

RockSim Program Guide

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RockSim Program Guide

A guide to all features and functions.

by Paul L. Fossey

This guide provides an overview of the RockSim program suite. In large part, this document contains the same information as the on-line help files shipped with RockSim. Several sections have been added to extend on the brief information in the on-line help files.

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Table of Contents

Foreword	1
Part I Overview	4
Part II The rocksim program	6
1 Main screen	6
Rocket design attributes	7
Rocket design components	8
Mass Override	9
Cd override	9
Flight simulations	10
Menu functions	11
File menu	11
Export menu option	12
Edit menu	12
View menu	12
Rocket menu	13
Simulation menu	13
Help menu	14
2 View screen overview	14
Changing the visible rockets stages	15
2D Side view	16
2D Base view	17
3D View	17
3D Display options	17
3D Camera control	19
Part III Application wide settings	24
1 Application settings overview	24
2 RockSim preferences	25
Simulation	25
Simulation summary	25
Units	27
2D Drawing	28
3D Rendering	30
Miscellaneous	31
Part IV Designing rockets	34
1 Component screens	34
2 Construction and Finish	35
3 Radial position	35
4 Nose cone	36
5 Body tube	37
6 Inside tube	38

7	Transition	39
8	Simple fin set	41
9	Complex fin set	42
10	Free form fin planner	44
11	Graph paper style	45
12	Tube fin set	46
13	Ring tail	46
14	Bulkhead	46
15	Centering ring	47
16	Sleeve	48
17	Tube coupler	49
18	Engine block	50
19	Launch lug	51
20	Subassembly	51
21	Streamer	52
22	Parachute	53
23	Mass object	54
24	Cluster wizard	55
25	Component color	56
26	Component texture	58
27	Database update screen	62
28	Drag analysis	63
29	Stability analysis	63
Part V Simulations		66
1	Simulation data	66
	Simulation properties overview	66
	Engine selection	67
	Flight events (Recovery device setup)	69
	Simulation controls	70
	Launch guide setup	70
	Launch conditions	70
	Competition settings	72
	Engine Selection List	73
	Screen shots for ProVersion	74
2	Simulation graphs	78
	Graph selection screen	78
3	Flight profile	79
	2D Flight profile	79
	2D Details	80
	2D Flight profile settings	81
	Flight screen settings	82
	Flight track settings	83
	Rulers settings	84

Vector overlay settings.....	84
Smoke effects settings.....	84
Rocket animation settings.....	85
4 Optimal mass prediction.	86
Optimal mass prediction.	86
5 Exporting data	87
Exporting data	87
Part VI Database files	90
1 Materials database	90
2 Rocket component data files	91
Part VII Printing	94
1 Print selections	94
Part VIII Tutorials	98
1 Basic operations	98
Opening a design file (copy)	98
2 Simulation related	100
Creating a new simulation	101
Changing an existing simulation	101
Adding a new engine	103
Adding multiple engines	104
2D Flight profile	105
Starting the flight profile.....	105
3 Design	107
Creating a rocket design	107
Setting up the design parameters.....	108
Adding the nose cone.....	109
Adding the main body tube.....	111
Adding the motor mount tube.....	115
Adding a centering ring.....	118
Making another centering ring.....	121
Adding fins.....	123
Adding a streamer.....	124
Creating tube clusters	126
Starting the cluster wizard.....	126
Choosing a cluster pattern.....	128
Create the cluster pattern.....	130
Part IX Appendices	134
1 Supported platforms	134
2 Simulation data	134
3 Simulation atmosphere model	137
4 Nose cone and transition mathematics	137
5 Static stability calculations	138
6 References	139

7 Command line operation	140
8 File formats	141
RockSim XML format	141
General description of the database files	141
Nose cone database file	142
Transition database file	143
Simple fin set	143
Free form fin set	144
 Index	 147

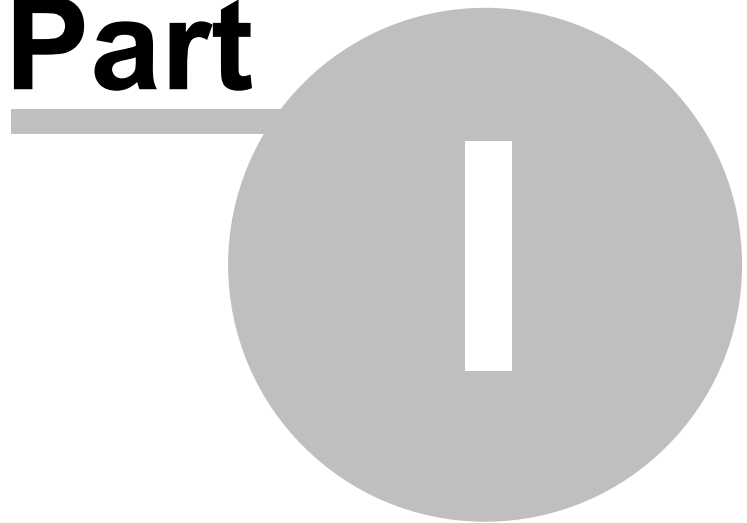
Foreword

This is just another title page
placed between table of contents
and topics

Top Level Intro

This page is printed before a new
top-level chapter starts

Part



1 Overview

The RockSim application is a model rocket design and flight simulation system. RockSim can help you to visualize your rocket designs and then simulate their flights with various engines and launch conditions. Please bear in mind that the results you obtain with RockSim are only a simulation. Just because the simulation results indicate a stable rocket and a safe flight, there is no guarantee that the actual rocket will behave in a safe manner. You should always follow NAR safety guidelines when launching real rockets.

How this guide is organized:

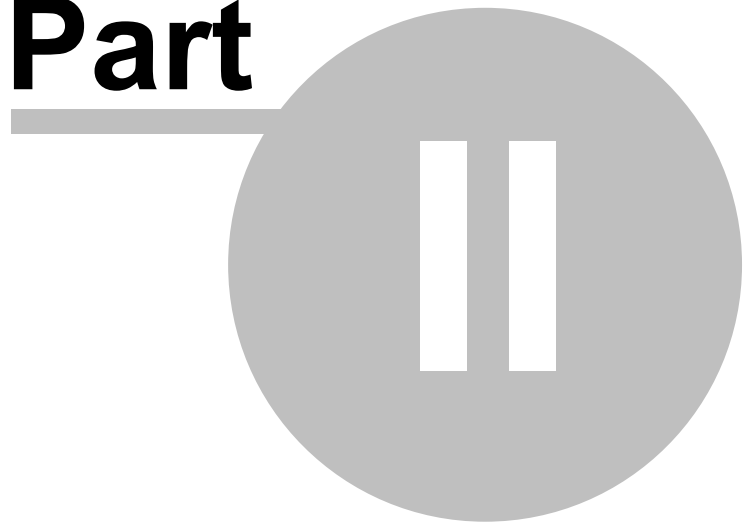
This guide presents help in two distinct ways. The first presentation defines the meaning of each screen and provides some notes on usage. The second set of presentations is in the form of tutorials. The tutorials are designed as step by step guides for specific operations.

General information: Supported computer platforms Menu functions Application preferences	The 2D view screen: Changing the visible stage count 2D Side view 2D Base view	The 3D view screen: 3D View 3D Display options 3D Camera control	Design components: The component selection and layout The component editor screens
General tutorials: Opening an existing rocket design.	Rocket design tutorials: Creating a simple rocket design. Creating a tube cluster.	Simulation tutorials: Creating a new simulation. Editing an existing simulation. Displaying a flight animation.	

Top Level Intro

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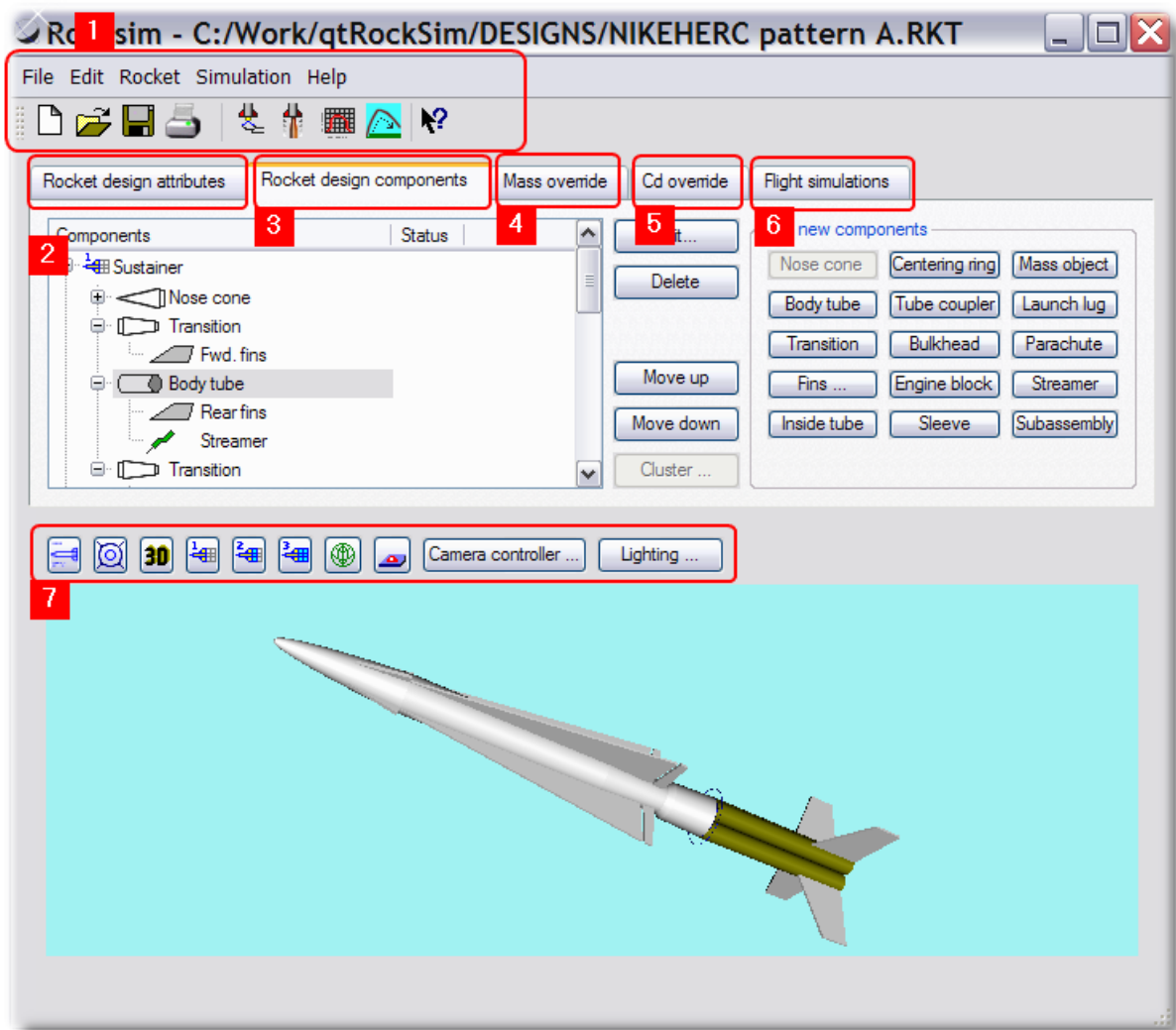
Part



2 The rocksim program

2.1 Main screen

This is an overview of the main RockSim screen. You can click on the image to jump to a new topic or you can continue to browse.



- 1** Menu functions. - Descriptions of the available menu options.
- 2** Rocket design attributes - Defines the general characteristics of the current design.
- 3** Rocket design components - Defines the components with which the current design is built.
- 4** Mass override - Rocket mass properties, and CP override options.
- 5** Cd override - Drag coefficient calculation options.

- 6** Flight simulations - Displays the results of flight simulations.
- 7** View screen overview - Controlling the view of your design.

2.1.1 Rocket design attributes

Rocket name is a description of the rocket.

Additional information about the design such as Rocket designer, Comments, and Revision history can be entered by pressing the **More...** button to the right of the rocket name field or by selecting the **File - Description...** menu item.

RockSim calculates the static stability for your design in two places. The static stability is calculated as you are designing your rocket. The instantaneous stability is also calculated during simulated launches. There are two methods of calculation available in RockSim. These are briefly described here:

Barrowman:

Rocket designs that are comprised of standard nose cone, transition, and fins shapes can be analyzed using the Barrowman equations. These equations have been proven over the last 30 or so years and are quite reliable within their constraints.

Rocket designs that do not fall into the Barrowman equation model require alternate CP determination methods. The RockSim program provides two such methods.

RockSim:

This is a proprietary method of static CP determination.

It is an extension of the Barrowman equations that enables RockSim to estimate the static CP location for rocket configurations that are not supported by the traditional Barrowman equations. Additional information is available in the Appendix.

Cardboard cutout:

This is the old standby method for CP determination. It is simply a cardboard cutout of the side view of your rocket. The CP is the balance point of the cutout. This method tends to produce VERY over stable rockets. Over stable is, however much safer than under stable.

Calculation method

Specifies the stability calculation method that will be displayed on the design screens.

Simulation method

Specifies which stability calculation method to use for simulations. You can choose from either Barrowman or RockSim. The Cardboard cutout method cannot be used for simulation calculations due to the fact that it does not yield the normal force coefficients required by the simulation system.

Number of stages describes the stage configuration for the rocket. There are three possible configurations available. A **Single stage** rocket consists of only a sustainer. A **Two Stage** rocket consists of a sustainer, and a single booster stage. A **Three stage** rocket consists of a sustainer and two booster stages. The Rocket configuration can be changed at any time during the design of a rocket. In other words you can simulate the launch of only the sustainer in a multiple stage rocket by temporarily selecting Single stage configuration, and then running a new simulation.

Also of interest:

Component layout

Mass override

Common features of all component editor screens.
instantaneous

2.1.2 Rocket design components

This screen is used to create or change the various components which are part of the rocket. The screen consist of three sections. On the left is a display of the current rocket components for all stage configurations. The Selected component actions section allows you to change or delete existing components. The Add new component section allows you to add new components to the rocket.

Adding new components:

In order to add a new component to the rocket design, you must first select the location on the rocket where the new component is to be placed. New components are always added after the selected component. When a component is selected, the various buttons in the **Add new component** section will become available.

The following **Add new component** buttons are available:

Outer airframe components:	Passive guidance components:	Other components:
Nose cone - (Specifications)	Simple trapezoidal or elliptical - (Specifications)	Mass object - (Specifications)
Body tube - (Specifications)	Free form fins - (Specifications)	Sleeve - (Specifications)
Transition - (Specifications)	Tube fins - (Specifications)	Sub assembly - (Specifications)
Launch lug - (Specifications)	Ring tails - (Specifications)	Tube coupler - (Specifications)
Internal components:	Recovery devices:	
Bulkhead - (Specifications)	Parachute - (Specifications)	
Centering ring - (Specifications)	Streamer - (Specifications)	
Engine block - (Specifications)		
Inside tube - (Specifications)		

Modifying existing components:

There are two ways to modify components:

- * Double click the component with the left mouse button.
- * Select the component and then press the **Edit...** button.

When a component is selected for modification, an appropriate component editor screen is displayed. You can have multiple editors opened at the same time.

Removing components from the rocket:

Select the component that you wish to remove, then press the **Delete** button.

Creating clustered motor mounts:

The following procedure is used to create clustered motor mounts:

- 1) Create an inside tube and designate it as a motor mount.
- 2) Select the motor mount tube in the design tree.
- 3) Click the Cluster wizard.. button.

The cluster wizard screen is then displayed. From here you specify cluster configuration. You may create as many cluster patterns as you can fit within the airframe.

Clipboard support:

Copy - Copy the selected component and all of the components attached to it to the windows clipboard.

Cut - Copy the selected component and all of the components attached to it to the windows clipboard. The components are then deleted from your design.

Paste - Paste the components previously copied to the clipboard into you design. The pasted components are owned by the selected component.

Drag & Drop support:

You can move one or more components from one location in your design to another using drag & drop.

