which has been made obsolete. The property 'Colour' has been made obsolete, and so is also shown greyed out.

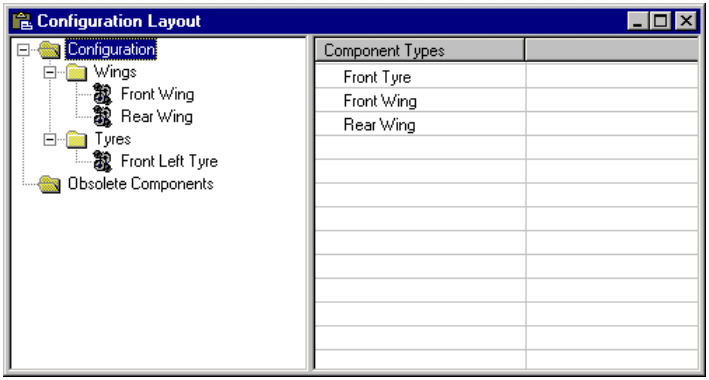
If 'None' is selected from the Obsolete values box, all the greyed out data disappears.



Configuration layout

Once you have defined some component types in your inventory, you can define the list of components that make up the car. This is displayed as a treeview, and appears in the right-hand pane of the Results window.

From the main menu, select **Configuration Layout** from the View menu.



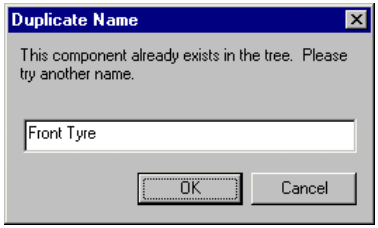
On the right are all the available component types. On the left is the treeview representing all the components on the car.

Note that there is only one configuration layout defined in PiAero at a time. All results windows will show the car's configuration using the same layout, even for a run performed years previously with a completely different set of components on the car. Components that were in use at the time of the run, but which no longer feature in the configuration layout, are bundled together in the 'Obsolete Components' folder.

Defining a new component

To define a new component on the car, drag a component type from the right pane to the relevant folder in the left pane.

Note that PiAero will not let you have two components with the same name. If you are using the same component type more than once in the configuration layout, then PiAero will prompt you to enter a new name.



Deleting / restoring a component

To delete a component, click on it and press the Del key. It will be moved down to the bottom folder - 'Obsolete Components'. To restore the component, drag it back up from the Obsolete Components folder.

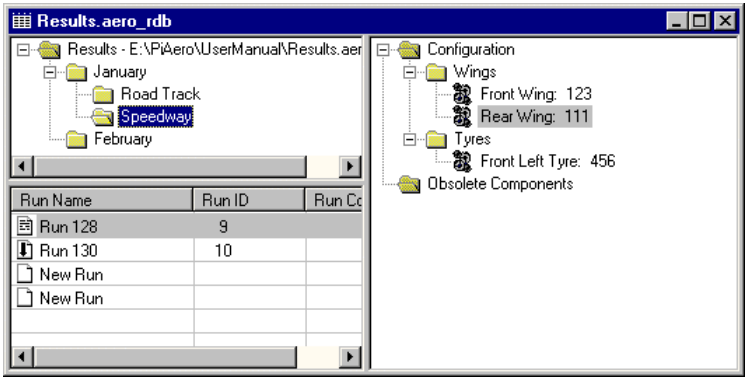
Changing the folder structure

You can create new folders by right-clicking on the parent or sibling folder and selecting 'New folder'. Folders can be renamed by clicking on the name and typing the new name.

Setting the configuration for a run

Once the inventory has been defined, you can define the configuration for each run.

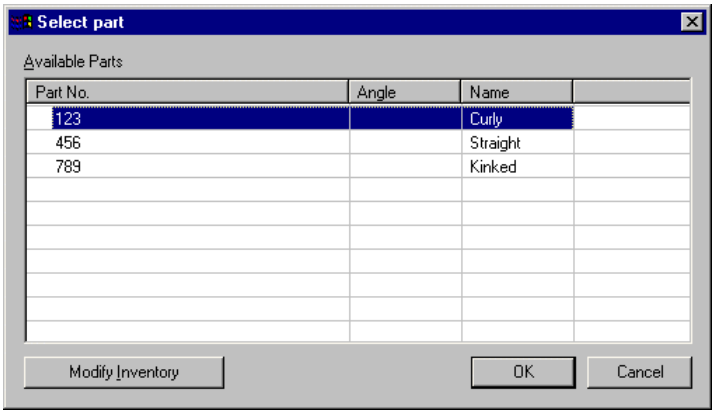
When you select a run in the bottom left pane of a Results window, its configuration is shown in the right-hand pane.



Note that when a new run is created, either because run data has arrived, or because you've created one manually, it will have the same configuration as the previous run.

Selecting a part

To select a different part for a component, double-click on it in the right-hand pane, or right-click and choose **Select Part...**

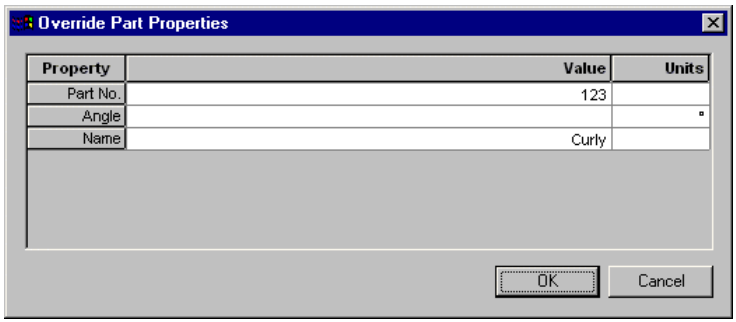


Click on the part you want and press OK. If the part you require is not in the list, or if the list is incorrect, then press the Modify Inventory button and make the necessary adjustments.

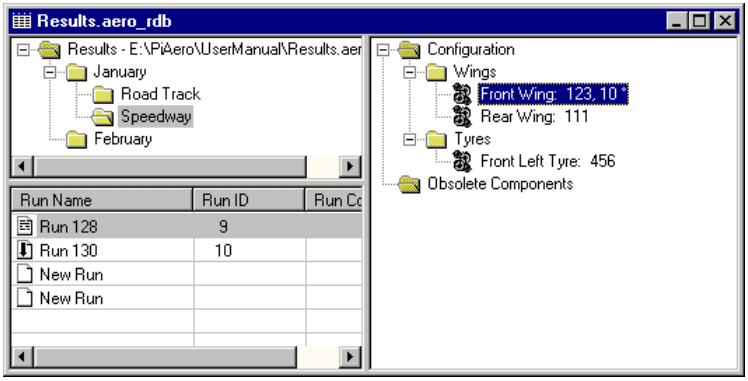
Note: If you edit the properties of an existing part, then the new properties will apply to all runs where that part was selected.

Making a local property change

If you want to change the value of a property without changing the inventory then right-click on the component and choose **Override Part...**



Enter the new value that you want and press OK. This will appear in the configuration layout next to the displayed property.



Copying configurations from one run to another

To copy a whole configuration:

- Right-click on the source run in the bottom left pane of the Results window, and select **Copy Configuration**.

To copy part of a configuration:

- Right-click on the part of the configuration to copy and select **Copy Subcomponent**

To paste the selected configuration data:

- Right-click on the destination run, and select **Paste Configuration**.

Undoing Paste Configuration

The paste configuration operation can be undone by right clicking on a run and selecting **Undo Paste Configuration**.

Placement definitions

A Placement file defines what data gets placed in an Excel worksheet, and in what format.

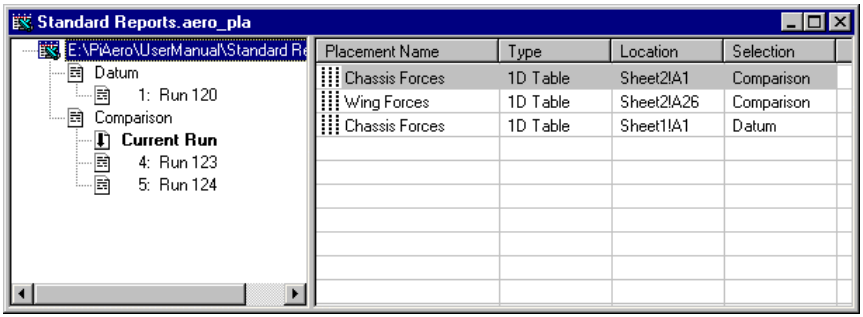
The format is determined by placement methods, which define which channels go where, in what order, with what qualification etc... The three types of placement method are:

- 1D table
- 2D table
- Configuration values

You can define any number of placement methods.

Selection Groups determine which runs are to be used as a source of data. Again, you can define any number of selection groups.