To drag a component, click on it with the left mouse button, and do not release the mouse button. Drag the component to it's new location and release the mouse button. If you dropped the component onto a valid location, the components will be relocated in your design.

Also of interest:

General design settings

Mass override

Common features of all component editor screens.

2.1.3 Mass Override

RockSim will, by default attempt to calculate the mass and center of gravity for the rocket. If you wish to override these calculations, you can do so by selecting the "**Use the values shown below for all simulations**" option. This can be useful when you want to run a simulation against a partial rocket design, or to help find optimal engine configurations.

Measured mass data:

Sustainer is the mass of the sustainer without any engines installed.

Second booster is the mass of the second booster stage without any engines installed.

First booster is the mass of the first booster stage without any engines installed.

Measured center of gravity (CG) data:

The values for CG are measured from the tip of the rockets nose cone unless otherwise noted.

Sustainer is the CG of the sustainer stage.

Sustainer + second booster is the CG of the sustainer and the second booster combined.

Sustainer + second + first booster is the CG of the sustainer, the second booster, and the first booster combined.

Second booster alone is the CG of the second booster measured relative to the front of the booster.

First booster alone is the CG of the first booster measured relative to the front of the booster.

Also of interest:

General design settings

Component layout

Common features of all component editor screens.

2.1.4 Cd override

Calculate Cd at simulation time.

This option, if selected, will enable the Cd prediction software in the simulator. The drag coefficient for the rocket design will be estimated at each iteration in the simulation.

If you want to specify your own drag coefficient values, then you can uncheck this option.

Note: The values below are only used if Calculate Cd at simulation time is NOT checked.

Cd for the sustainer stage alone

The drag coefficient of the sustainer stage alone. If the design is a single stage rocket, then this is simply the drag

coefficient of the rocket.

Cd for the sustainer plus one booster

The combined drag coefficient of the sustainer stage and one booster stage.

Cd for the sustainer plus two boosters

The combined drag coefficient of the sustainer stage and two booster stages.

Cd for the second booster alone

The drag coefficient for the second booster stage by itself.

Cd for the first booster alone

The drag coefficient for the first booster stage by itself.

2.1.5 Flight simulations

The results of previously run simulations are displayed on this tab. The results are displayed in tabular format. The set of results columns displayed can be configured to suit your needs. Please refer to the links at the bottom of this page for more information.

The default simulation data is shown below:

Simulation Number - The sequence number of the simulation.

Results - An icon which indicates the results of the simulation. (See below)

Engines - The engine load for the simulation.

Max Altitude - The maximum altitude attained.

Max. Velocity - The maximum velocity attained.

Max. Acceleration - The maximum acceleration attained.

Time to apogee - The time in seconds until apogee is reached.

Velocity at deployment - The speed of the rocket at the time of recovery system deployment.

Altitude at deployment - The altitude of the rocket at the time of recovery system deployment.

Optimal delay - This is the optimal ejection delay for recovery deployment at apogee.

The results pictures are shown here



The rocket never left the pad. Typical under powered results.



The recovery system ejected before apogee.



The recovery system ejected at apogee.



The recovery system ejected after apogee.



The rocket impacted with the ground prior to the deployment of a recovery device.

Selecting a single simulation

In order to select a single simulation for plotting, deletion, or printing, you must click on the row for the simulation. A selected simulation is displayed in reverse video.

Selecting multiple simulations

Multiple simulations can be selected for deletion. This can be done in several ways.

Using the mouse: Ctrl-Left-Click on each simulation you wish to select.

Using the mouse: Left-Click on the first simulation you wish to select, Shift-Left-Click on the last simulation.

The full range of simulations between the first and last will be selected.

Using the keyboard: Press shift-up arrow, shift-down arrow, shift-home, or shift-end to select a range of simulations.

Also of interest

Changing the results columns.

[Using abbreviated column labels.](#)

[Changing the units for the simulation results.](#)

2.1.6 Menu functions

This section provides an overview of the menu options in RockSim.

The main menu entries are as follows:

File menu - Open designs, Printing, and Export functions.

Edit menu - Standard edit functions, and access to application settings (Windows only).

View menu - Design view options.

Rocket menu - Cd analysis, Flight analysis.

Simulation menu - Provides access to the various flight simulation functions.

2.1.6.1 File menu

New...

This command clears the current rocket design and it's associated simulations from the RockSim screen. You can use this command when you wish to start a new design. You will be asked if you wish to save any current design changes prior to clearing the screen.

Open...

The File open function displays a standard dialog box from which you can select a rocket design to load into the system. RockSim design files have a (.RKT) extension. Once you select a file to open, the simulations and design information are displayed on the screen. Any previously loaded information is replaced.

Open recent file...

Displays a list of recently opened files. If you attempt to open one of these files, and the open process fails, then that entry will be removed from the list. In order to change the number of files in this list, you need to go to the Application settings - Miscellaneous tab.

Save...

The File save function writes the currently displayed simulations and rocket design information to disk. If you select File save on a new (Untitled) design, then File save acts like File save as.

Save As...

The File save as function displays a standard dialog box into which you enter a name and location for your rocket information. When you press OK from this dialog box, your simulation and design information is written to disk.

Export...

The Export menu item displays a secondary menu of export targets. From this menu you can export your rocket design, and simulation results in various formats.

Import...

The import menu item displays a secondary menu of import sources. At present, the only files you can import into RockSim are database files. In order to activate this option you need to go to the Application settings - Miscellaneous tab.

Reload engines...

Display the engine data file selection screen. This is where you specify the engine data files that you wish to use.

Description...

Displays the file description dialog box. From here you can enter additional information about the rocket design. The three additional free form text fields are **Designer**, **Comments**, and **Revision history**.

Print...

This print menu displays the Print Selection Screen. From this screen you can choose what you wish to print.

Printer Setup...

The File print setup function displays the standard printer setup dialog box. The values which you select in this dialog box are retained until you close the RockSim program.

Exit...

Exit the RockSim program.

Note: On the Max OS X platform the exit menu item is located under the application menu.

2.1.6.2 Export menu option**2D Image...**

Export the rocket design drawing as a 2D image file.
This function displays the export 2D screen.

3D Image...

Export the rocket design as a 3D image.
This function displays the export 3D screen.

3D Model...

Export the rocket design as a 3D model.

Simulation data...

Displays the Simulation export screen. The simulation export function is used to export selected simulation data in comma delimited format. This data can then be imported into other applications for analysis.

2.1.6.3 Edit menu**Preferences...**

This menu option displays the application setting screen.

2.1.6.4 View menu**tool bar**

Show or hide the tool bar.

Status bar

Show or hide the status bar.

Side view

View the rocket design as a 2D blueprint style image.


Base view


View the rocket from the bottom as a 2D blueprint style image.


3D view

View the rocket as a 3D model. The 3D view screen

In each of the views described above, you can choose to display various stage configurations. This applies to multi stage designs only.

Sustainer 
Display the sustainer (Upper stage) only.

Sustainer + Booster 
Display the sustainer and one booster.
This option applies to two, and three stage rockets.

Sustainer + two Booster stages 
Display the sustainer and both booster stages.
This option only applies to three stage rockets.

2.1.6.5 Rocket menu


Parts list...
Display a report of the components in the current design.

Materials...
Display the Materials Database maintenance screen.


Cd Analysis...
Display the Cd analysis screen.


Stability analysis...
Display the Stability analysis screen.

2.1.6.6 Simulation menu

Prepare for launch... 
Display the Simulation preparation screen. This is where you specify engine load out, recovery options, and launch site conditions.

Edit selected...
Display the Simulation preparation screen using the simulation parameters from the currently selected simulation.

Launch... 
Run a new simulation using the current engine load out, recovery options, and launch site conditions. The results of the simulation are displayed on the Simulation results screen.

Plot... 
Displays the Graph selection screen. From this screen you can select the data elements that you wish to graph, and how you would like the data presented. Once a graph is selected, then the plot screen is displayed. Pressing the Esc key or clicking the close button on the plot screen will close it.

Display details...

Displays a detailed report of the currently selected simulation. Pressing escape or the close button will close the screen.

2D Flight profile... 

Display the 2D flight profile screen for a selected simulation. This screen displays a flat screen view of the rockets flight characteristics.

Predict Optimal Mass...

Displays the Optimal mass prediction screen. This screen provides the tools required to predict the optimal mass for your model. The mass of your rocket design can be tuned to produce maximum altitude, or maximum coast time.

Delete

Deletes the selected simulations. You can also press the delete key when the simulation list is selected.

Recalculate all simulations

All of the simulations currently displayed for your design are run again.
When your design changes, the previous simulation results could be invalidated.

Recalculate selected simulations

The simulations currently selected for your design are run again.
When your design changes, the previous simulation results could be invalidated.

2.1.6.7 Help menu

Help

Displays this help file.

Read the user guide

Display the RockSim user guide.

This is a user's guide for the RockSim model rocket design and flight simulation system. It describes the procedures you use to design model and high power rockets, perform simulated rocket flights and graph, export and print the data generated.

About...

Displays the RockSim about box. If you are unsure about the version number of RockSim, or you are amused by reading Copyright information then check out this screen.

2.2 View screen overview

RockSim provides three views of your design. There are two side views, and a 3D view. This section describes the features of the different viewing modes.

If your design is a two to three stage rocket, then additional controls are available choose the display stage configuration. Click on the links below for the details.

[Changing the visible stage configuration](#)

[Displaying the side view of your design](#)

Displaying the base view of your design


Displaying the 3D view of your design

2.2.1 Changing the visible rockets stages

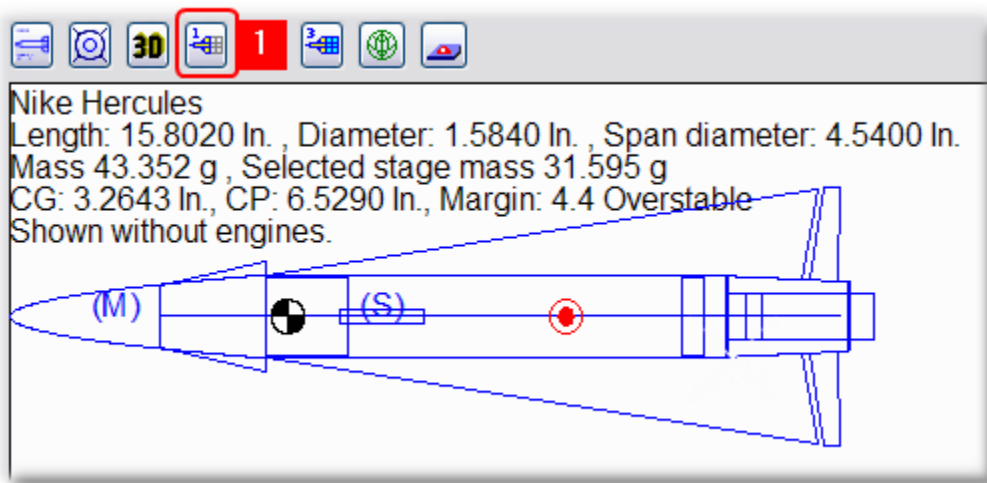
This section shows you how the stage view buttons can effect the drawings that you see on the screen. To illustrate the changes made by the stage view buttons, we will continue with our two stage example design.


Changing the displayed stage configuration



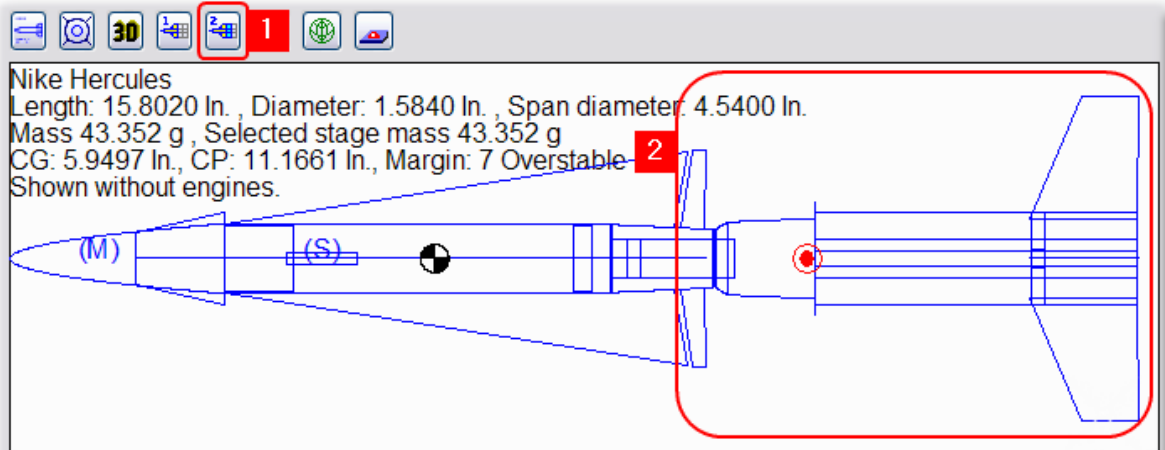
1  Clicking the stage buttons changes the visible stage configuration. These buttons work in all three view modes.


Displaying the upper stage only (This is also called the Sustainer stage)



- 1**  Clicking the view single stage button displays only the upper or sustainer stage.

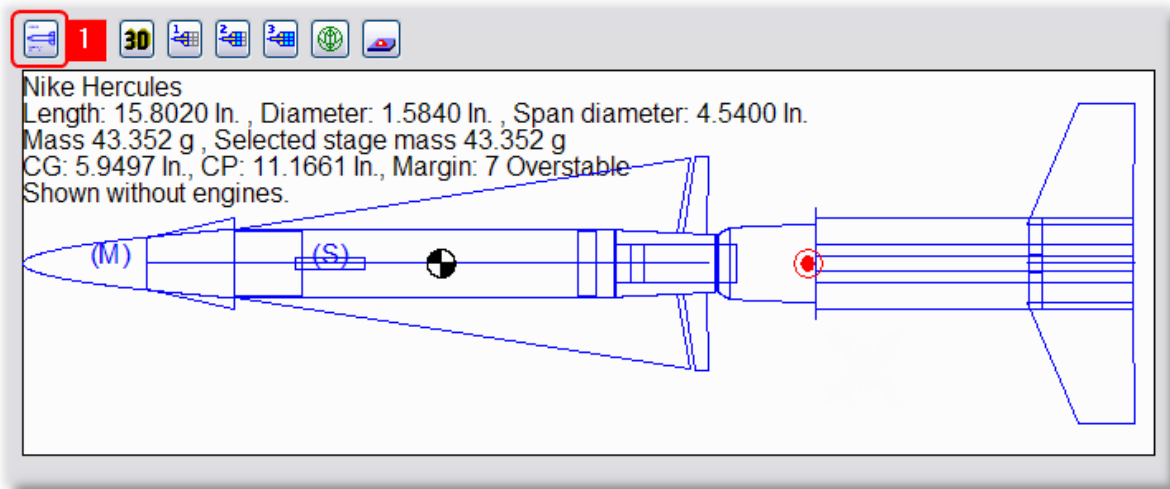
Displaying both stages (The sustainer and the booster)




- 1**  Clicking the view two stage button displays both the upper stage and the booster.
- 2** Note: The booster stage is now visible.

2.2.2 2D Side view

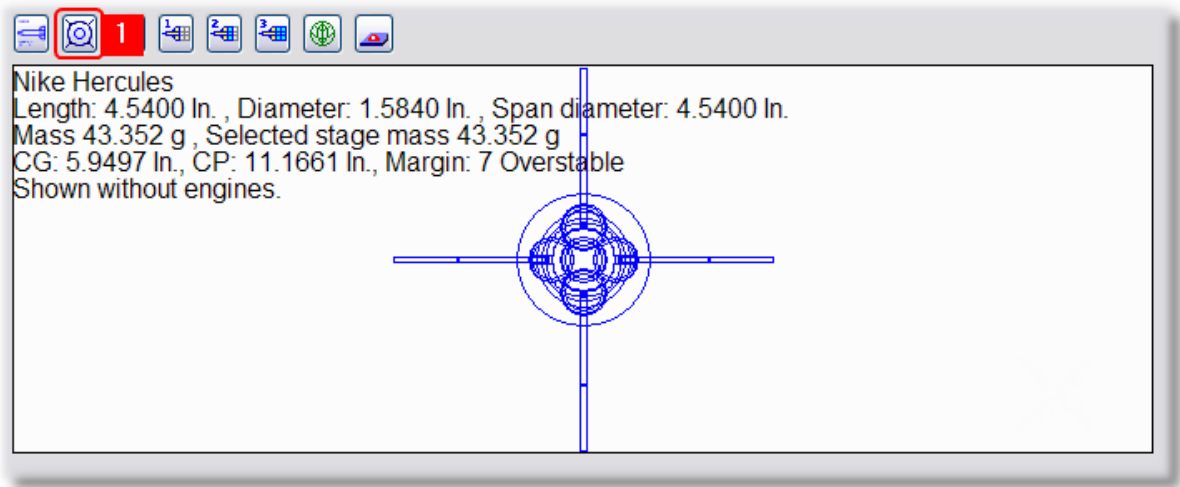
2D Side view




- 1**  Clicking the side view button displays a side view of your design.

2.2.3 2D Base view

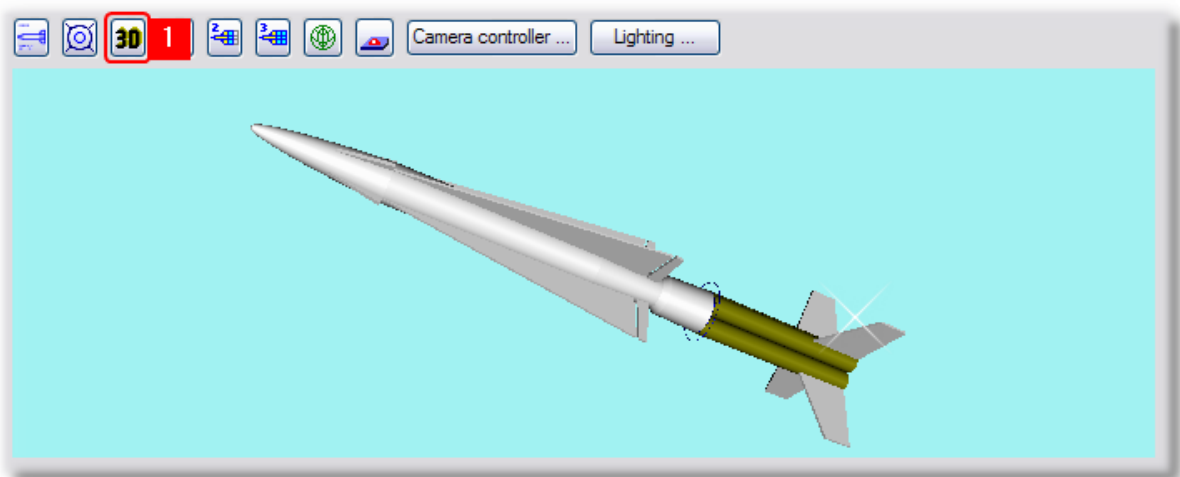
2D Base view



1  Clicking the base view button displays a bottom view of your design.

2.2.4 3D View

3D View



1 **30**  Clicking the 3D view button displays your design as a 3D model.


2.2.5 3D Display options

When you are viewing the rocket design in 3D mode, the image that you see on the screen is controlled by positioning an imaginary camera. The position and orientation of the camera can be controlled by the tool bar, or

by using the mouse buttons and cursor position. You can also control how the image is rendered.

Movement style

The camera movement mode can be set to **Joystick** (*Position sensitive*) or **Track ball** (*Motion sensitive*). These settings only apply to camera movements directly driven by the mouse cursor position.


Track ball  Keyboard: T
Select this option to switch to Track ball mode.

In Track ball mode, motion occurs only when the mouse button is pressed and the mouse pointer is moving.

Joystick  Keyboard: J
Select this option to switch to Joystick mode.


In Joystick mode, motion occurs continuously as long as the mouse button is pressed.

Rendering style

Wire frame  Keyboard: W
Select this option to cause all 3D objects to render themselves as Wire frame drawings. This can be useful on very slow machines, or when dealing with very complex models.



Wire frame example

Solid  Keyboard: S
Select this option to cause all 3D objects to render themselves as shaded solid images.



Solid model example

Red / Blue 3D viewing

You can also switch between standard 3D view and Red/Blue 3D mode. The Red/Blue 3D mode can be used with 3D glasses having Red and Blue filters. Toggle this mode on and off by using the '3' key.

Camera movement using the tool bar buttons:

The tool bar at the top of the screen gives you access to the most common camera controls.

*The picture below illustrates the possible camera movements.
Match the color coded movement arrows with their corresponding movement interface.*

Controlling the position of the camera

Camera movement using the mouse buttons:

Mouse Button 1 (Left Mouse Button)

Rotate the camera around its focal point. This simultaneously changes the camera azimuth and elevation. The rotation is in the direction defined from the geometric center of the screen towards the mouse position.

<Ctrl> Left Mouse Button

Rotate the camera around its own viewing axis.

Mouse Button 2 (<Shift> Button 1, <Shift> Left Mouse Button)

Pan the camera. In Joystick mode, the direction of pan is from the geometric center of the screen towards the mouse position. In Track ball mode, the direction of pan is the same as the direction the mouse moves.

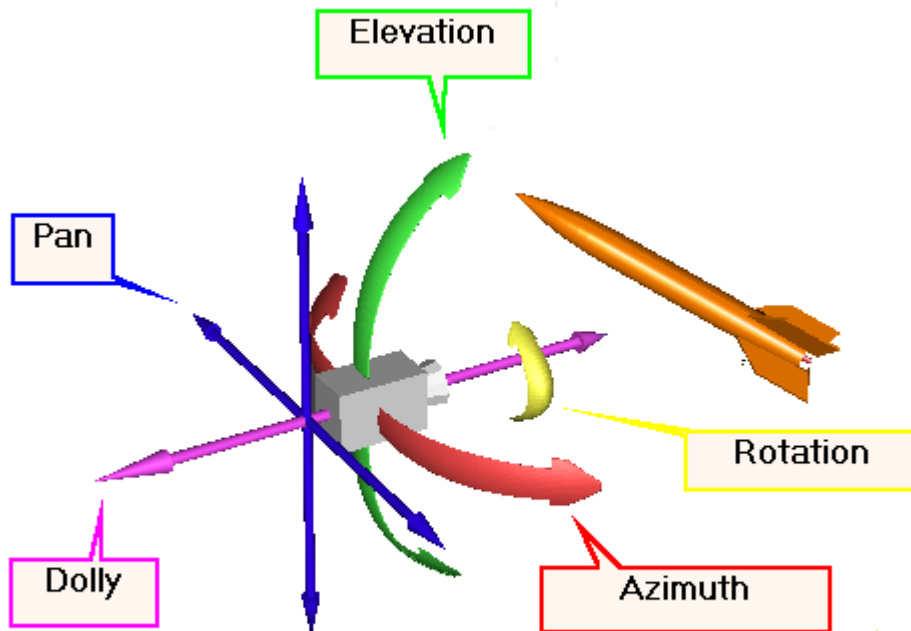
Mouse Button 3 (Right Mouse Button)

Move (Dolly) the camera forward and backward from the focal point. If the mouse is positioned in the top half of the screen, then move the camera closer to the focal point. If the mouse is in the bottom half of the screen, then move the camera away from the focal point. In Joystick mode, the rate of movement is determined by the distance above or below the horizontal centerline of the screen.

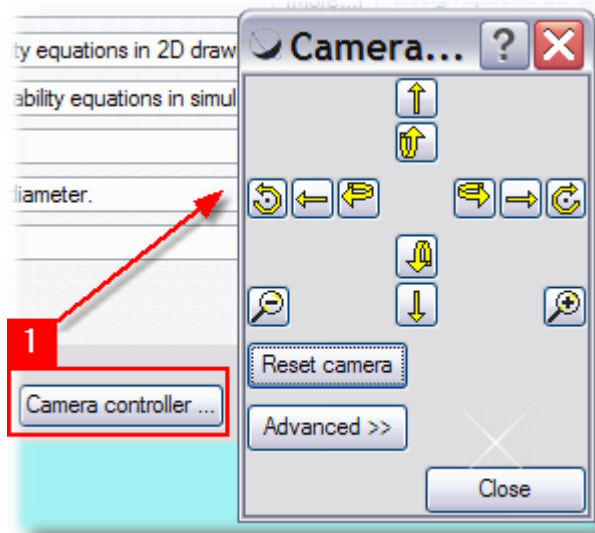
2.2.6 3D Camera control

When you are viewing a design in 3D mode you can move the camera around to change your view of the design. The 3D view screen provides two interfaces for moving the camera. You can interact directly with the image using the keyboard and mouse or you can use the camera control window.

The diagram below describes the types of camera movement that are supported:





Using the Camera controller





- 1 Click the camera controller button to display the camera controller. The camera controller window can be moved to a convenient location. Additional information about the camera controller is available on the next page.





Azimuth

Click  to rotate your view to the left.
 Click  to rotate your view to the right.



Elevation

Click  to rotate your view up.
 Click  to rotate your view down.



Pan

Click  to slide your view to the left.
 Click  to slide your view to the right.
 Click  to slide your view up.
 Click  to slide your view down.

Dolly

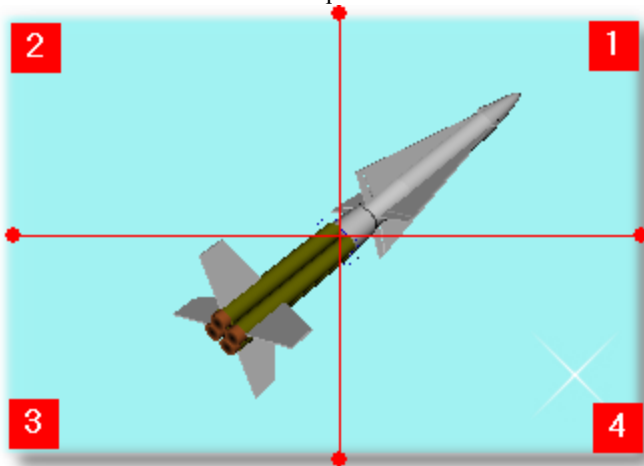
Click  to dolly the camera closer to the model.
 Click  to dolly the camera away from the model.

Rotate

Click  to rotate your view to the right.
 Click  to rotate your view to the left.

Using the mouse to control the camera

In order to understand how to use the mouse to control the position of the camera you need to imagine that the 3D screen is divided into four quadrants. This is illustrated below:



	Apple Mac OS X	Windows PC
Azimuth	Click in any quadrant	Click in any quadrant
Elevation	Click in any quadrant	Click in any quadrant
Pan	Shift+Click in any quadrant.	Shift+Click in any quadrant

Dolly	Ctrl+Click above or below the center line	Right+Click above to below the center line
Rotate	Apple+Click above or below the center line	Ctrl+Click above or below the center line

Examples:

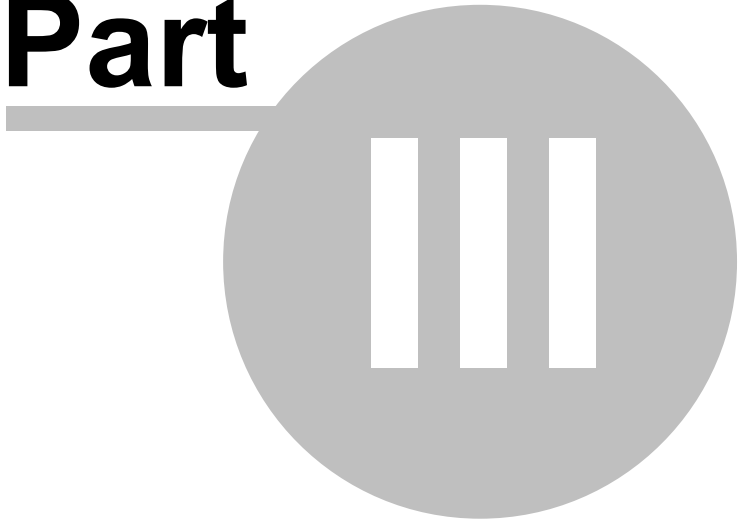
- 1) Click in quadrant **2** and your Azimuth and Elevation will change. Your view will move up and to the left.
- 2) Click in quadrant **4** and your Azimuth and Elevation will change. Your view will move down and to the right.
- 3) Ctrl+Click (or Right Click) in quadrant **1** or **2** to move closer to the model.
- 4) Ctrl+Click (or Right Click) in quadrant **3** or **4** to move away from the model.

This can be a bit confusing to explain. If you just play a bit with the mouse movement it will be come clear in less time than it's taken you to read this section.

Top Level Intro

This page is printed before a new top-level chapter starts

Part



3 Application wide settings

3.1 Application settings overview

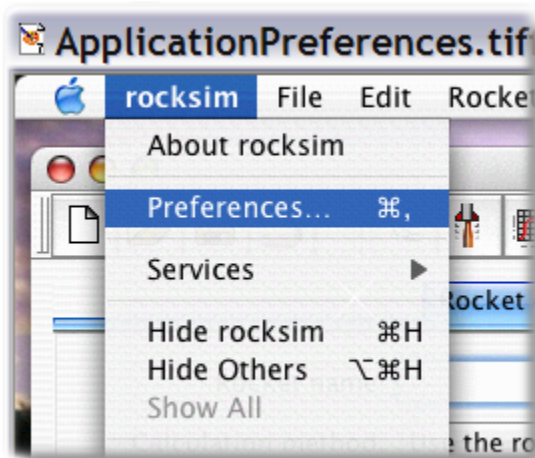
The preferences screen provides access to several pages of global settings that are used by RockSim. The values for these settings are stored in a file called RockSimSettings.dat. These settings are used regardless of the RockSim design file that is currently opened.

The menu that you use to access these settings differs depending on the operating system that RockSim is running on.

Windows preferences access:



Mac OS X preferences access:



The preferences screen is divided into four pages:

Simulation - Define the default simulation settings.

Simulation summary - Define the layout of the simulation summary screen, and the simulation resolution and method.

Units - Defines the default units used throughout RockSim.

2D Drawing - Defines the general display properties of the 2D blueprint drawing.

3D Rendering - Defines the general display properties of 3D rocket components.

OK

Save your application settings, and exit this screen.

Cancel

Discard your changes, and exit this screen.

Help

Display the help screen associated with the currently active page.

3.2 RockSim preferences

3.2.1 Simulation

Minimum velocity for stable flight

This velocity is used to determine the required launch guide length. The rocket needs to reach this velocity before its flight will be stable.

Please be aware that this value is just a ballpark guess used for reporting. The true minimum velocity is dependent on the particular rocket, and the flight conditions at launch time.

Minimum Cd prediction velocity

The Cd prediction system yields unrealistic results at very low velocities / Reynolds numbers. This value specifies the minimum velocity used to predict the Cd of your design during simulations. If the current simulation velocity is lower than this value, then this value is used in the calculation.

3.2.2 Simulation summary

Simulation resolution in samples per second

The number of calculations per second used when running rocket launch simulations. The accuracy of simulation results is directly proportional to this value. The default value is 1000 samples per second. Some guidelines for this value are shown below.

For vertical flights of sub-sonic rocket: Use a minimum of 100 samples per second.

For any flights of super sonic rockets: Use a minimum of 400 samples per second.

For non-vertical flights or flights with wind: Use a minimum of 400 samples per second.

Descent resolution in samples per second

The number of calculations per second used when the rocket is descending on a recovery device. When a simulation is run, and all of the stages components are descending on recovery devices, then this value is used as the sample rate. It is a good idea to keep this value low in order to reduce the amount of memory required to store the simulation results.