You might typically have one selection group containing a datum run, and a second selection group containing a run for comparison. By placing data from these two selection groups in different areas of the workbook, you could create another area within the spreadsheet that takes the difference between the two. This therefore enables comparisons between runs.



In the example above, there are two selection groups:

- Datum
- Comparison

The selection group called 'Datum' has one placement method, called 'Chassis Forces'. This is a 1D table that places data starting at the Sheet/Cell Datum!A1. Run 120 is currently the only run in the selection group, so the 1D table will contain data for that run only.

The other selection group called 'Comparison' contains three runs - the Current Run (which changes dynamically as the instrumentation generates new data), and runs 123 and 124. The data from these runs will be placed according to three placements methods, as listed in the right-hand pane.

To set up a Placement file properly, you need to carry out the following steps:

1. open / create a placement file
2. select a target Excel worksheet
3. create a Selection Group
4. define a Placement Method
5. select the runs which you want to act as a source of data

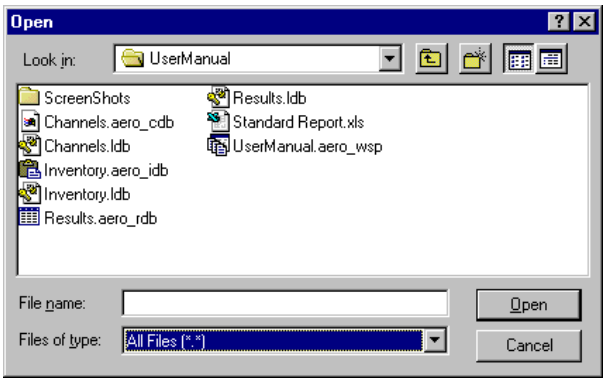
Opening / creating a Placement file

Opening a Placement file

1. There are three methods for opening a Placement file:

   either: select Open from the File menu;
   or: type Ctrl-O;
   or: click on the Open File button 

This will bring up the following dialog:



2. Narrow down the selection to Placement files using the file type filter at the bottom of the dialog. Placement files have the file extension *.aero_pla, and are identified by this icon. 

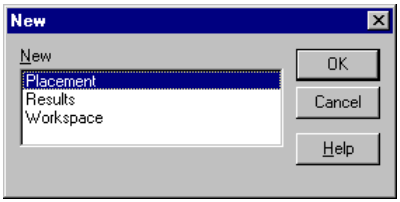
3. Select that file you want and press Open. If you can't find it in the current directory, use the browsing controls to change directory.

Creating a new Placement file

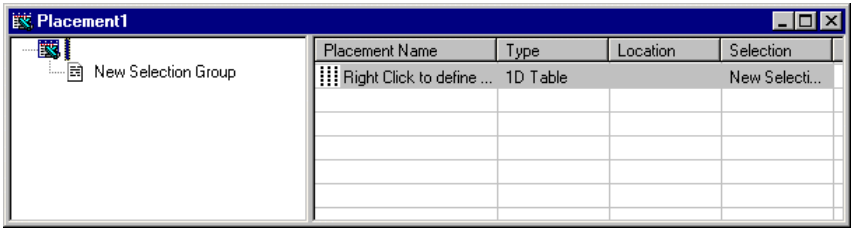
1. There are three methods for creating a new Placement file:

   either: select New from the File menu
   or: type Ctrl-N;
   or: click on the New File button 

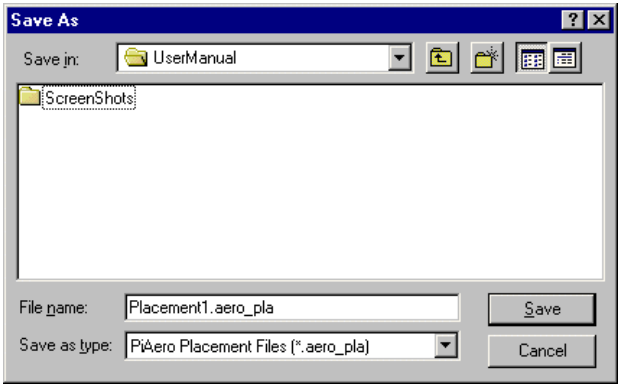
   This will bring up the following dialog:



2. Click on Placement and press OK. This automatically starts an unnamed Placement file.



3. You will then need to save it with a file name using Save As... from the file menu (see over):



4. Choose a directory and enter a file name, then press Save.

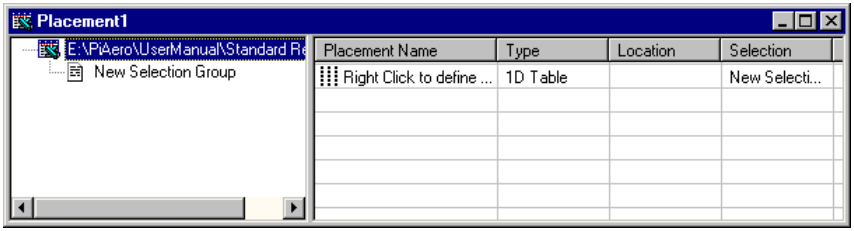
Selecting the target Excel worksheet

You cannot create a new worksheet from within PiAero, so make sure that you have an Excel file available before you proceed.

Typically you will devise a spreadsheet that matches the placement methods, and then use the same spreadsheet over and over as a template.

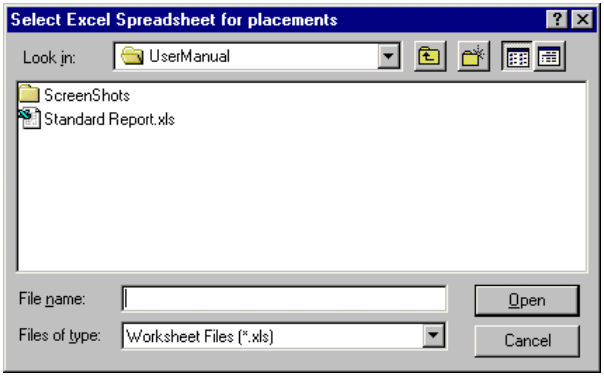
To select a worksheet:

1. Right-click on the Excel file icon at the top of the selection tree in the left-hand pane.

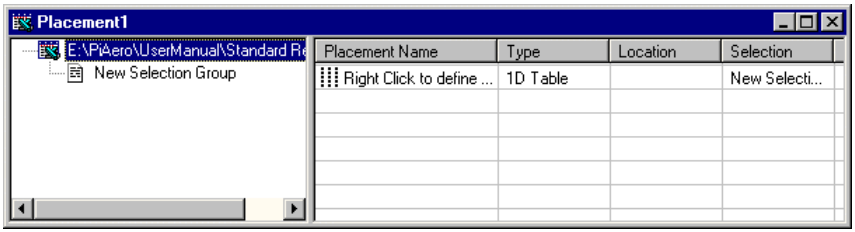


2. Choose Select worksheet...

The following dialog will appear, allowing to browse and select a worksheet:



When you have made your selection, the name of the worksheet appears at the top of the Selection tree:

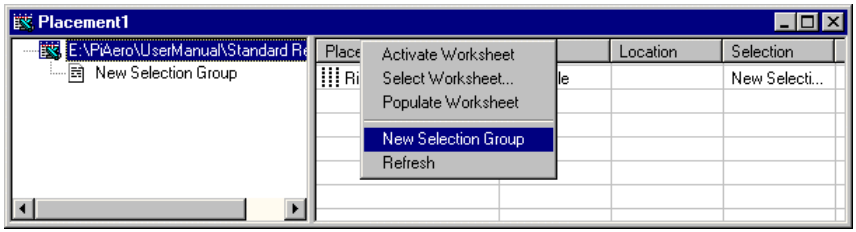


Selection Group

Creating a Selection Group

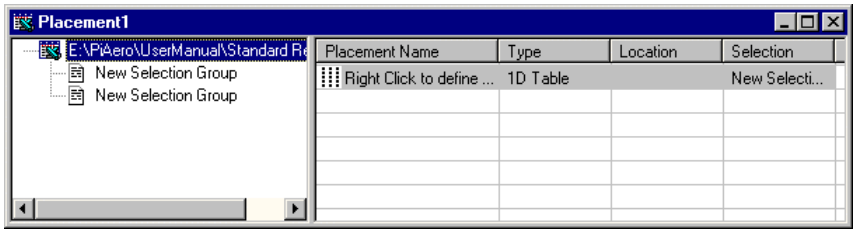
By default, a new Placement file will always contain one Selection Group. To add another:

1. Right-click on the Excel file icon at the top of the selection tree in the left-hand pane.



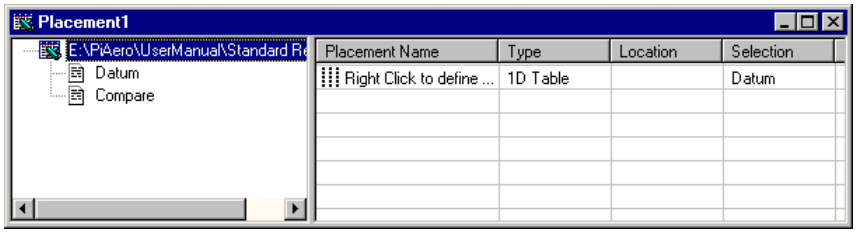
2. Choose New Selection Group.

The new Selection Group will appear at the bottom of the selection tree.



Naming a Selection Group

You can change the names of Selection Groups by clicking on their names. The names of the Selection groups are used by the Placement methods so that they know where to get their data from. Below is an example of two Selection groups that have been renamed "Datum" and "Compare".



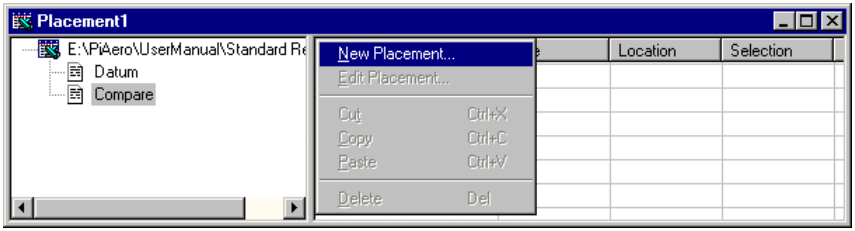
Deleting a Selection Group

You can delete a Selection Group either by clicking on it and pressing the Del key, or by right-clicking on it and choosing Delete. This will delete the Selection Group and the Placement methods associated with it.

Defining a placement

To create a new placement method, follow these steps:

1. select the Selection Group that you want to act as the source of data for the placement method
2. Right-click in the right hand pane



3. choose New Placement...

You have now started the "Placement Method Wizard" which will guide you through the steps required to define the placement in detail.

The first thing to select is whether you want a 1D table, a 2D table or the model configuration placed on the spreadsheet. This is done by selecting the appropriate method at the top left of Step 1 of the wizard.

1D table placement

A 1D table has (horizontally) one or more columns, each corresponding to a channel, and (vertically) one or more "bands", each containing a single result drawn from the Results Database. Typically a band will consist of one row in the spreadsheet, but it is possible to define a band with more than one row, such that (for example) the wheel drag forces can be laid out with rear forces positioned below the front forces.

Examples

A 1D table with 5 columns and three 1-row bands:

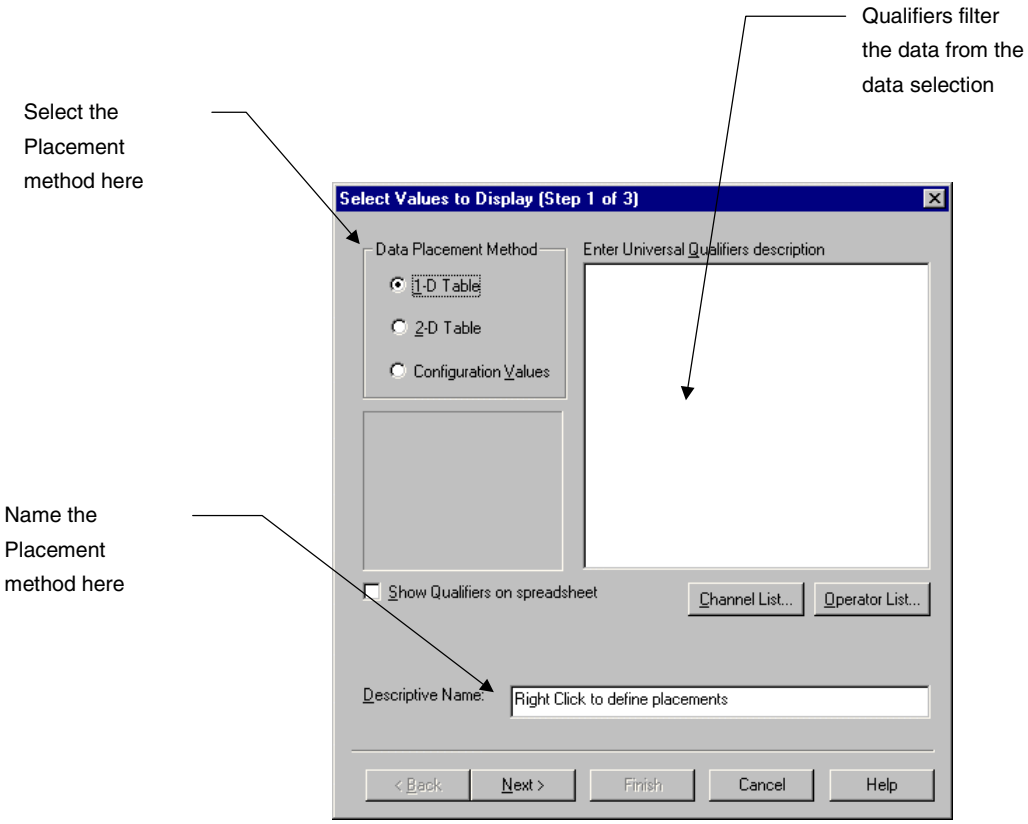
Front ride	Rear ride	Total Lift	Body Drag	Rear lift%
10	10	2198	456	37.21
10	15	2178	449	38.09
15	20	2092	427	37.98

A 1D table with 4 columns and two 2-row bands:

Front ride	Rear ride	FL wheel RL wheel	FR wheel RR wheel
10	10	208	209
		376	388
15	20	215	217
		380	391

Placements are defined using the placement wizard as described overleaf.

Step 1 of the Wizard



You can also set a name for the placement method. This has no significance other than acting as an aide memoir, and it appears in the list of placement methods in the right hand pane. If, for example, you are defining a 1D table that creates a summary report of all the forces, then you could call the method "Force summary table".

The last feature of Step 1 of the Placement wizard are the qualifiers. These act as a filter for the data from the data selection. For example, if you only want to place data into the Excel spreadsheet for results where Front ride = 10 and Rear ride = 10, then you would enter the qualifier shown overleaf.

"Front ride" = 10

AND

"Rear ride" = 10

There follows a description of the syntax required by the qualifiers.

Qualifiers

The qualifier for the data is entered as text in the box at the top right of the wizard step 1. You can enter the text simply by typing into the box, or you can build it up using the Channel List... and Operator List... buttons.

A formal description of the syntax of a qualifier is as follows:

qualifier = (NOT) expression { logical_operator (NOT) expression }

where:

expression "channel_name" comparison_operator "channel_name"

logical_operator AND | OR

comparison_operator < | <= | = | >= | > | <>

channel_name the name of a channel from the wind tunnel data, the inventory, or a label generated internally by PiAero

() indicates an optional entry

{} indicates zero or more iterations

a | b | c means choose only one or a, b or c

Note: The names of the channels must be contained within quotation marks "".

Precedence of logical operators

AND takes precedence over OR, in the same way that multiplication takes precedence over addition. So:

"Roll" = 0 AND ("Front ride" = 10 OR "Rear ride" = 10)

means that data will only be selected for results where either the front or rear ride heights are at 10, and the roll angle is 0. E.g. from the following set of results, only the highlighted one will be selected:

Roll	Front ride	Rear ride
0	5	15
0	10	15
1	5	10
1	15	15

If the qualifier had been:

"Roll" = 0 AND "Front ride" = 10 OR "Rear ride" = 10

then the following highlighted results would be selected:

Roll	Front ride	Rear ride
0	5	15
0	10	15
1	5	10
1	15	15

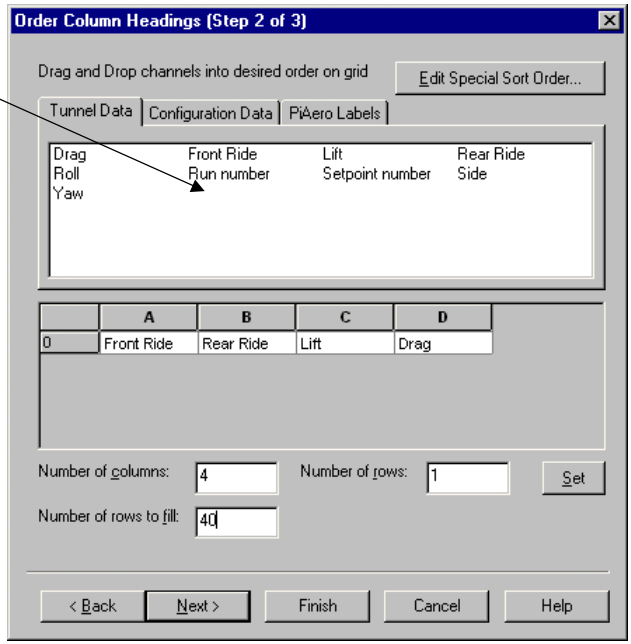
If in doubt about precedence, use parentheses in your qualifier definition

Step 2 of the Wizard

This is where you define the contents of the table:

- To put a channel into a band, drag it from the channel list onto the grid. If you drag to the right of an existing column, it will create a new column. (Tip: to find a channel quickly, click in the channel list area and then type the first letter of the channels name).
- You can force the size of a band by entering values into "Number of columns" and "Number of Rows" and pressing the Set button.
- Delete an unwanted entry by clicking on it and pressing the Del key.
- Number of rows to fill : sets the maximum number of rows that PiAero will try to place into Excel

Drag and drop a channel into a location in the grid



Note that the available channels are divided into the following:

- Tunnel Data - channels generated by the wind tunnel instrumentation
- Configuration Data - values from the inventory
- PiAero Labels - these are values generated by PiAero to help it keep track of the data.