Simulation method

The mathematical method that is to be used for approximating flight simulation data. There are currently two choices here. The first choice is the *Explicit Euler method*; this is the same method used in the original RASP program. The Euler method is relatively fast and reasonably accurate. The second choice is the *4th order Runge-Kuta method*. The Runge-Kuta method is extremely accurate, even at smaller step sizes. The price you pay for this accuracy, is MUCH slower execution speed.

Some notes on accuracy:

The accuracy of a numerical approximation system cannot exceed the worst case accuracy of the inputs to that system. Some of the areas in the simulation that contribute to the overall inaccuracy are shown below:

***Cd prediction** – Empirical methods of Cd prediction are really a best guess.*

***Engine mass and thrust data** – This data is accurate to about +/- 10%. The thrust curves in the engine data files are a representation of typical engine performance.*

***Flights at angles of attack of greater than 10-11 Degrees.** – The effects of lifting surface stall angle and the non-linear effects of high angle of attack flight are not handled in this release.*

***Wind effects** – The simulation uses a very simple wind model. Nature on the other hand is a bit more unpredictable. The cross wind drag force, like the Cd prediction is a best guess.*

The highest degree of accuracy can be obtained in pure vertical flight with no wind.

Use long column names on the simulation summary screen

Select this option to use full column names in the simulation list on the main screen. De selecting this option displays the simulation list with abbreviated column labels.

Available simulation summary columns

This is a list of available simulation data that can be displayed on the main screen. You can choose one or more items from this list, and use the **Add** -> button to move them to the **Displayed simulation summary columns** list.

The available simulation data is shown below:

Altitude at deployment - The altitude of the rocket at the time of recovery system deployment.

Comments – User specified comments about the simulation.

Engines - The engine load for the simulation.

Execution time - The elapsed time required to run the simulation.

Max. Acceleration - The maximum acceleration attained.

Max Altitude - The maximum altitude attained.

Max. Velocity - The maximum velocity attained.

Optimal delay - This is the optimal ejection delay for recovery deployment at apogee.

Results - An icon which indicates the results of the simulation. (See below)

Simulation Number - The sequence number of the simulation.

Time to apogee - The time in seconds until apogee is reached.

Velocity at deployment - The speed of the rocket at the time of recovery system deployment.

Displayed simulation summary columns

This is the simulation data that will be displayed on the main screen. You can choose one or more items from this list, and then use the **← Remove columns** button to eliminate them from the main screen display.

Add columns

Copy the selected items in the **Available simulation summary columns** list into the **Displayed simulation summary columns** list.

Remove columns

Remove the selected items in the **Displayed simulation summary columns** list.

Save

Saves the application settings to your hard drive. The settings are stored in a file called RockSimSettings.dat. This file is located in your RockSim root folder.

Cancel

Discards any changes made to the application settings, and closes the settings screen.

Help

Displays this help file.

3.2.3 Units

Display altitude in:

Altitude values will be displayed in the selected units.

Display velocity in:

Velocity values will be displayed in the selected units.

Display acceleration in:

Acceleration values will be displayed in the selected units.

Display mass in:

Mass values will be displayed in the selected units.

Display lengths in:

Length values will be displayed in the selected units.

Length values are used for rocket components.

Display temperature in:

Temperature values will be displayed in the selected units.

Display barometric pressure in:

Barometric pressure values will be displayed in the selected units.

Display wind velocity in:

Wind speed values will be displayed in the selected units.

Use default English units.

Selects the following units:

Altitude in feet.

Velocity in feet / sec.

Acceleration in feet / sec / sec.

Mass in ounces (Advp.).

Lengths in inches.

Temperature in degrees Fahrenheit.

Barometric pressure in inches of Hg.

Use default metric units.

Selects the following units.

Altitude in meters.

Velocity in meters / sec.

Acceleration in meters / sec / sec.

Mass in grams.

Lengths in millimeters.

Temperature in degrees centigrade.

Barometric pressure in mm of Hg.

Note: The RockSim application stores all of its rocket design data in the units shown below. Whenever data is displayed or printed, it is converted from these internal units, into your selected units. This can occasionally

result in some minor rounding errors.

Altitude in meters.

Velocity in meters / sec.

Acceleration in meters / sec / sec.

Mass in grams.

Lengths in millimeters.

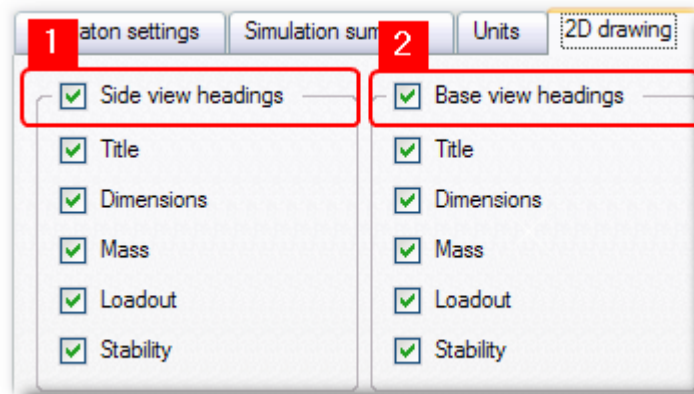
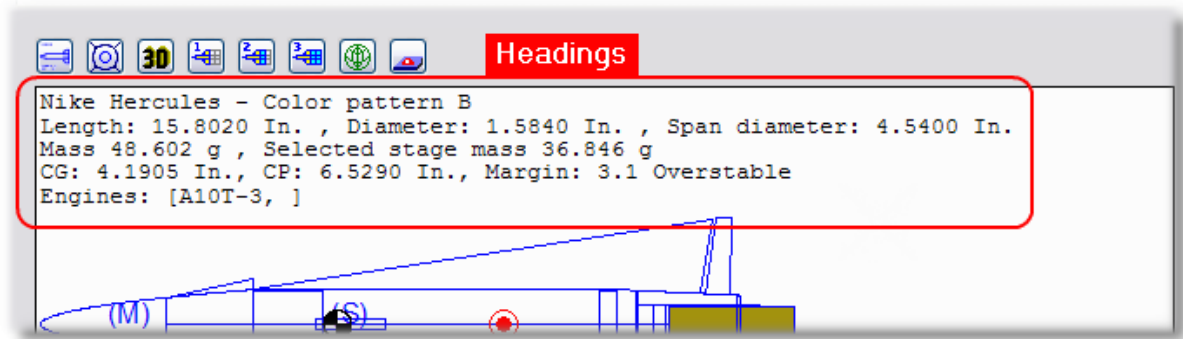
Temperature in degrees centigrade.

Barometric pressure in mm of Hg.

3.2.4 2D Drawing

The 2D drawing preferences are divided into several logical groups:

The **Side view headings** and **Base view headings** groups define the heading text that is displayed on the 2D drawings.



1 Side view headings

The check box on this group will enable or disable the display of all the items in the group.

2 Base view headings

The check box on this group will enable or disable the display of all the items in the group.

Title

Displays the rockets name at the top of the screen.

Dimensions

Displays the length, diameter, and span diameter of the rocket.

Mass

Displays the calculated mass of the rocket.

Load out

Displays a description of the current engine load out.

Stability

Displays a table containing the calculated static stability data for the rocket.

Display text and markers with the drawing

Selecting this option enables the display of the items below.

If this option is not selected, then none of the items shown below will be displayed.

Display the scale of the drawing

Displays the current scale ratio of the rocket.

Side view decorations**CG marker**

Displays the standard CG marker icon on the side of the rocket.

CP marker

Displays the standard CP marker on the side of the rocket.

Base view decorations**Stability graph overlay**

Displays a graph that indicates the relative static stability based on the angle of light into the wind. This graph is only useful if your design contains asymmetrical fins or other passive guidance components.

Show grid angle

Displays the angle of flight relative to the wind if the **Stability graph overlay** option is selected.

Grid color

This is the color used for the grid lines in the Stability graph overlay.

CG color

This is the color used to represent the CG position in the Stability graph overlay.

Stable color

This is the color used to indicate stable wind angles in the Stability graph overlay.

Unstable color

This is the color used to indicate unstable wind angles in the Stability graph overlay.

Common settings**Drawing pen width**

Selects the drawing pen width. The default value is 1 Pix. A value of 1 Pix is usually fine for a screen display. Note that the pen width can be specified in a number of different units.

Background color

This is the background color used in the drawing.
To change this color, press the button to the right of the color label.

CG Marker color

This is the color used to draw the CG marker.

RockSim CP color**Barrowman CP color****Cutout CP color**

Specifies the color used to draw the CP marker. The color displayed is determined by the calculation method that is in use.

Engine color

Specifies the color used to render engines loaded into the design.

Default non-highlight color - *This applies to component editor screens only.*

Specifies the color used to render all of the components except the one being edited.
The component being edited is displayed in it's own color.

Text color

Specifies the color used to display heading and marker text.

Header font

Specifies the font and color used display the heading text.

Dimension and drawing font

Specified the font used to render any text that is part of the design drawing.

3.2.5 3D Rendering

Render internal surface details

If this option is selected then 3D objects will render their internal walls and details.
This setting can effect 3D display performance.

Use variable resolution parts

When the camera is being moved on slower systems, or if the model is very complex, the frame rate can be very slow. Selecting this option will reduce the resolution of some or all of the model components while the camera is being moved. This can improve performance on slower systems.

Object resolution section

The 3D objects that are created to represent your rocket design are made up of multiple polygons. The appearance of the object is improved with a larger number of polygons. The rendering speed, however is greatly effected by the total number of polygons being displayed. The settings that follow control the number of polygons used to render different types of parts. The simplest way to set these values is to user the Low Res....., Medium Res....., and High Res.... buttons.

Low Res....

Preset all resolution values to low resolution.

Medium Res....

Preset all resolution values to medium resolution.

High Res....

Preset all resolution values to medium resolution.

Extrusion

These settings effect the resolution of all Nose Cones, Transitions, Body Tubes, Launch Lugs, and Engines.

Curve

This is the number of points used to create the profile of Nose Cones, and transition sections.

Filter

This is the number of points used around the circumference of round components.

3.2.6 Miscellaneous

File open recent limit

This is the maximum number of files to display in the File Open recent popup menu.

Prompt on delete

Select this option if you want to be prompted for confirmation when you delete items in RockSim. If you disable this option, then item delete operations will be immediate and for the most part, not reversible.

Enable database imports

Select this option if you wish to allow database file imports. If this option is selected then the **File – Import – Database files...** menu option will be available. Importing new database files can be a potentially dangerous process. Unless you are very sure of the integrity of the files being imported you should not perform this operation.

Allow template exports

Select this option if you want to allow the export of rocket component templates. If this option is selected then an **Export template** button will be displayed on the component editor screens where appropriate. Component templates can be used to print cutting templates or to provide the raw data to drive external CAM systems. At this time template data can only be exported in SVG format, or in CSV format.

Allow database path overload

Select this option if you wish to specify a new location for the RockSim database files. If this option is selected then the Database path field will be enabled. RockSim will assume that the specified path contains all of the required *name.CSV* files that are normally stored in the **RockSim/Data** folder. If you specify a network folder for your database files, then you need to insure that the folder is available prior to running RockSim.

Database path (Available only when **Allow database path overload** is selected)

This is the location for the RockSim database files. In order to specify an alternate database path you must Select the Enable database path overload option. RockSim will assume that the specified path contains all of the required *name.CSV* files that are normally stored in the RockSim/Data folder. If you specify a network folder for your database files, then you need to insure that the folder is available prior to running RockSim.

If you specify a path with a prefix of *./* then the path is interpreted as relative to the current RockSim root folder.

PC example:

RockSim is installed in `c:\Program files\RockSim 8`.

A path of `./Data` becomes `c:\Program files\RockSim 8\Data`

Mac example:

RockSim is installed in /Applications/RockSim 8

A path of **./Data** becomes **/Applications/RockSim 8/Data**

Top Level Intro

This page is printed before a new
top-level chapter starts

Part

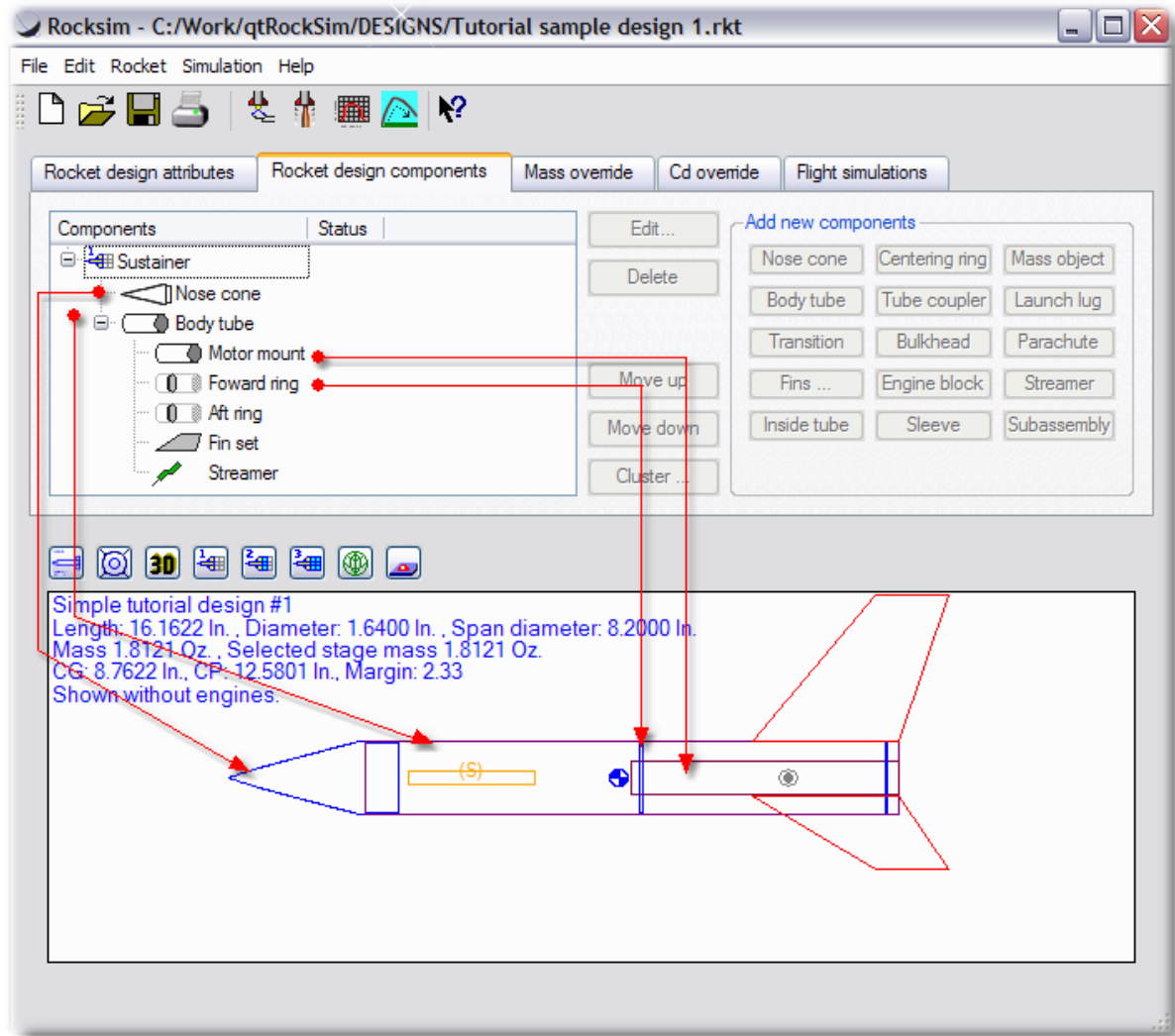


4 Designing rockets

This section contains information about the component data entry screens.

The components that make up a rocket design are displayed on the Rocket design components tab on the main screen.

The diagram presented below outlines the relationship between the component tree display and the rocket drawing.



4.1 Component screens

All of the component design screens have the same general layout.

Component mass

This is the calculated mass of the component being edited. As changes to the component specifications are made, this data will be updated.

Note: If you have selected a mass override setting for the component, then this value will not be recalculated.

Mfg. Part description

If the component specifications originated from the database, then the part description is displayed here. If the component is new, or not from the database, then Custom is displayed here.

Choose from database...

Displays the list of components currently stored in the database. You can choose a component from this list.

Save to database...

Displays the Database update screen. From here you can enter the manufactures Name, Part number, and description for the component, and save it to the database.

OK

Closes the component editor window. Any changes that you have made to the component are retained in the rocket design.

Cancel

Undo any changes made to the component, and close the component editor window. If the component was newly created, then it is removed from the rocket design.

Help...

Display online help.

Common data tabs for the component editors:

Radial position - Location of the component around the circumference of the airframe.

Drawing tab - The 2D and 3D color specifications.

Also of interest:

General design settings

Component layout

Mass override

2D view screen.

3D view screen.

3D camera control.

4.2 Construction and Finish

Default surface finish.

This specifies the relative surface characteristics of the rocket design. There are four finish types available. A brief description of these types is shown below:

This value will be allied to all new components that you add to your design.

Polished indicates a slick glossy surface.

Gloss indicates a typical gloss spray paint finish.

Matte indicates a dull hand painted type of surface.

Unfinished indicates the worst case surface finish.

4.3 Radial position

The settings on this tab control the positioning of components relative to the airframe centerline.

Radial distance (not present for all components)

The distance from the centerline of the component to the centerline of the airframe.

Angle

The angle from 0 to 360 degrees where the centerline of the component is located. The angle is measured clockwise from a point on the right hand side of the component.

4.4 Nose cone

Name

This is the component name that will be displayed in the component selection list, and in the parts list report.

Shape

This is the general shape of the nose cone. You can choose from several shape classifications. The choices are **Conical , Ogive , Parabolic, Elliptical, Power series, Parabolic series, and Sears-Haack.**

Shape control

For the Power series, Parabolic series, and Sears-Haack selections, an additional shape control parameter is displayed on the screen. The slider control adjacent to the **Shape control** field will vary the relative curvature of the nose cone.

[Tell me more about the mathematics behind the nose shapes.](#)

Length

This is the distance from the nose cone tip to the body tube junction.

Diameter

This is the base diameter of the nose cone. This value is usually the same as the outer diameter of the associated body tube.

Base length

This is the length of an optional straight section of the nose cone that extends from the base of the selected shape to the base of the nose cone.

Material

The material that the nose cone is made of.

Construction

Specifies the construction type of the nose cone. You can choose between *Solid* and *Hollow*. If *Hollow* is specified, then *Thickness* is required.

Wall Thickness

This is the wall thickness for a *Hollow* nose cone. This value is only required for *Hollow* nose cones.

Core diameter

If a *Solid* nose cone has a hole drilled in the base extending into the nose cone, then this is the diameter of that hole.

Core length

If a *Solid* nose cone has a hole drilled in the base extending into the nose cone, then this is the depth of that hole.

Note: If either *Core diameter* or *Core length* is set to zero, then both values will be ignored.

Shoulders

Shoulder

This part of the nose cone fits into the attached body tube.

Length

This is the length of the nose cone shoulder.. If a shoulder Dia. is specified, then you must specify this value.

Diameter

This is the outer diameter of the shoulder. If a shoulder Len. is specified, then you must specify this value.

Choose compatible body tube

Display a database selection screen with a list of body tubes. You can choose a body tube that the nose cone is destined to fit. The shoulder diameter will then be set to the correct size.

Clear shoulder settings

Remove the nose cone shoulder by setting the Length and Diameter to zero.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc.... And Mass fields will override the calculated CG and mass for the nose cone. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc....

This is the location of the nose cone CG. This distance is relative to the top of the nose cone.

Mass

This is the measured mass of the nose cone. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

[Common features of all design screens.](#)

4.5 Body tube

*General***Name**

The name of the body tube.

OD

The outside diameter of the body tube.

ID

The inside diameter of the body tube.

Length

The length of the body tube.

Material

The material that the body tube is made of.

This tube is a motor mount

Selecting this option specifies that the body tube will be used as a motor mount. At least one tube must be designated as a motor mount. If you do not specify a motor mount tube, then you will not be able to run flight simulations on your design.

Engine diameter

This is the engine diameter that will be loaded into this motor mount tube. When you first designate the body tube as a motor mount, RockSim will calculate the default engine diameter. You can override this value if you choose.

Radial position

These settings only apply to inside body tubes.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the body tube. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc....

This is the location of the nose cone CG. This distance is relative to the top of the body tube.

Mass

This is the measured mass of the body tube. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

Component layout

[Common features of all design screens.](#)

4.6 Inside tube

*General***Name**

The name of the inside tube.

OD

The outside diameter of the inside tube.

ID

The inside diameter of the inside tube.

Length

The length of the inside tube.

Material

The material that the inside tube is made of.

This tube is a motor mount

Selecting this option specifies that the inside tube will be used as a motor mount. At least one tube in each stage must be designated as a motor mount. If you do not specify a motor mount tube, then you will not be able to run

flight simulations on your design.

Note: Inside tubes can be converted into clusters of tubes within the air frame. For additional information on the creation of cluster arrangements please refer to the Component layout screen, and the Cluster wizard screen.

Radial position

Radial distance

This is distance between the center line of the inside tube, and the center line of the owning component. A radial distance of zero will exactly center the inside tube within the owning component.

Angle

This is the angular location of the inside tube. This is a value between 0 and 360 degrees. Zero degrees corresponds to the right hand side of the owning component as viewed from the rear end.

Mass override

Use known CG/Mass.

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the inside tube. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc...

This is the location of the nose cone CG. This distance is relative to the top of the inside tube.

Mass

This is the measured mass of the inside tube. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

[Common features of all design screens.](#)

4.7 Transition

General

Name

The name of the transition component.

Shape

This is the general shape of the transition. You can choose from several shape classifications. The choices are **Conical , Ogive , Parabolic, Elliptical, Power series, Parabolic series, and Sears-Haack.**

Shape control

For the Power series, Parabolic series, and Sears-Haack selections, an additional shape control parameter is displayed on the screen. The slider control adjacent to the **Shape control** field will vary the relative curvature of the transition.

[Tell me more about the mathematics behind the transition shapes.](#)

Front Dia.

This is the front diameter of the transition.

Rear Dia.

This is the rear diameter of the transition.

Length

This is the length of the transition. This dimension does not include the length of the shoulders.

Displayed below the Len. you will see a text notation for the *Equiv. nose Len.* This information serves a very specific, and obscure purpose. If you wish to mount fins on you nose cone, you need to know this length value. RockSim does not directly support attaching fins to nose cones. RockSim does, however support attaching fins to transitions.

Material

The material used for the transition.

Construction: Solid , or Hollow

Specifies the construction type of the transition. If Hollow is specified, then Thickness is required.

Wall Thickness

This the wall thickness for a Hollow transition.

Core Dia.

This specifies the diameter of a drilled out core extending through the transition component. This diameter is only applied to **Solid** transitions.

*Shoulders***Front / Rear shoulders**

Transition parts often fit into the front attached body tube, and the rear attached body tube. If the transition is a boat tail, then there will be no rear shoulder.

Front shoulder:**Front shoulder length.**

This is the length of the front shoulder. If Front shoulder Dia. is specified then you must specify this value.

Front shoulder diameter.

This is the outer diameter of the front shoulder. If Front shoulder Len. is specified, then you must specify this value.

Choose a compatible body tube.

Push this button to choose the front transition dimensions to fit a particular body tube.

Upon selection of a body tube, the Front Dia, and the Front shoulder Diameter. will be set to the correct dimensions.

Rear shoulder**Rear shoulder length.**

This is the length of the rear shoulder. If Rear shoulder Dia. is specified, then you must specify this value.

Rear shoulder diameter.

This is the outer diameter of the rear shoulder. If the **Rear shoulder Len.** is specified, then you must specify this value.

Choose a compatible body tube.

Push this button to choose the rear transition dimensions to fit a particular body tube. Upon selection of a body tube, the Rear Dia, and the Rear shoulder Dia. will be set to the correct dimensions.

Mass override

Use known CG/Mass.

If this value is selected, then the following CG Loc... And Mass fields will override the calculated CG and mass for the transition. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc...

This is the location of the transition CG. This distance is relative to the top of the transition.

Mass

This is the measured mass of the transition. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

[Common features of all design screens.](#)

4.8 Simple fin set

General

Number of fins

This is the number fins in this fin set. It is assumed that the fins will be placed symmetrically around the owning body tube. The current version of RockSim does not support asymmetric fin designs.

Fin shape

This is the general shape of the fin. Chose trapezoidal or elliptical.

Root chord Len.

This is the length of the root chord fin edge. This is the fin edge that attaches to the owning body tube.

Tip chord Len.

This is the length of the fin tip chord. This edge is parallel to the root chord. The fin tip chord only applies to trapezoidal fin shapes.

Sweep angle

The sweep angle is the deflection angle of the leading edge of the fin. This angle is measured from a line perpendicular to the airframe centerline .

Sweep Len

This is the horizontal distance between the leading root chord edge and the leading tip chord edge. The sweep distance only applies to trapezoidal fin shapes. The sweep distance can be positive or negative. Positive sweep distances place the leading tip cord edge behind the leading root cord edge. Negative sweep distances place the leading tip cord edge in front of the leading root cord edge.

Span

This is the perpendicular distance between the root chord edge and the tip chord edge.

Location

This is the distance from the front of the owing body tube to the leading root chord edge.

Thickness

This is the thickness of the fin stock.

Material

This is the material used for the fin set.

*TTW Fin mount (TTW == **T**hrough **T**he **W**all)*

Tab offset

The distance from the front of the root edge to the fin tab.

Tab length

The length of the fin tab.

Tab depth

The depth of the fin tab. This is the distance from the root edge of the fin to the bottom of the fin tab.

Calculate the tab depth for me

Press this button, and the program will attempt to calculate the fin tab depth. This depth is determined by looking for the location of inside body tubes that are beneath the fins.

Mass override

Use known CG/Mass.

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the fin set. This feature is typically used for manufactured parts, where you don't know the material, thickness, Etc..

CG Loc....

This is the location of the fin set CG. This distance is relative to the front of the fin root edge.

Mass

This is the measured mass of the fin set. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

Common features of all design screens.

4.9 Complex fin set

General

Number of fins

This is the number fins in this fin set. It is assumed that the fins will be placed symmetrically around the owing body tube.

Note: The Barrowman equations only support fin counts of 3, 4, or 6. If you choose any other fin count, then only the RockSim method can be used for static stability calculations.

Location

This is the distance from the front of the owing body tube to the leading root chord edge.

Edit fin plan

The [fin planner screen](#) is displayed when you press this button. The fin planner screen is used to edit the vertex points that define the shape of the fin.

Thickness

The thickness of the material used to build the fins.

Cross section

The cross sectional shape of the fin. This property is used to determine the drag coefficient for the fins.

Material

This is the material used for the fin set.

*TTW Fin mount***Tab offset**

The distance from the front of the root edge to the fin tab.

Tab length

The length of the fin tab.

Tab depth

The depth of the fin tab. This is the distance from the root edge of the fin to the bottom of the fin tab.

Calculate the tab depth for me

Press this button, and the program will attempt to calculate the fin tab depth. This depth is determined by looking for the location of inside body tubes that are beneath the fins.

*Radial position***Angle**

The radial position of the fin(s) around the airframe. This is the position of the first fin in the set.

An angle setting of zero degrees is straight up as viewed from the base of the rocket. Angles increase in a clockwise direction like a compass reference.

Note: The Barrorman equations only support multiple symmetrical fins sets if the first fin in all sets are located at the same radial angle position on the airframe.

If you choose to use different radial angle positions for multiple fins sets, then only the RockSim method can be used for static stability calculations.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the fin set. This feature is typically used for manufactured parts, where you don't know the material, thickness, Etc..

CG Loc....

This is the location of the fin set CG. This distance is relative to the front of the fin root edge.

Mass

This is the measured mass of the fin set. If Use known CG/Mass is selected, then a value must be specified for

this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

Component layout

[Common features of all design screens.](#)

4.10 Free form fin planner

The tool bar buttons:

Grid

Show or hide the grid lines.

Grid labels.

Show or hide the grid labels. Grid labels are only displayed when the grid is set to visible.

Snap to grid.

Enable or disable snap to grid. When snap to grid is enabled, then points which you add or move will align themselves to the nearest **Snap to** coordinate.

Show line end points.

Show or hide the end points of the fin plan data points. When your fin plan contains many points which are close together, this option can be useful.

Zoom in.

Magnify the view of the fin plan.

Zoom to fit all.

Set the zoom level to view all of the plan points.

Zoom out.

Shrink the view of the fin plan.

Add or change plan data points.

This is the default operating mode. This allows you to add new plan points or move existing plan points.

* To add a new plan point, click on, or near the line where you wish to add the new plan point.

* To move an existing plan point, left click (and hold the mouse button down), then drag the plan point to another location. When you release the mouse button, the plan point will be placed on the grid.

* To select an existing plan point without moving it, Shift-Click on the plan point.

Delete plan data points.

Select this option to delete existing plan points. Each time you click on an existing point, that point will be removed from the plan.

Chamfer the plan corner at the selected point.

Select this option to chamfer (Round off) a corner of the fin plan at the currently selected point. You will be

prompted for a radius and resolution for the chamfer.

Undo last

Click this button to undo the last change you made to the plan.

Each time you add, move, or delete a point, the previous fin plan is saved in memory. The same is true of chamfer operations. Pressing the Undo button restores the previous fin plans to the display in reverse order.

Preferences

Click this button to display the [graph paper style screen](#).

This function allows you to change the display characteristics of the fin plan graph paper.

Selected point X1, Y1.

These are the coordinates of the currently selected plan point. If you wish to change the coordinates of the selected plan point, you can enter override values for X1 or Y1. When you manually alter one of these fields, a small check mark will appear next to the field. Click the check mark to accept the new value you entered.

Grid size

This is the size of the grid overlay in current design units.

Snap to

This is the size of the invisible snap to grid overlay in current design units.

Hide

Press this button to [return to the custom fin set screen](#).

Also of interest:

[Common features of all design screens](#).

4.11 Graph paper style

Background color

The background color of display area.

Grid color

The color of the grid lines.

Point color

The color of the plan point markers.

Selected point color

The color of a selected plan point.

Line color

The color of the lines connecting the plan points.

Selected line color

The color of a selected line.

Grid label font and color

The screen font and foreground color of the grid axis labels.

Also of interest:

Return to the Free form fin planer screen.

[Common features of all design screens](#).

4.12 Tube fin set

Mass override

Use known CG/Mass.

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the fin set. This feature is typically used for manufactured parts, where you don't know the material, thickness, Etc..

CG Loc....

This is the location of the fin set CG. This distance is relative to the front of the fin root edge.

Mass

This is the measured mass of the fin set. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

Component layout

[Common features of all design screens.](#)

4.13 Ring tail

Mass override

Use known CG/Mass.

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the fin set. This feature is typically used for manufactured parts, where you don't know the material, thickness, Etc..

CG Loc....

This is the location of the fin set CG. This distance is relative to the front of the fin root edge.

Mass

This is the measured mass of the fin set. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

Component layout

[Common features of all design screens.](#)

4.14 Bulkhead

General

Name

This is the name of the bulkhead.

OD

This is the outer diameter of the bulkhead. The outer diameter is determined by the inner diameter of the owning body tube.

ID

This is the inner diameter of the bulkhead. An inner diameter of zero indicates a solid bulkhead.

Thickness

This is the thickness of the bulkhead.

Auto size known dimensions

Select this option if you want RockSim to calculate the OD of the bulkhead.

Location

This is the location of the bulkhead relative to the front of the owning body tube.

Material

This is the material used for the bulkhead.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the bulkhead. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc...

This is the location of the bulkhead CG. This distance is relative to the top of the bulkhead.

Mass

This is the measured mass of the bulkhead. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

Component layout

[Common features of all design screens.](#)

4.15 Centering ring

Name

This is the name of the centering ring.