Sorting the data

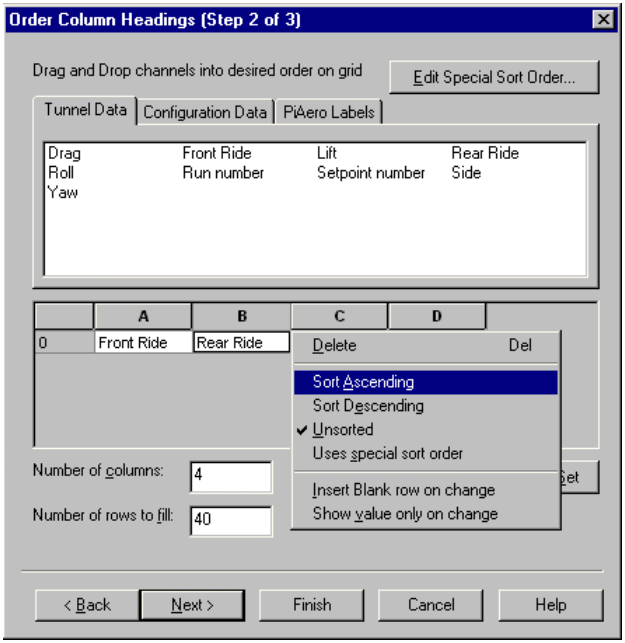
When PiAero places a 1D table into the Excel worksheet, it will, by default, place the data in the order in which it finds it in the Results Database. You can force it to place the data in a specific order as follows:

- each column can be sorted ascending or descending. Left-hand columns take precedence over right hand columns.
- you can force one or more columns to be sorted using a specified value order.

In addition, you can force PiAero to insert a blank row every time the value of a column changes, and you can make it so that the value is only displayed in the column when it changes.

Sort ascending / descending

Right-click on the channel that you want to sort, and select Sort Ascending or Sort Descending from the drop down menu.



Left hand columns take precedence over right hand columns. So, for example, if both Front ride and Rear ride are sorted ascending, then the following would occur:

Unsorted		Sorted	
Front ride	**Rear ride**	**Front ride**	**Rear ride**
15	10	10	10
20	20	10	15
25	50	15	10
10	15	15	15
10	10	15	20
25	30	20	20
15	15	25	30
15	20	25	50

Show value only on change

If you had also specified that the Front ride should "Show value only on change", then the table would look as follows:

Front ride	Rear ride
10	10
	15
15	10
	15
	20
20	20
25	30
	50

Insert blank row on change

Lastly, if you had specified "Insert blank row on change" for Front ride, then the table would look as follows:

Front ride	Rear ride
10	10
	15
15	10
	15
	20
20	20
25	30
	50

Special sort order

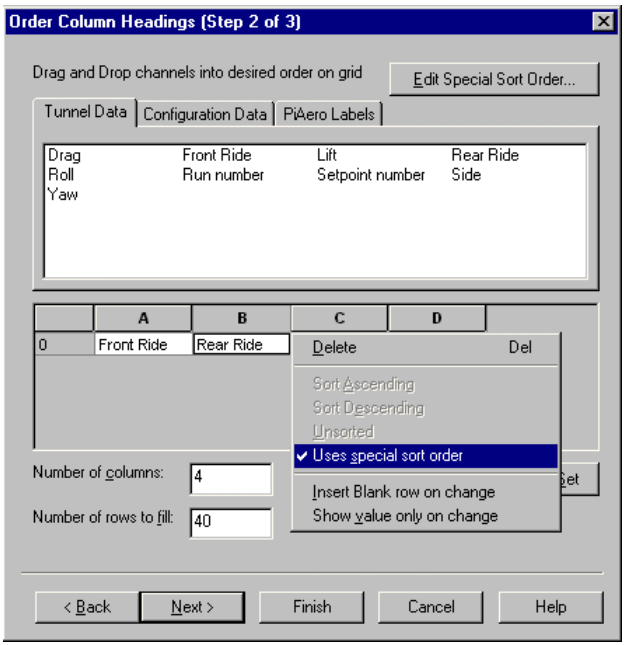
If you want the results to appear in a specific order, then you can assign a special sort order to one or more channels.

For example, to force the following order:

Front ride	Rear ride
10	10
15	15
20	20

you would need to follow the steps shown overleaf.

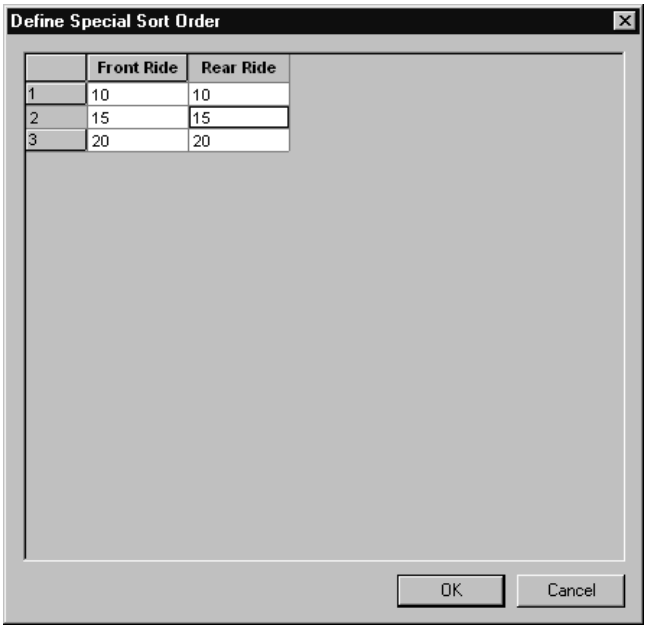
1. Right-click on Front ride and select "Uses special sort order" from the drop down menu.



2. Repeat for Rear ride.

3. Press the Edit Special Sort Order... button at the top right of the Wizard. This brings up a table with the special sort columns.

4. Enter the values that you want in the sort order:



When you are editing the special sort order, you can use many of the shortcuts found in a Microsoft Word table:

- use the tab key to go from one cell to the next
- tabbing off the last cell will create a new row
- select a row or column by clicking on the row or column label
- delete the contents of a selected cell(s) by pressing the Del key
- use cut (Control-X) to remove a row

You can even paste contents in directly from another package - e.g. copy a table of values from a Word table or an Excel spreadsheet (Ctrl-C) , click on the selected cell in the Special Sort table and paste (Ctrl-V).

The 1D table will now be forced to use those values for Front ride and Rear ride, even if there are no results available for all of them.

Take the following example data set, which has various results for different roll angles, front and rear ride heights:

Roll	Front ride	Rear ride	Total Lift
0	10	10	2198
0	10	15	2178
0	15	15	2092
2	20	20	2052
2	10	10	1996
1	10	10	2007
3	15	20	1975

If the special sort order is used for Front ride and Rear ride, and Roll angle is sorted ascending, then the 1D table would look as follows:

Roll	Front ride	Rear ride	Total Lift
0	10	10	2198
0	15	15	2092
0	20	20	
1	10	10	2007
1	15	15	
1	20	20	
2	10	10	1996
2	15	15	
2	20	20	2052

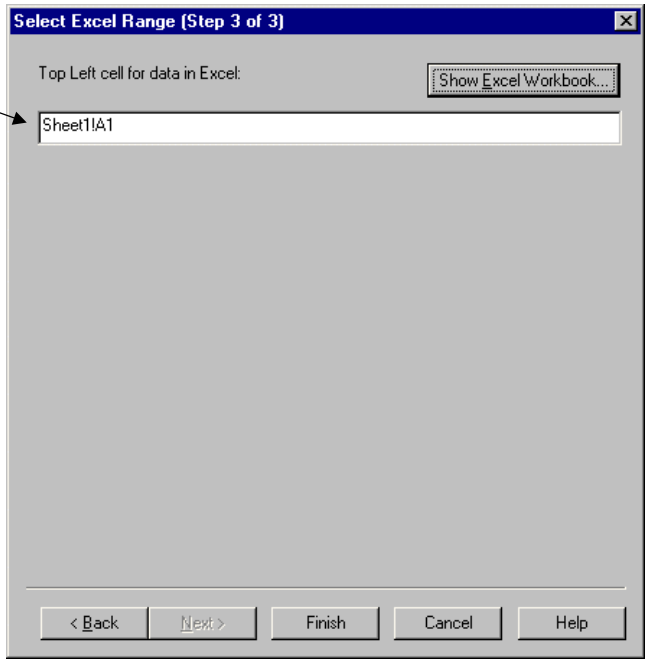
Note the following:

- three roll angles were detected in the results set, so three blocks of the special sort are created, even though four of the rows have no associated results
- two of the results no longer appear, as their Front ride and Rear ride values do not match anything in the special sort order - (10,15) and (15,20).