OD

This is the outer diameter of the centering ring. The outer diameter is determined by the inside diameter of the owning component.

The hole pattern in a centering ring is calculated automatically based on the position of the centering ring relative to the position(s) of the inside tubes in the design.

Thickness

This is the thickness of the centering ring.

Auto size known dimensions

Select this option if you want RockSim to calculate the OD of the centering ring, and the position and diameter of any required holes. The location and dimension of the drilled holes is determined by the position of the centering ring relative to inside tubes.

Location

This is the location of the centering ring relative to the front of the owning body tube.

Material

This is the material used for the centering ring.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the centering ring. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc....

This is the location of the centering ring CG. This distance is relative to the top of the centering ring. Usually this is simply 1/2 the thickness of the centering ring.

Mass

This is the measured mass of the centering ring. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

[Common features of all design screens.](#)

4.16 Sleeve

*General***Name**

This is the name of the sleeve.

OD

This is the outer diameter of the sleeve.

ID

This is the inner diameter of the sleeve.

The inner diameter is determined by the outer diameter of the owning body tube.

Length

This is the length of the sleeve.

Auto size known dimensions

Select this option if you want RockSim to calculate the ID of the sleeve.

Location

This is the location of the sleeve relative to the front of the owning body tube.

Material

This is the material used for the sleeve.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the sleeve. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc...

This is the location of the nose cone CG. This distance is relative to the top of the sleeve.

Mass

This is the measured mass of the body tube. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

[Common features of all design screens.](#)

4.17 Tube coupler

*General***Name**

This is the name of the tube coupler.

OD

This is the outer diameter of the tube coupler.

ID

This is the inner diameter of the tube coupler.

Length

This is the length of the tube coupler.

Auto size known dimensions

Select this option if you want RockSim to calculate the OD of the tube coupler.

Location

This is the location of the tube coupler relative to the front of the owning body tube.

Material

This is the material used for the tube coupler.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the tube coupler. This feature is typically used for manufactured parts, where you don't know the material,

wall thickness, Etc..

CG Loc...

This is the location of the nose cone CG. This distance is relative to the top of the tube coupler.

Mass

This is the measured mass of the tube coupler. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

[Common features of all design screens.](#)

4.18 Engine block

*General***Name**

This is the name of the engine block.

Outer diameter

This is the outer diameter of the engine block. The outer diameter is determined by the inner diameter of the owning motor mount tube.

Inner diameter

This is the inner diameter of the engine block.

Thickness

This is the thickness of the engine block.

Auto size known dimensions

Select this option if you want RockSim to calculate the OD of the engine block.

Location

This is the location of the engine block relative to the front of the owning body tube.

Material

This is the material used for the engine block.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the engine block. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc...

This is the location of the engine block CG. This distance is relative to the top of the engine block.

Mass

This is the measured mass of the engine block. If Use known CG/Mass is selected, then a value must be specified for this field.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

[Common features of all design screens.](#)

4.19 Launch lug

Outer diameter

The outside diameter of the launch lug.

Inner diameter

The inside diameter of the launch lug.

Length

The length of the launch lug.

Mfg. Type

The manufactured part number. The default selection is "Custom", which implies that you will fully specify the launch lug.

Material

The material that the launch lug is made of.

Drawing

Refer to the Drawing topic for information on assigning colors and surface characteristics.

Also of interest:

[Common features of all design screens.](#)

4.20 Subassembly

General

A subassembly is a place holder component. You attach parts to the sub assembly component, and you can then treat the group of parts as a single unit.

Name

The name of the sub assembly. This is the name that will be displayed in the parts list, and on the component screen.

File name

This is the name of the disk file containing the data for the sub assembly. This file name is specified when you press the Save to database button.

Description

This provides additional notes or comments about the sub assembly.

Relative location

Changes the relative position of all of the components attached to the subassembly.

Note: The operation of the Choose from database... , and the Save to database... buttons is different for subassemblies. Please refer to the description that follows.

Choose from database...

Open a sub assembly file. A standard file open window is displayed asking you to specify a subassembly file. If you choose to open the file, then the contents of the subassembly is replaced by the file.

Save to database...

Saves the subassembly to a file. A standard file save window is displayed asking you to specify a file name for the subassembly. If you choose a file name, and then elect to save, the contents of the subassembly and all of it's associated components are written to a file in XML format.

Also of interest:

Common features of all design screens.

4.21 Streamer

Length

This is the length of the streamer.

Width

This is the width of the streamer.

Number of streamers

This is the number of streamers.

Position in tube

This is the position from the front of the owning body tube.

Thickness

This is the thickness of the streamer.

Material

This is the material that the streamer are made of.

This streamer is folded

Select this option if the streamer is folded in a ziz zag pattern. This increased the Cd of the streamer. Note that you will not see the effects of this unless you have also selected Auto calculate the Cd. The Cd prediction model increases the Cd by a factor of three when folded is selected.

Auto calculate the Cd

Select this option if you want RockSim to calculate the Cd of the streamer for you. If this option is not selected, then you can enter you own value for the Cd.

Cd

This is the drag coefficient of the streamer that will be used in descent rate calculations during simulation.

Recommend a streamer

Calculate an acceptable streamer for the current rocket design.

*Mass override***Use known CG/Mass.**

If this value is selected, then the following CG Loc..., and Mass fields will override the calculated CG and mass for the streamer. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

CG Loc....

This is the location of the nose cone CG. This distance is relative to the top of the streamer.

Mass

This is the measured mass of the streamer. If Use known CG/Mass is selected, then a value must be specified for this field.

Also of interest:

[Common features of all design screens.](#)

4.22 Parachute

Shape

This is the shape of the parachute. Choose from Round, Square, 5 Sided , 6 Sided , 7 Sided or 8 Sided.

Chute count

This is the number of parachutes.

Spill hole diameter

This is the spill hole diameter.

Shroud line count

This is the number of attached shroud lines.

Outer diameter

This is the outer diameter of the parachute.

Location in tube

This is the location from the front of the owning body tube.

Use known CG/Mass.

If this value is selected, then the following CG Loc.... And Mass fields will override the calculated CG and mass for the nose cone. This feature is typically used for manufactured parts, where you don't know the material, wall thickness, Etc..

Mass

This is the measured mass of the transition. If Use known CG/Mass is selected, then a value must be specified for this field.

Thickness

This is the thickness of the parachute material.

Mfg. Type

The manufactured part number. The default selection is "Custom", which implies that you will fully specify the parachute.

Chute material

This is the material used for the parachute canopy.

Recommended rates: Low , Mid , High

Press these buttons to calculate parachute specifications for a range of descent rates.

Current rate

This is the rate of descent that the parachute specifications will produce. Changes to other parachute specifications will cause this field to change. Making changes to Current rate will recalculate a new parachute

diameter.

Calculated descent mass

This is the mass of the stage configuration that will be descending with the parachute. This is the mass of the rocket components plus the mass of any engine casings loaded into the stage.

Descent rate analysis

An analysis of the current parachute configuration is displayed just above the rocket image. The analysis results are based upon the recommended descent rates. Your rocket design may well be able to handle descent rates that are outside the recommended range.

Also of interest:

Common features of all design screens.

4.23 Mass object

Name

This is the name of the mass object.

Classification

There are two choices here.

- General - Use this for most mass objects. Only a name and a known mass is required.
- Shock cord - Use this to specify a shock cord for the rocket design.

General mass objects:**Location**

This is the location of the mass object in the owning body tube.

Mass

This is the mass of the object. It's CG is assumed to be the same as it's location. This data is only specified for mass objects with a general classification.

Why use mass objects

Mass objects with a general classification can be used whenever you need to add an arbitrary mass to a body tube. For example, you could use a mass object to represent a pay load, or some other component that is not explicitly supported by RockSim. A shock cord is a special type of mass object. Shock cords require a length and material specification.

Shock cords**Location**

This is the location of the shock cords center of mass within the owning body tube.

Length

This is the length of the shock cord.

Material

This is the material that the shock cord is made from.

Also of interest:

Common features of all design screens.

4.24 Cluster wizard

The cluster wizard consists of a series of related screens. The Next and Back buttons are used to move from one screen to another. When you get to the final screen, you have the option of accepting the cluster pattern or closing the cluster wizard screen without any changes.

RockSim creates clusters by cloning inside motor mount tubes. In other words, you select an individual motor mount tube, and the cluster wizard makes n copies of the tube, and arranges them within the airframe according to the pattern you select. You can combine as many cluster patterns as you like. You are of course restricted by the number of tubes that will fit in the airframe.

The cluster wizard screens are as follows:

Introduction

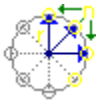
This screen just displays some notes about using the cluster wizard.

Pattern selection

A list of available fixed cluster patterns is available, and there is a variable ring configuration. Click on the desired pattern and then click next.



Fixed cluster patterns



Variable ring pattern

User defined cluster (Variable ring pattern only)

Number of tubes in the cluster

Specifies the number of tubes that form the cluster ring.

Cluster radius

Specifies the distance from the airframe centerline to the center line of the cluster tubes.

Calculate the minimum radius

Click this button to set the Cluster radius to its smallest possible value based on the tube sizes and count.

Calculate the maximum radius

Click this button to set the Cluster radius to its largest possible value based on the tube sizes and count.

Cluster naming and position

Tube name prefix

This text is used to generate names for the tubes that will make up the cluster arrangement. Example: if Name prefix is "Mount", then the tube names would become "Mount 1", "Mount 2", Etc.

Rotation angle

A rotation angle applied to all of the tubes in the cluster. This is used to create clusters that overlap. For example, you could rotate the tubes of a cluster pattern into the empty spaces in a previously created cluster pattern.

A possible message may appear on this screen:

WARNING: The cluster as specified will not fit in the airframe.

You are not allowed to create clusters that are outside the airframe. The reason for this is that we currently do not have code in place to predict the effect on CP or Drag coefficient.

Final step

This is the last screen in the cluster wizard. Here you are shown a base view of the design with the new cluster pattern in place.

Next

Previous

Cancel

Click this button to close the cluster wizard screen, and make no changes.

Tutorials:

Creating tube clusters.

4.25 Component color

The Color tab is presented with all component editor screens. This information determines the 2D drawing color, and 3D surface characteristics for the components.

2D Drawing

Color

This is the 2D drawing color that will be used for this component.

3D Rendering

Use a simple color model

Selecting this option greatly simplifies the color selection for 3D rendering. You need to specify only the base color for the component. All other parameters are automatically calculated by the program. If you do not select this option, then you can specify all of the 3D surface rendering parameters yourself. See the additional options below.

Opacity

This determines the degree to which light will pass through the component. The range of values is between 0.0 and 1.0. A value of 1.0 renders the component as completely opaque. A value of zero renders the component completely transparent.

Advanced options:

Diffuse color

This is the color reflected off of the component.

Diffuse level

This is the intensity level applied to the Diffuse color.

Use the Diffuse color for Ambient, and Specular color

If you select this option, then the specified Diffuse color will be substituted for the Ambient color, and the Specular color.

Ambient color

This is the color that appears on the component even without a light source illuminating it.

Ambient level

This is the intensity level applied to the Ambient color.

Specifications for surface finish.**Specular color**

This is the color of the reflection highlights.

Specular level

This determines how much light is apparently reflected from the surface of the component.

Specular power

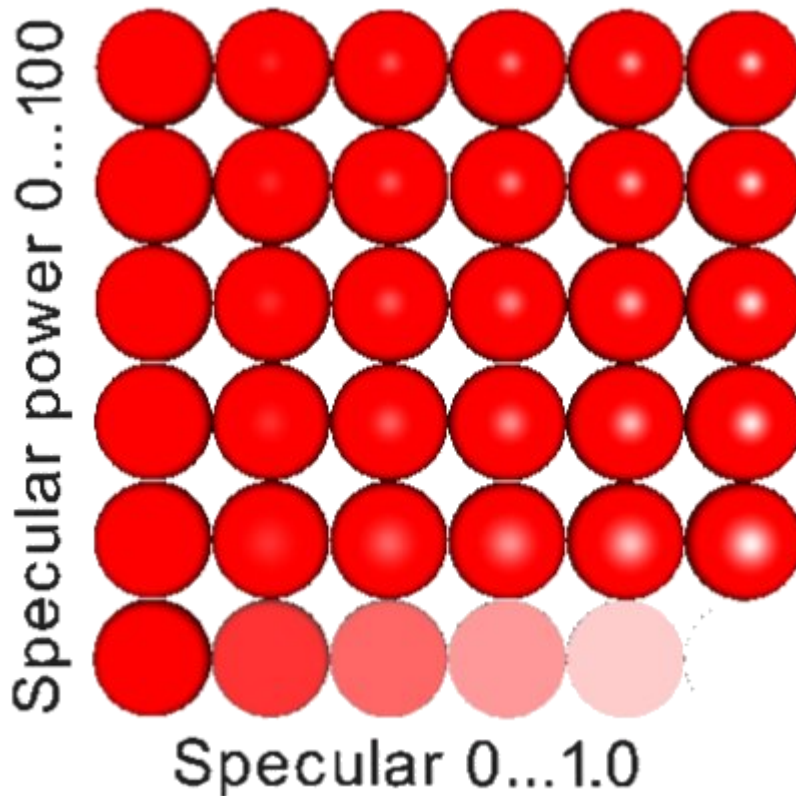
This determines how smooth the surface of the object appears to be.

The picture show below illustrates the function of the specular parameters.

In this picture The Diffuse color is Red, and the Specular color is White.

The Specular level is varied from 0 to 1.0 along the horizontal.

The Specular power is varied from 0 to 100 along the vertical.

**Also of interest:**

General design settings
Component layout
Common features of all component editor screens.
Texture settings

4.26 Component texture

You can apply texture bitmaps to 3D components. This can produce some interesting 3D rocket images. Texture mapping is a fairly complex subject and what is presented here is a very brief overview.

Texture fields and options

Texture map R origin

This is the origin or center of the texture map along the horizontal axis. A value of 0.5 is the center of the texture map. A value of 0.0 is the left edge of the texture map and a value of 1.0 is the right edge of the texture map.

Texture map S origin

This is the origin or center of the texture map along the vertical axis. A value of 0.5 is the center of the texture map. A value of 0.0 is the top edge of the texture map and a value of 1.0 is the bottom edge of the texture map.

Texture map R position

This is an optional texture map position adjustment along the texture map horizontal axis.

Texture map S position

This is an optional texture map position adjustment along the texture map vertical axis.

Prevent seams

Note: This option is primarily used when mapping textures to cylindrical surfaces.

If this option is selected then cylindrical surfaces are split in half along their length and the texture is applied individually to each half. If this option is not selected then the texture is applied to the cylindrical surface as a whole.

Repeat pattern.

Selecting this option will cause the image to be tiled on the surface of the component. The size of the tiles is determined by the relationship between the size of the image and the size of the component. The size of the image can be altered by way of the X Scale and Y Scale values.

Rotate around the R axis

Selecting this option will flip the texture image about it's horizontal axis. Note that the horizontal axis of the texture image does not always match the horizontal axis of the 3D component.

Rotate around the S axis

Selecting this option will flip the texture image about it's vertical axis. Note that the vertical axis of the texture map will not always be the same as the vertical axis of the 3D component.

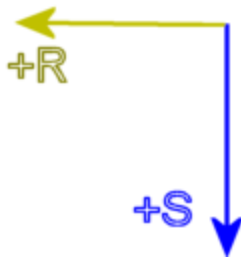
Texture Coordinates vs. Screen Coordinates

The texture map is assumed to be 1 X 1 units in size, and has an origin of (0.5, 0.5). Regardless of the actual texture bitmap size, the 1 X 1 model is used to map the pixels on the 3D object. This concept will become clearer when you look at the diagrams below.

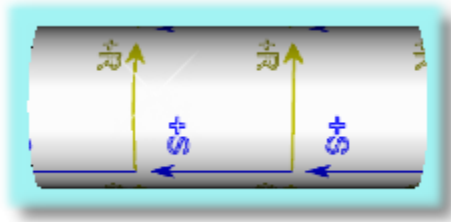
The coordinates that you see on the screen when you view a texture map are transformed into (S,R) texture coordinates when you apply the texture map to a 3D object in your design. You can reverse the orientation of the texture coordinates by selecting the **Rotate around the R axis** and **Rotate around the S axis** options.

Example: (Map a 128 X 128 Pixel image onto a body tube)

This is the bitmap as you would see it on your screen.



This is how it looks mapped onto a body tube in your design. (The reason the coordinate system appears rotated 90 degrees to the right is because of how the rocket design is oriented in 3D space.)



Texture scaling (Note: The Repeat pattern option must be selected for scaling to work as illustrated)

The way scaling is handled in texture mapping is different that the scaling you would use when editing a 2D bitmap. The 3D object that is having the texture applied is assumed to have dimensions of 1 X 1 units. The texture bitmap is also assumed to have dimensions of 1 X 1 units.

Example: (Map this 32 X 32 image onto a body tube)



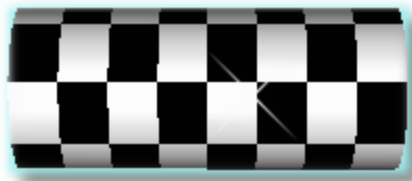
If Scaling on the R,S axis is left at it's default value of 1 then the texture map is stretched to fit the entire surface of the body tube as shown here.



If Scaling on the R,S axis is set to 2 then the 1 X 1 texture map is applied to a surface that is 2 X 2 units.



If Scaling on the R,S axis is set to 4 then the 1 X 1 texture map is applied to a surface that is 4 X 4 units.



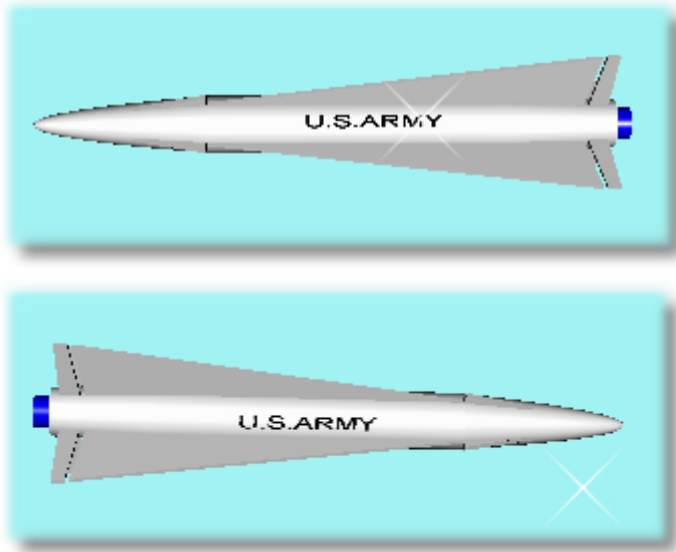
Decals

Texture maps are not the same as decals that you can apply to a real world model. Decals are individual images that are applied at specific locations.

A texture on the other hand is a complete image that is mapped over the entire surface of a 3D object.

You can still create decals, although the process is tedious. An example is shown below.

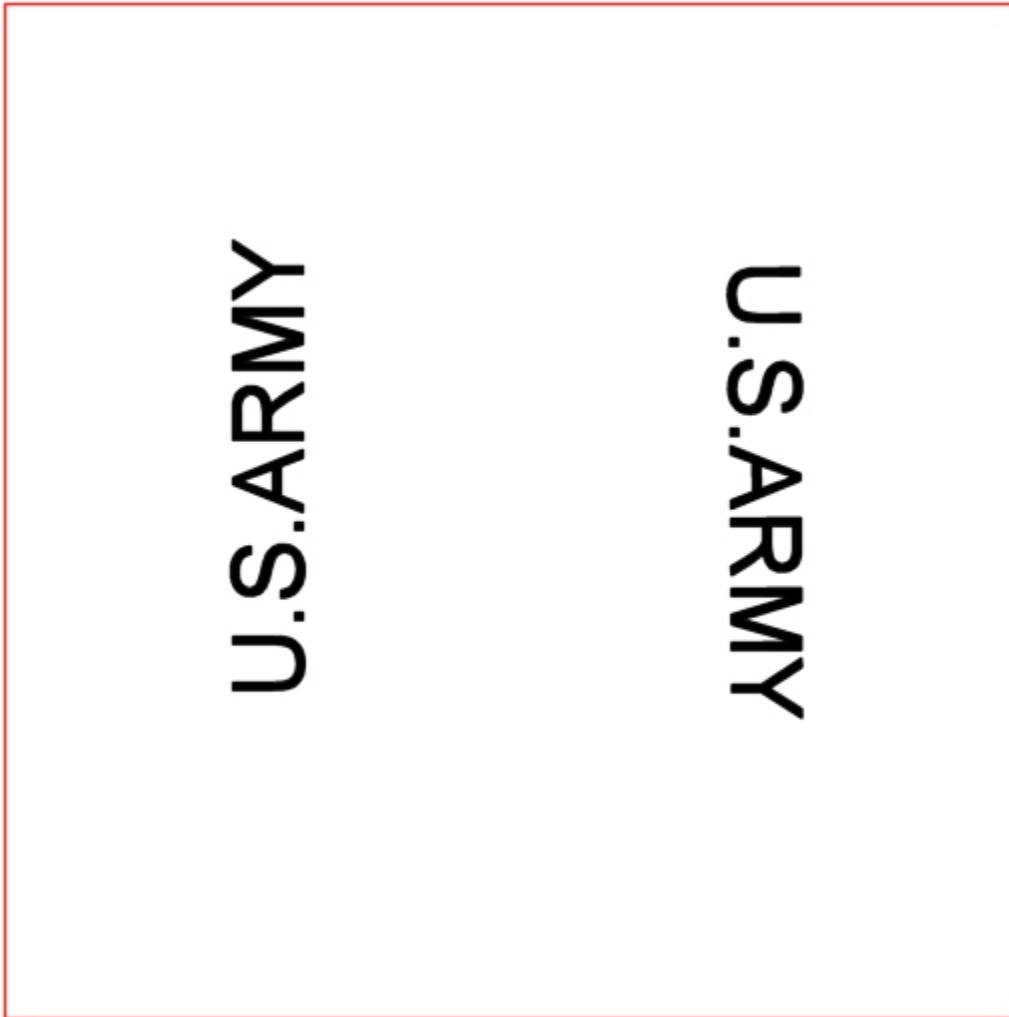
The sample design file pictured below is `.../RockSim/Designs/Texture/NIKEHERC pattern B.rkt`.



The following bitmap texture file was used to create the decal effect:

`../RockSim/Designs/Texture/usarmy_decal.jpg`

The bitmap is 512 X 512 Pixels. The border around the image below is displayed only to illustrate the size and position relationships in the image.



4.27 Database update screen

This screen is used by all component editors to save specifications to the database.

The list at the top of the screen displays a summary of the records currently stored in the database. You can copy data from this list into the fields on the bottom of the screen by using the arrow buttons next to the fields.

Manufacturer

Specifies the name of the component vendor for the new component.

Note: Commas will be stripped out of this text due to the file format used for the data files.

Part number

Specifies the manufacturer's part number for the new component

Note: Commas will be stripped out of this text due to the file format used for the data files.

Part description

Provides additional information about the part.

Note: Commas will be stripped out of this text due to the file format used for the data files.

Save

Store the component specifications in the database, and then close the database update screen.

Cancel

Close the database update screen. The component specifications are not saved to the database.

4.28 Drag analysis

The drag coefficient for your rocket design is the sum of the drag components shown below.

Nose and body

The combined drag coefficient of the nose cone and body tube.

Base

The drag coefficient caused by the low pressure at the rear of the rocket.

Fin

The drag coefficient caused by all of the fin sets.

Launch lug

The drag coefficient caused by the launch lugs.

Predicted Cd

The sum of (Nose and body Cd) + (Base Cd) + (Fin Cd) + (Launch lug Cd).

Cd adjusted for transonic and supersonic effects.

When the velocity of your rocket exceeds mach 0.8, the Cd is adjusted to simulate the sharp increase in drag coefficient encountered at these speeds.

Velocity

Adjust this slider control to observe the Cd of your rocket at various velocities. All of the Cd components mentioned in the above text are recalculated when you change the velocity.

Mach number

The ratio of the speed of sound to your rockets velocity. (Mach number = Speed of sound / Velocity).

4.29 Stability analysis

The stability plot selection screen contains the settings that govern the appearance of the stability analysis graph.

The support for asymmetrical fin placement in RockSim requires a different method of viewing static stability. In designs that contain asymmetrical fin designs, the calculation of static stability is dependent on the direction of the wind relative to the rocket. The stability analysis graph presents a polar style graph that indicates the static stability from all possible radial angle positions.

Graph type:

You can choose between two styles of stability analysis graphs.

1) Plot CP, and CG Vs. radial view angle

This graph type shows the relationship between the CP and CG of the model for radial angles between 0 degrees, and 359.9 degrees.

2) Plot static margin Vs. radial view angle

This graph type shows the static margin for radial angles between 0 degrees and 359.9 degrees.

The next section contains the settings that determine the Color and Line style used to represent the data in the graph.

CG reference line:

Determines the color and line style used to represent the rocket CG.

Stable configuration indicator:

Determines the color and line style used to indicate stable configuration for a given wind angle.

Unstable configuration indicator:

Determines the color and line style used to indicate unstable configuration for a given wind angle.

Display fin placement annotation:

Enable this option if you want to display the placement of the fins in the background of the stability graph.

Fin placement annotation:

Determines the color and line style of the fin position indicators. Please note that the fin position indicators are not drawn to their actual scale.

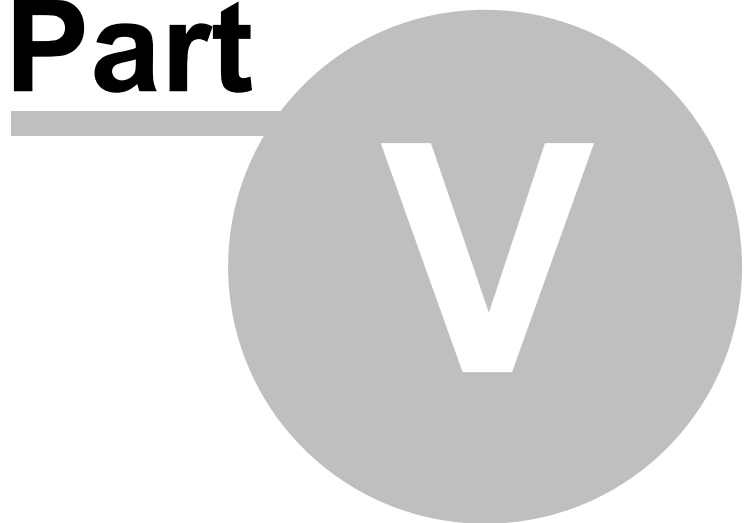
Fin placement end marker:

Determines the color and style of the fin position indicator end points. These indicators improve the visibility of the fin placement indicator lines.

Top Level Intro

This page is printed before a new
top-level chapter starts

Part



5 Simulations

5.1 Simulation data

RockSim has a sophisticated flight simulation system that can be used to simulate real world flights of your rocket design. The information obtained from these simulations can be used to fine tune your design and determine how it will perform with various engines.

A simulation consists of three data areas. These areas are Simulation parameters, Simulation results, and Raw simulation data. These areas are defined below:

Simulation parameters

The simulation parameters define the input conditions for the simulation. This information in conjunction with the rocket design are fed into the simulation process in order to produce the Simulation results and Raw simulation data.

Simulation parameters are stored within the RockSim design file.

There is also a set of Simulation parameters stored in the application settings for RockSim. This copy of the Simulation parameters is retained between RockSim sessions.

Simulation results

The simulation results are the final output of the simulation process. This information can be viewed in the simulation details report and on the simulation summary screen.

Raw simulation data

Simulation results are stored within the rocket design file.

The raw simulation data is the output of the simulation process for each time slice used in the integration process. This is potentially a huge amount of data. The raw data is stored in temporary disk files.

This data is used for the following:

- Creating simulation plots.
- Creating simulation animations.
- Export to spreadsheet files.

Raw simulation data only exists after running a simulation. Only one set of data is stored at a time and the data is removed when you exit the RockSim program.

Also of interest:

- Detailed description of the raw simulation data.
- Simulation preparation screens.

5.1.1 Simulation properties overview

In order to run a flight simulation in RockSim you need to provide two items. The first, of course, is a rocket design containing at least one body tube designated as a motor mount. The second set of information is the input conditions that drive the simulation. These simulation parameters are entered by way of the Rocket simulation properties screen.

The **Launch** button

Clicking this button will launch your rocket using the current set of parameters.
The rocket can also be launched from the main screen by way of the Simulation menu.

The **Flight profile...** button

Clicking this button will launch your rocket using the current set of parameters.
Upon successful completion of the simulation, the Flight profile screen will be displayed.

The **OK** button.

Clicking this button will save the engine load out and all of the simulation parameters.

The **Close** button

This button will close the Simulation preparation screen. The engine load out that was in place prior to changes made on this screen will be restored.

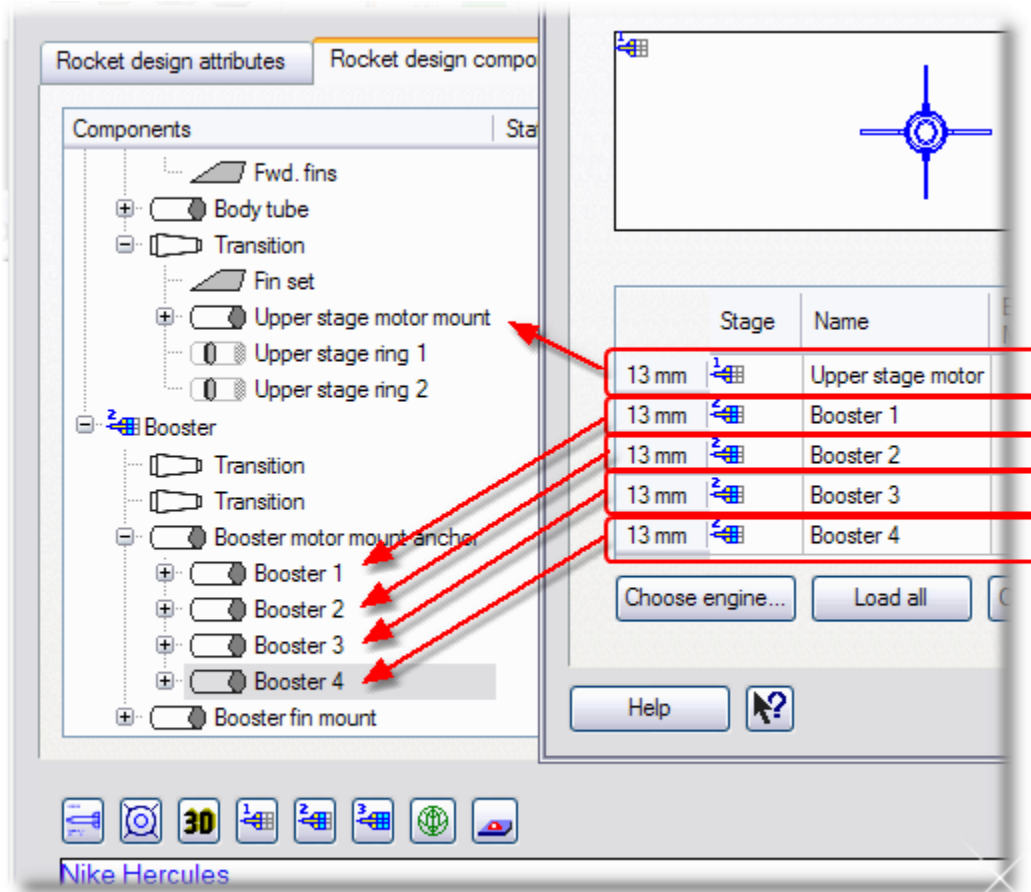
Also of interest:

Simulation engine selection.
Simulation flight events (Recovery device deployment).
Simulation controls.
Launch guide position.
Launch conditions.
Competition settings.