Step 3 of the Wizard

This is where you define where to place the data in the worksheet.

This is the top-left cell of the 1D table



A quick method of selecting the top-left cell of the 1D table is as follows:

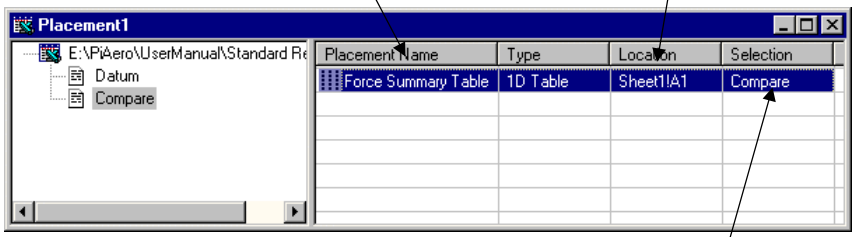
1. Click on Show Excel Workbook...
   This brings Excel up as the active application.
2. Click on the cell that you want to be the top left cell.
3. Go back to PiAero (e.g. press Shift-Tab).

The name of the sheet and cell number will be entered into the wizard.

Once you have completed the third wizard step, you have finished defining the Placement Method. This will now appear in the right hand pane.

This is the name that you defined in step 1 of the wizard

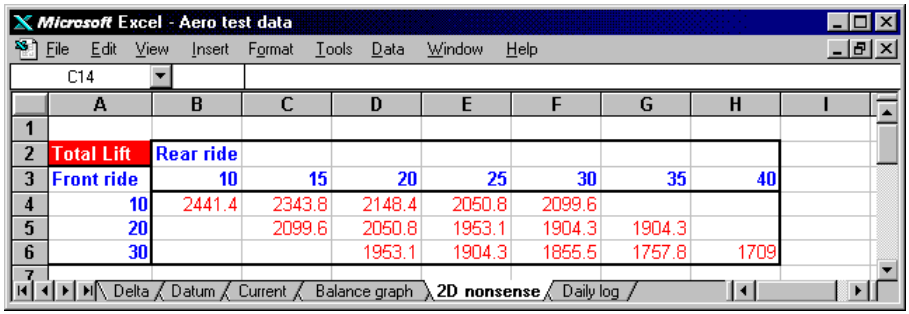
Top left cell for the 1D table



This placement method draws data from the "Compare" Selection Group

2D table placement

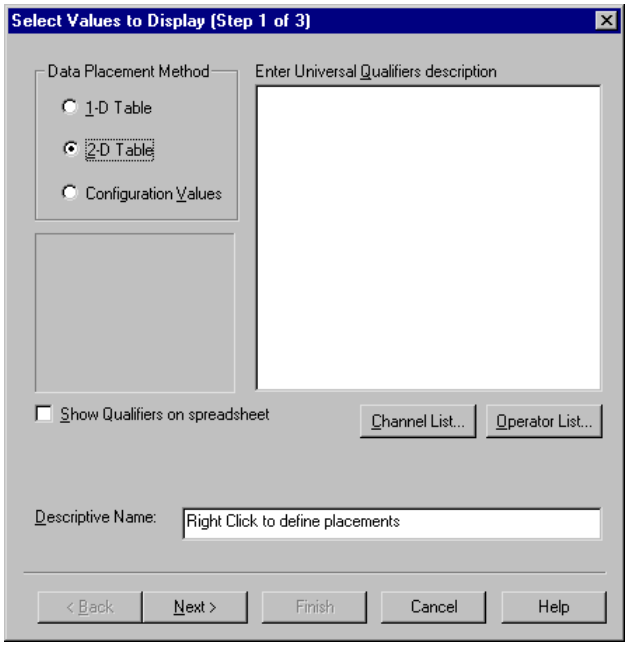
A 2-D table is defined by two channels (typically indices such as front and rear ride height) which are used for the row and column indices, and a third channel whose value is inserted in the table.



	A	B	C	D	E	F	G	H	I
1									
2	Total Lift	Rear ride							
3	Front ride	10	15	20	25	30	35	40	
4	10	2441.4	2343.8	2148.4	2050.8	2099.6			
5	20		2099.6	2050.8	1953.1	1904.3	1904.3		
6	30			1953.1	1904.3	1855.5	1757.8	1709	
7									

Wizard step 1

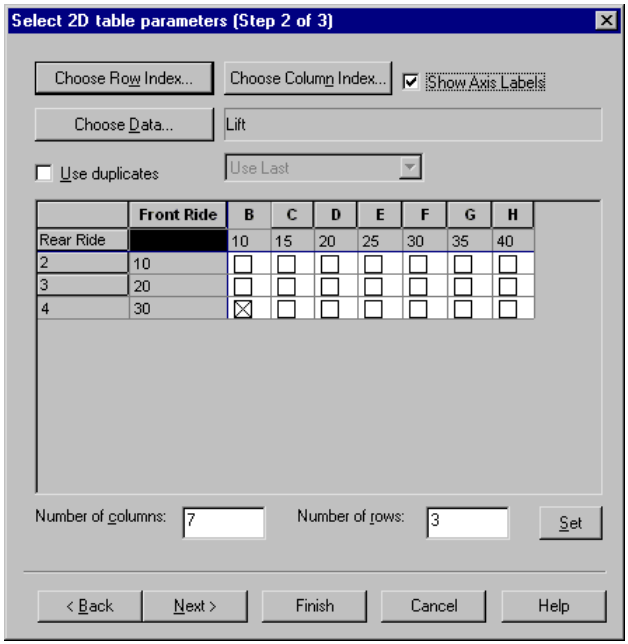
This is where you define qualifiers, which act exactly as for a 1D table (i.e. they filter the data in the Data Selection).



Wizard step 2

This is where you define the following:

- which channels are to be used for the indices (e.g. Front ride)
- which channel is to be used to fill out the table
- the values of the indices (e.g. 10, 15 etc...)



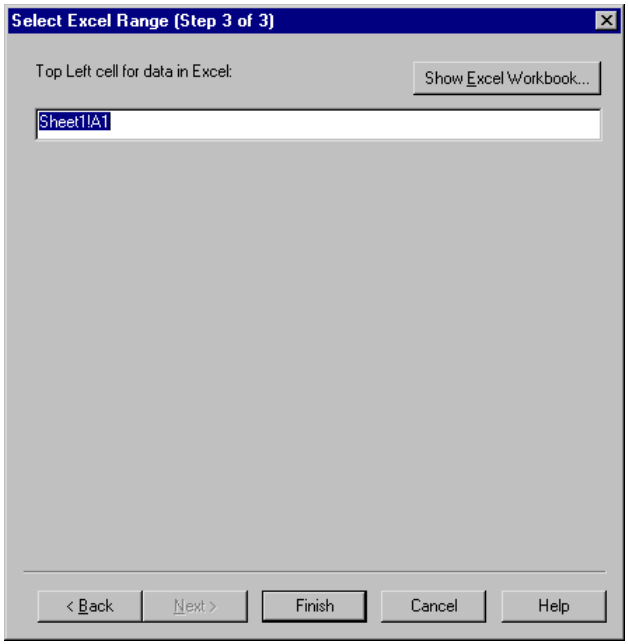
The default behaviour of PiAero is to place the text 'DUP' into Excel for data where duplicate values are found. Check the Use duplicates option, if you want to override the default behaviour. Use the combo box to select which of the duplicate values to place. The options available are 'Use First' and 'Use Last'

Note that if you put a check mark in one of the table cells (e.g. in (10,30) in the above example) then PiAero will leave that cell untouched, even if there is data available for that ride height. Otherwise, PiAero will overwrite that cell - with data if it is available, or with a blank if there is no data.

If you are putting Excel formulae into some of the cells (e.g. an interpolation function), then you should protect those cells with a check mark.

Wizard step 3

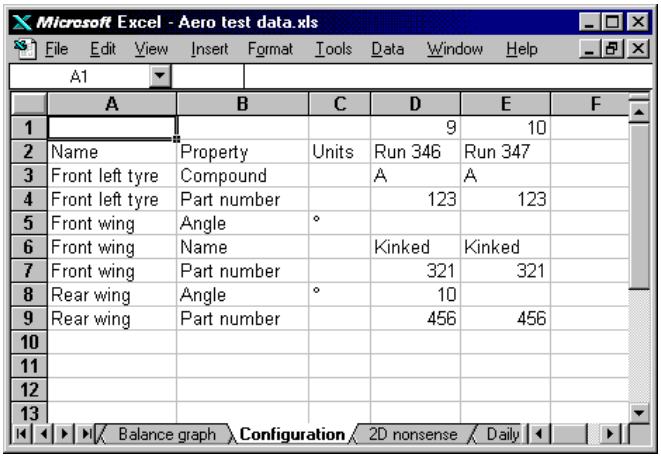
This defines where to put the data in the spreadsheet:



Configuration values placement

This placement method simply dumps the entire car configuration to a spreadsheet in the following format:

- there is one row for each property for each component
- the first row contains the run IDs (for internal use by PiAero)
- the second row contains headings to describe the columns
- column 1 contains the name of the components
- column 2 contains the names of the component properties
- column 3 contains the units of the component properties
- columns 4 onwards contain the values of the component properties for each run in the placement selection.

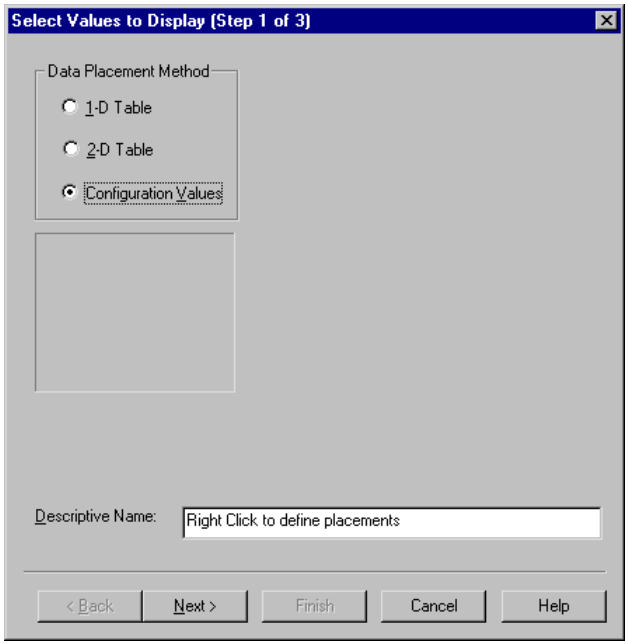


	A	B	C	D	E	F
1				9	10	
2	Name	Property	Units	Run 346	Run 347	
3	Front left tyre	Compound		A	A	
4	Front left tyre	Part number		123	123	
5	Front wing	Angle	°			
6	Front wing	Name		Kinked	Kinked	
7	Front wing	Part number		321	321	
8	Rear wing	Angle	°	10		
9	Rear wing	Part number		456	456	
10						
11						
12						
13						

There is very little to define for this placement method.

Wizard step 1

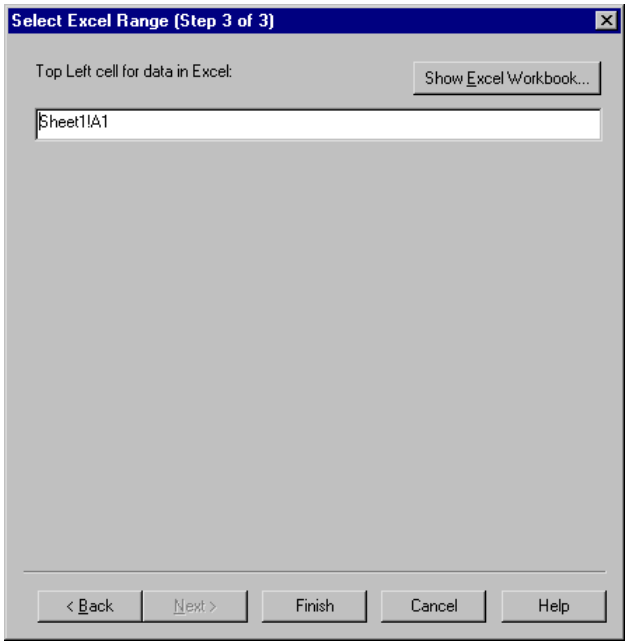
There are no qualifiers relevant for this placement.



Note that since Wizard step 2 does not apply in this case, the step 3 dialog box appears immediately.

Wizard step 3

Select where you want to place the configuration data.


Select Excel Range (Step 3 of 3)
Top Left cell for data in Excel:
Show Excel Workbook...
Sheet1!A1
< Back
Next >
Finish
Cancel
Help

Sending data to Excel

Once you have defined a placement and a Selection Group, you can send data over to the Excel worksheet by:

1. Putting one or more runs into the Selection Group.
2. Enabling the "Update Excel" tool on the toolbar button 
3. Pressing the "Refresh" tool on the toolbar 

If Update Excel is enabled, then each time you make a change to any Selection Group, the data will automatically be updated in the Excel worksheet. This may sometimes be inconvenient, especially if you are wanting to make a lot of changes to the Selection Groups. Depressing the "Update Excel" button will stop changes being reflected in Excel.

The "Refresh" button will update the view of runs in the results database and then populate Excel - providing that the "Update Excel" tool is enabled.

There are three ways of putting runs into the Selection Group:

Individual runs

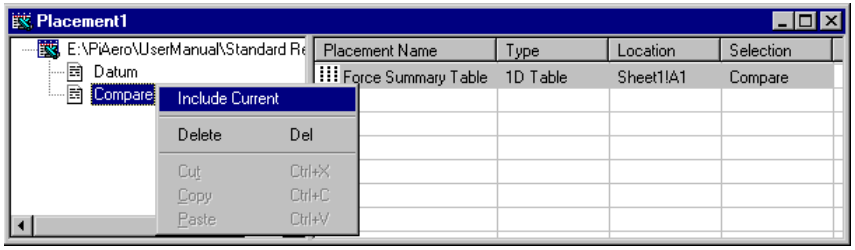
Drag one or more runs from the Results Database into the Selection Group.

- If you drag the run over the Selection Group name, you will add the run to the Selection Group
- If you drag the run over a run in the Selection Group, then you will replace that run

Current run

The current run can be included in the Selection Group. This means that each time a result comes in from the instrumentation, the spreadsheet will be updated.

To include the current run, right-click on the Selection Group name and choose Include Current.



Folders of runs

You can include an entire folder of runs into a Selection Group. This is particularly useful if you want to create a summary report of a day's testing.

Drag a folder from the Results Database into the Selection Group.

- If you drag the folder over the Selection Group name, you will add the run to the Selection Group
- If you drag the folder over another folder in the Selection Group, then you will replace it

Note that if the folder in the Results Database includes the current run, it this will be included in the Selection Group, and the worksheet will be updated each time a result comes in.

Triggering Excel macros

The following Excel macros are called by PiAero. If you want to make use of this facility, simply define macros with these names in the Excel that is linked to PiAero:

OnPiAeroRefresh

Triggered whenever PiAero has finished refreshing the placements in Excel. This will therefore happen as follows:

- When you activate the Update Excel button
- Each time a 'DATA' line is received from the instrumentation (i.e. when data is reduced at the end of a sample), but only if the Update Excel button is active and one of the placements contains the current run

This macro could be used to refresh pivot tables or charts that are hanging off the placed data.

OnPiAeroEndRun

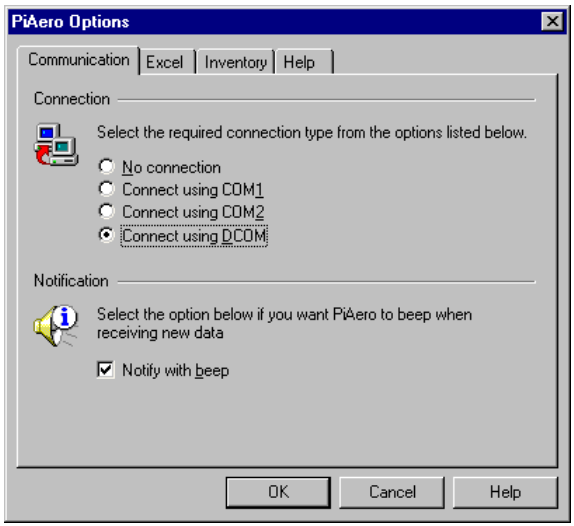
Triggered whenever PiAero receives an 'END' line from the instrumentation. This happens at the end of a run that got as far as sending data to PiAero. This macro could be used to print out a run summary, or bundle the data off to your simulation package...

These macros will only be triggered by the copy of PiAero that is receiving the data. If you want to get other networked copies of PiAero to run macros automatically, then you will have to get the receiving machine to relay on the calls.

PiAero Options

There are various PiAero options that can be accessed via the Settings\Options... menu.

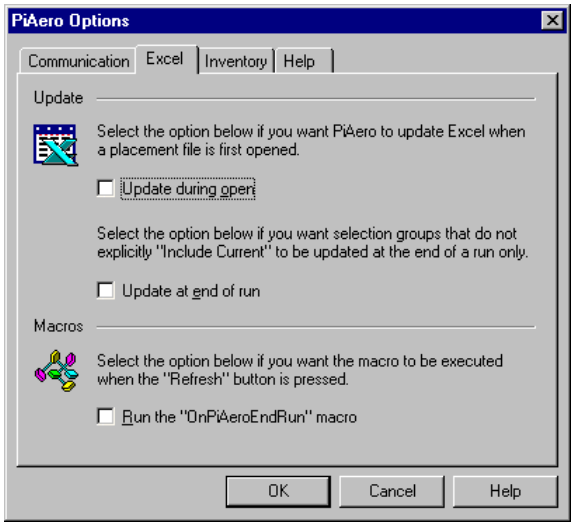
Communication tab



The options presented under *Connection* define how PiAero receives data from the instrumentation. COM1 and COM2 are for serial communication. DCOM is for communication over a local network

The *Notification* option selects whether PiAero notifies the user with a 'beep' when new data is received

Excel tab

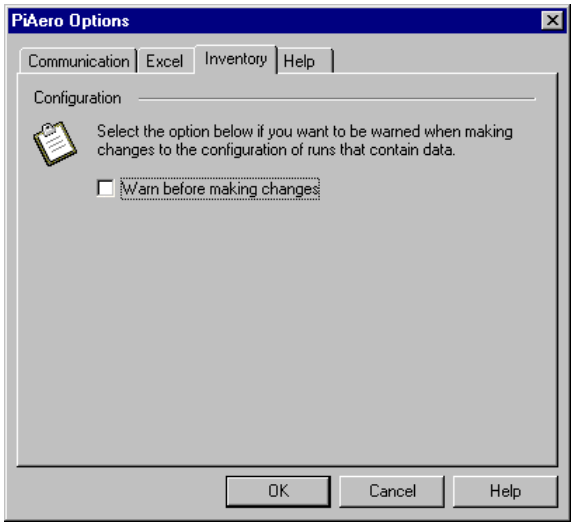


Update during open selects whether PiAero should populate Excel when a placement files is first opened.

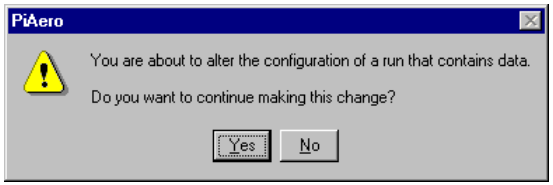
Update at end of run forces PiAero to populate Excel only with folders of data that implicitly include current at the end of a run . The default behaviour is to populate with a selection group if it explicitly includes current, or if it contains a folder which contains the current run

The macro option forces PiAero to run the "OnPiAeroEndRun" macro when the "Refresh" button is pressed. This is useful when working off-line (i.e. not connected to the instrumentation), but you want PiAero to behave as if it were on-line.

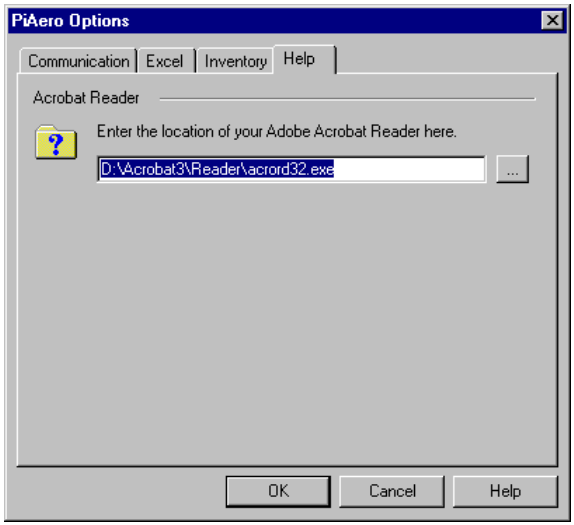
Inventory tab



The Configuration option makes PiAero warn the user when they are altering the configuration of a run that already contains data:



Help tab



The Acrobat Reader option allows the user to specify the location of their Adobe Acrobat Reader which will be used to display the on-line user manual

Data Recovery

The data recovery menu provides a means of starting the Pi Aero Data Recovery Wizard which will rebuild a Pi Aero database in the event of data corruption.

Warning: Incorrect or inappropriate use of the Data Recovery Wizard may result in the loss of data. For this reason, users are strongly advised to contact Pi Research and discuss any problem before using this wizard.

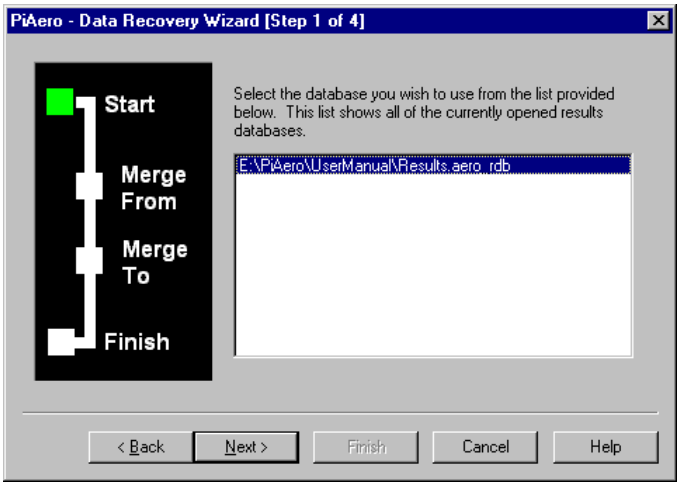
The following section summarises the steps involved in using the wizard:

1. Welcome and warning

Click Next > to move between the different steps.

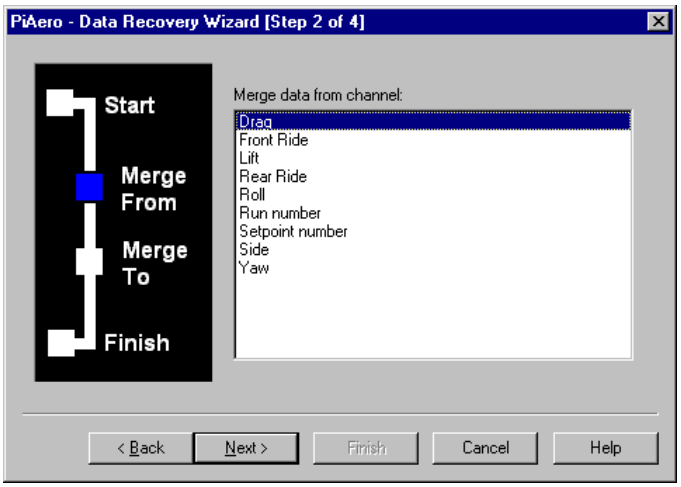
2. Database selection

This dialog box allows you to select the results database upon which you want the wizard to operate.



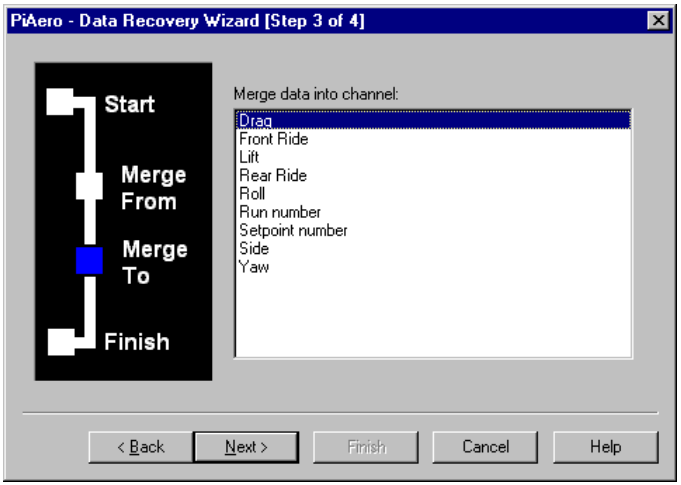
3. Source Channel selection

This dialog box enables you select the channel from which the data should be merged

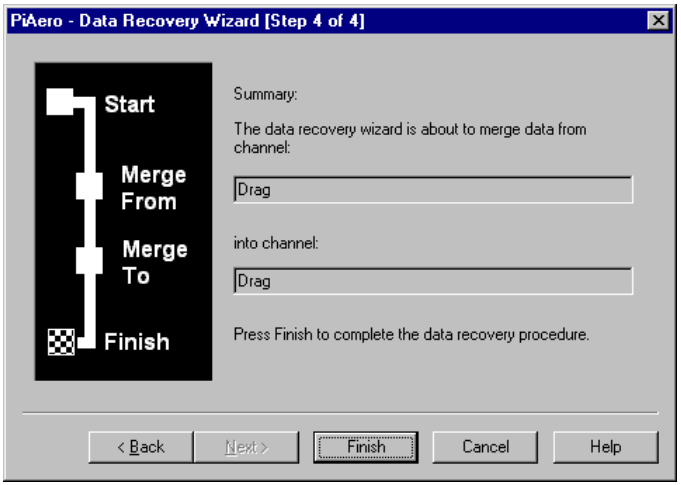


4. Destination channel selection

   This dialog box enables you to select the channel into which the data should be merged.



5. Summary of what is about to happen



The wizard performs the data recovery operation if the Finish button is pressed.

PiAero Administration

This program is installed in the same location as PiAero itself, and will typically be available on the Start menu next to PiAero.

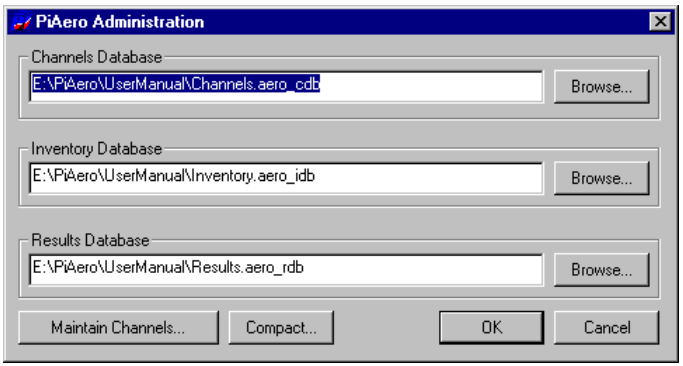
It enables you to do the following:

- select the channels, inventory, and active results databases used by PiAero
- delete channels stored in the channel database
- compact a PiAero database

You can only make changes if PiAero is not running.

Selecting channel and inventory databases

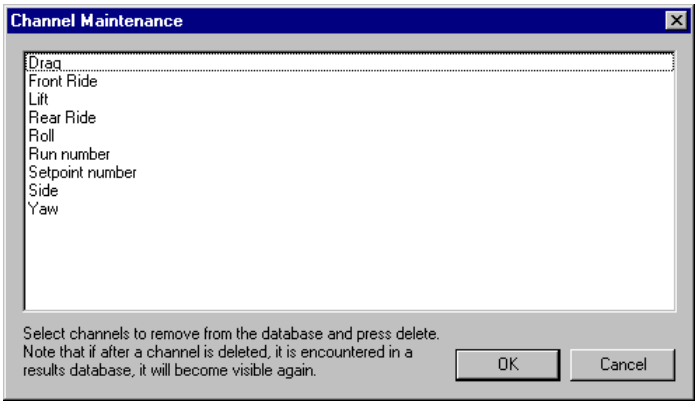
1. Start PiAero Administrator



2. Use the browse buttons to select the channel, inventory and result files. If your network is properly configured, this should enable you to access files on a remote computer.

Deleting channels

1. Click on the Maintain Channels button.



2. Click on and delete any channels that you want to remove.

Compacting databases

It is recommended that databases are compacted from time-to-time, as it improves performance and reduces the size of databases. PiAero files which can be compacted include: aero_rdb, aero_idb, aero_cdb.

To compact a database, click the "Compact..." button which will display a file selection dialog, allowing you to choose a PiAero database:

Once the file has been compacted, a new file called *.*_CompactBackup will exist in the selected folder. This file is a backup of the original database; it can be deleted once it has been confirmed that the compacted database is functioning properly.

Installation

System requirements

The requirements for a PC to run PiAero are as follows:

- The PC must be running Windows 95
- Microsoft Excel V7.0 or later must be installed.
- Performance specification:

	Minimum	Recommended
Processor	25 Mhz 386	100 MHz Pentium
RAM	16 Mbytes	32 Mbytes
Hard drive	20 Mbytes free	200 Mbytes free

- Note that the installation comes on 31/2" disks: it is therefore advisable to have a suitable floppy drive.
- If PiAero is to run on-line to Pi's wind tunnel instrumentation, then it must have one spare RS232 port if serial communication is to be used

Installation procedure

Pi Aero is supplied on a set of floppy discs containing:

- DAO Installation - this puts a copy of the Microsoft database engine on your PC
- PiAero Installation - this is the actual program

If you are upgrading from a previous version of PiAero, then you do not need to perform the DAO installation unless specifically requested in the release literature.

DAO installation

This puts a copy of Microsoft's Data Access Object on your PC. This is the engine for Access Version 7, which is used by PiAero for managing its databases. If you have this version of Access on your PC, then DAO may already be installed. However, you cannot do any harm by re-installing it, so it is recommended that you follow this installation procedure regardless.

Note that Pi have a licence to distribute the DAO to you with PiAero. It may not be legal for you to pass it on to a third party.

1. Insert DAO Disk 1 in your floppy drive.
2. Select Run... from the Win95 Start button, and enter a:\setup in the Run dialog box.
3. Walk through the DAO Setup to completion

PiAero installation

This installs the PiAero program and associated files onto your hard disk, and places a PiAero shortcut into your Start menu.

The files include sample databases for PiAero. If you are upgrading from a previous version of PiAero, then do not worry: none of your existing database files will be overwritten.

There are also various files for icons etc... which will be placed in standard Windows directories.

1. Insert PiAero Disk 1 in your floppy drive.
2. Select Run... from the Win95 Start button, and enter a:\setup in the Run dialog box.
3. The InstallShield Wizard is initialised, then the PiAero Setup program starts with a Welcome dialog. Select Next > to take you to the Working Directory selection dialog.
4. Choose a working directory for the program. This determines where the program files and the databases files go. The default is \Program Files\Pi Research\PiAero.O

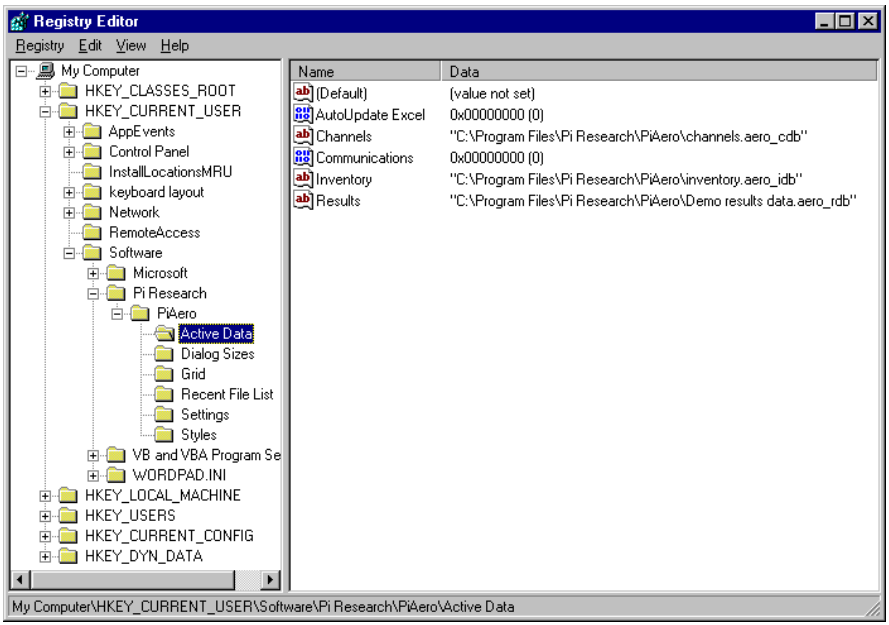
   ONCE PiAero IS INSTALLED, IT IS EXTREMELY INADVISABLE TO MOVE IT TO ANOTHER DIRECTORY. MAKE SURE YOU CHOOSE A WORKING DIRECTORY THAT YOU CAN STICK WITH.
5. Select Next > to take you to the Program Folder dialog.

6. Choose a program folder. This determines where the PiAero shortcut appears on the Start menu. The default is PiAero, which will create a new folder with a single item in. If you already have other Pi software on your PC (e.g. V6), then you may want to put them all into the one folder.
7. Select Next >.
8. The confirmation window shows the settings you have selected so far. If you wish to change any of these, then select Back >; otherwise, select Next >.
9. When asked, insert PiAero Disk 2 in your floppy drive and select Next>.

The installation will complete itself, install all the components and terminate.

Windows Registry

The windows registry contains various settings for PiAero, such as the defaults files used by the program. Changing these settings is an alternative to using PiAero Administrator. To view these, start REGEDIT (usually found in the \WINDOWS directory) and locate the settings in the folder \HKEY_CURRENT_USER\Software\Pi Research\PiAero



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