5.1.2 Engine selection

The engine selection screen is where you load engines into the rocket in preparation for launching a simulation.

The first step in loading engines into your design is understanding the relationship between your design and the engine load out screen. The names assigned to the motor mount tubes serve as the primary visual link. The following overview of the screen shows the relationship between your design and the engine selection table.



The motor mount table:

This is a list of all the motor mounts in your rocket design. In order to load an engine into the motor mount you need to first select the motor mount by clicking on it's row in the table. You may select more than one motor mount at a time. The Choose engine... button can then be used to display the engine selection dialog.

Load all

Load the current select engine specifications into all of the motor mounts.

Clear

Unloads the selected motor mount.

Clear all

Unloads all of the motor mounts.

Engine Mfg.

This is the engine manufacturer text for the current engine specifications. This field is read only. Use the Choose engine button (See Below).

Engine Code

This is the engine code for the current engine specifications. This field is read only. Use the Choose engine button (See Below).

Choose engine...

Displays the Engine Selection list.

Ejection delay

This is the time between engine burnout, and the firing of the ejection delay.

You can enter a delay in seconds, or choose one of the predefined values from the engine database.

Note: This time value is used to fire the next stage, or optionally deploy a recovery device.

Engine overhang from motor mount tube

This is the length of the engine casing that protrudes from the bottom end of the motor mount tube.

Tutorials:

Adding or changing a single engine.

Adding or changing multiple engines.

Also of interest:**Simulation overview.**

Recovery device setup.

Simulation controls.

Launch conditions.

Competition settings.

5.1.3 Flight events (Recovery device setup)

Current simulation events:

This is a list of all of the recovery devices (*streamers and parachutes*) in your design.

This screen is used to determine the deployment conditions for these recovery devices.

Select a recovery device from this list in order to change its deployment specifications.

Event type

Describes when in the flight the selected recovery device will be deployed. Depending on the event type, there may be additional information required (*see Altitude and Time below*).

The following deployment events are currently supported:

Deploy at apogee

The selected recovery device is deployed at apogee.

Deploy at engine ejection

The selected recovery device is deployed when the engine ejection timeout occurs.

Deploy at the specified altitude

The recovery device is deployed at the specified Altitude. This event will not occur until after apogee is detected.

Deploy at the specified number of seconds

The recovery device is deployed (Time) seconds after the stage is launched.

Deploy at the specified number of seconds after apogee

The recovery device is deployed (Time) seconds after apogee is detected.

Altitude

Deployment altitude used by the "Deploy at the specified altitude" event type.

Time

The deployment time in seconds used by the following event types:

Deploy at the specified number of seconds

Deploy at the specified number of seconds after apogee

Also of interest:

Simulation overview.
Engine selection
Simulation controls.
Launch conditions.
Competition settings.

5.1.4 Simulation controls

Simulation end point

Specifies point in the simulation where the calculations are terminated.

You have three choices here:

- * *End the simulation when the sustainer reaches apogee.*
- * *End the simulation when the first recovery device is deployed.*
- * *End the simulation when the rocket returns to the ground.*

Also of interest:

Simulation overview.
Engine selection
Recovery device setup.
Launch conditions.
Competition settings.

5.1.5 Launch guide setup

This screen specifies the position and length of the launch guide prior to launch.

5.1.6 Launch conditions

This screen describes the conditions of your simulated launch site.

Altitude

This is the altitude above sea level of your launch site.

% Relative humidity

This is the relative water vapor content of the air at ground level.
The air density, for a given temperature and pressure, is inversely proportional to the relative humidity.

Temperature

This is the ground level temperature.

Latitude

This is the latitude above or below the equator of the launch site.

Launch guide angle

This is the initial launch guide angle.

The value is specified in degrees from vertical.

- * Positive angles deflect the launch guide to the right.
- * Negative angles deflect the launch guide to the left.

Wind conditions:

This is a choice list that presents standardized wind speed ranges. Selecting a value from this sets the Low wind speed, and the High wind speed to standard NOAA values. If you choose Custom speed range, then you can manually set the Low wind speed, and High wind speed values.

Low wind speed

This is the lowest wind velocity at the launch site.

- * The wind is assumed to move only in a horizontal direction.
- * Positive values indicate the wind moving from left to right.
- * Negative values indicate the wind moving from right to left.

High wind speed:

This is the highest wind velocity at the launch site.

Wind turbulence:

This is a choice list that presents values for the Wind change frequency. This value is in radians per second. If you choose Custom turbulence, then you can manually set the Wind change frequency. If you choose No turbulence, then the value for Low wind speed will be used in the simulations.

Wind change frequency:

This is the rate of wind speed change used for simulations. The units are radians per second.

The wind model used by RockSim when a non zero wind change frequency is specified is a sin wave that oscillates between

Low wind speed, and High wind speed. The starting point on this curve is a random value.

Wind starts at altitude

This is the altitude when the wind velocity is added into the simulation equations.

Prior to this altitude the wind velocity is assumed to be zero.

Barometric pressure

This is the air pressure at ground level.

Cloud coverage:

This is a choice list that presents standardized cloud cover ranges. Selecting a value from this sets the **Cloud cover low limit**, and the **Cloud cover high limit** to standard NOAA values. If you choose Custom cloud coverage, then you can manually set the Cloud cover Low limit, and Cloud cover High limit values.

The values for cloud cover are used to determine the presence of Thermals at the launch site. The cloud cover percentage used in the simulation will be a random value between Cloud cover low limit, and Cloud cover high limit.

Cloud cover low limit:

This is the lowest possible cloud cover percentage.

Cloud cover high limit:

This is the highest possible cloud cover percentage.

Thermal positioning:

This is a choice list that presents standardized thermal positions. Selecting a value from this sets the **Thermal position** value. If you choose Custom position, then you can manually set the Thermal position value. If you

choose Random position, then the position of the nearest thermal will be randomly chosen.

Thermal position:

This is the position of the edge of the thermal relative to the launch point. Positive value place the location of the first thermal to the right of the launch position.

Thermal Dia:

This is the average diameter of the Thermals used in simulations.

Thermal height:

This is the average height of the Thermals used in simulations.

Thermal speed / Strength:

This is a choice list that presents fixed Thermal strengths. The strength of a Thermal is its Thermal speed. The choices are presented to give you some idea of typical Thermal strengths. If you choose Custom strength, then you can manually specify the average Thermal speed.

Thermal speed:

This is the velocity of the rising air column of Thermals used in simulations.

Allow multiple thermals:

This option allows the creation of multiple thermals. The position of the first thermal can be random, or absolute. Additional thermals are randomly placed further away from the launch site than the first thermal.

Maximum number of thermals:

This specifies the maximum number of thermals that will be created. This value only applies then **Allow multiple thermals** is n use.

Note: The selection for cloud cover determines the likelihood of any thermals appearing.

Also of interest:

Simulation overview.
Engine selection
Simulation controls.
Competition settings.

5.1.7 Competition settings

This screen presents competition settings to be used during simulations.

Use these random competition conditions during simulations:

This check box enables the use of all the settings contained on this page. If the check box is not set, then none of these conditions will be used for simulations.

Launch site diameter:

This is the diameter of the launch site. Any rockets landing within this circle are not considered lost.

Max. model drift range:

This specifies the maximum drift range beyond the outside of the Launch site diameter. Any rockets that drift beyond this range are considered lost.

Include igniter variability for Drag races:

This check box

Max engine ignition delay:

This value specifies the maximum igniter delay that will be applied to all engines during the simulation. This

value is only used when the Include igniter variability for Drag races check box is in use.

Failure modes / Disqualified flights:

These settings determine the various competition failure modes available during simulations. All of these values are expressed as decimal percentages. For example a value of 0.01 means there is a 1% chance of that failure mode happening.

Engine misfire:

This is the percent chance of an engine misfiring. This failure mode is applied to all of the engines in a simulation. If by chance, all of the engines in a simulation fail, then the simulation will simply not be run.

Model loss:

This is the percent chance of a model falling outside the Launch site diameter being lost.

Airframe failure:

This is the percent chance of a random airframe failure.

Recovery device failure:

This is the percent chance of a recovery device failing to deploy, or in some way failing. If this happens, then there is a chance that the rocket will crash.

Payload damage:

This is the percent chance that payload damage will occur.

Alt. track loss:

This is the percent chance that the altitude of the model could not be tracked.

Note:

All of the failure modes are displayed on the simulation detail report.

5.1.8 Engine Selection List

Motor mount

A description of the selected motor mount.

Engine diameter display

You can control the engine diameters that are displayed in the list by selecting one of the three options here.

(1) Show only engines that match the mount diameter.

(2) Show only engines that match the mount diameter, or are smaller.

Example: If the mount diameter is 18 mm, then all 18 mm, 13 mm, and 10.5 mm engines would be displayed.

(3) Show all engines.

You select an engine in one two ways:

(1) You can click on the engine in the list, and then press the OK button.

(2) You can double click on the engine in the list.

OK

Press this after selecting an engine, and the Engine selection list will be closed. The engine that you selected will be loaded into the motor mount.

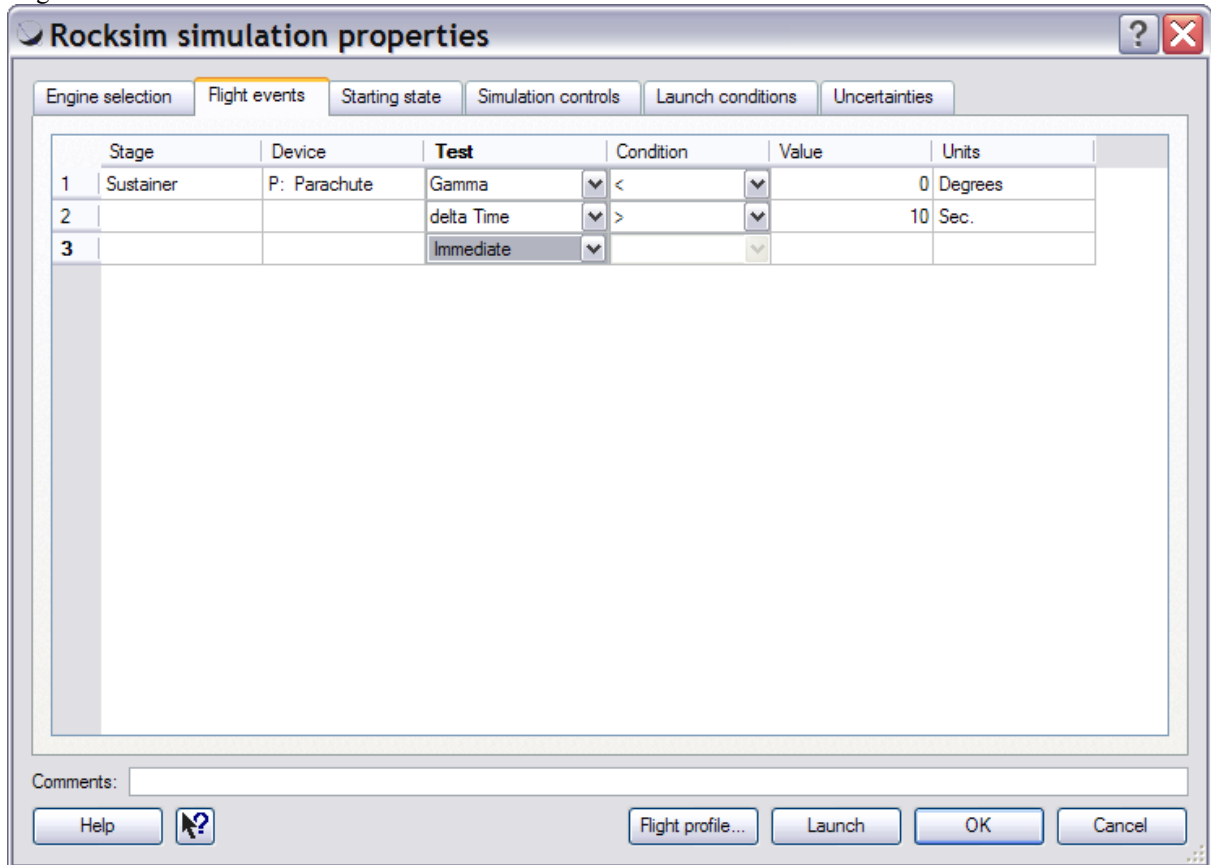
Cancel

Press this to close the Engine selection list without selecting and engine.

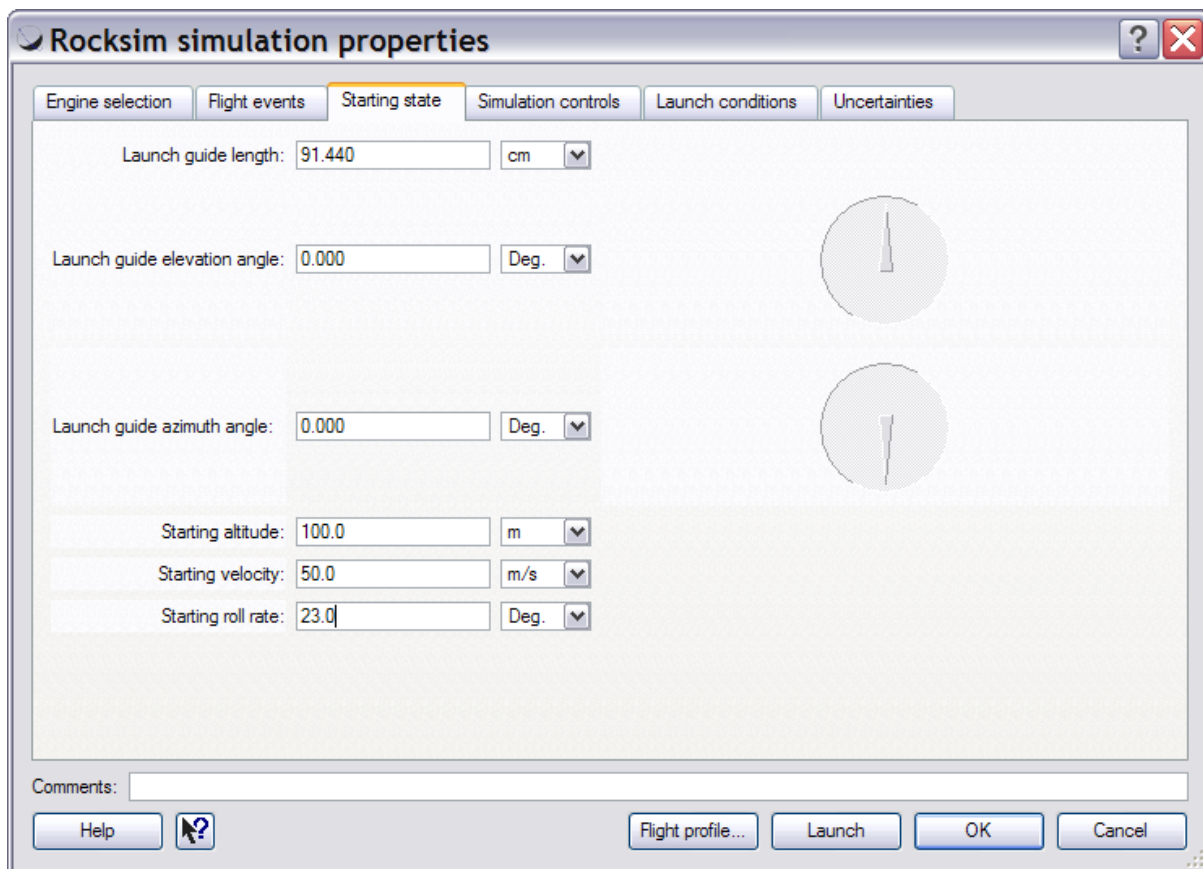
5.1.9 Screen shots for ProVersion

Enter topic text here.

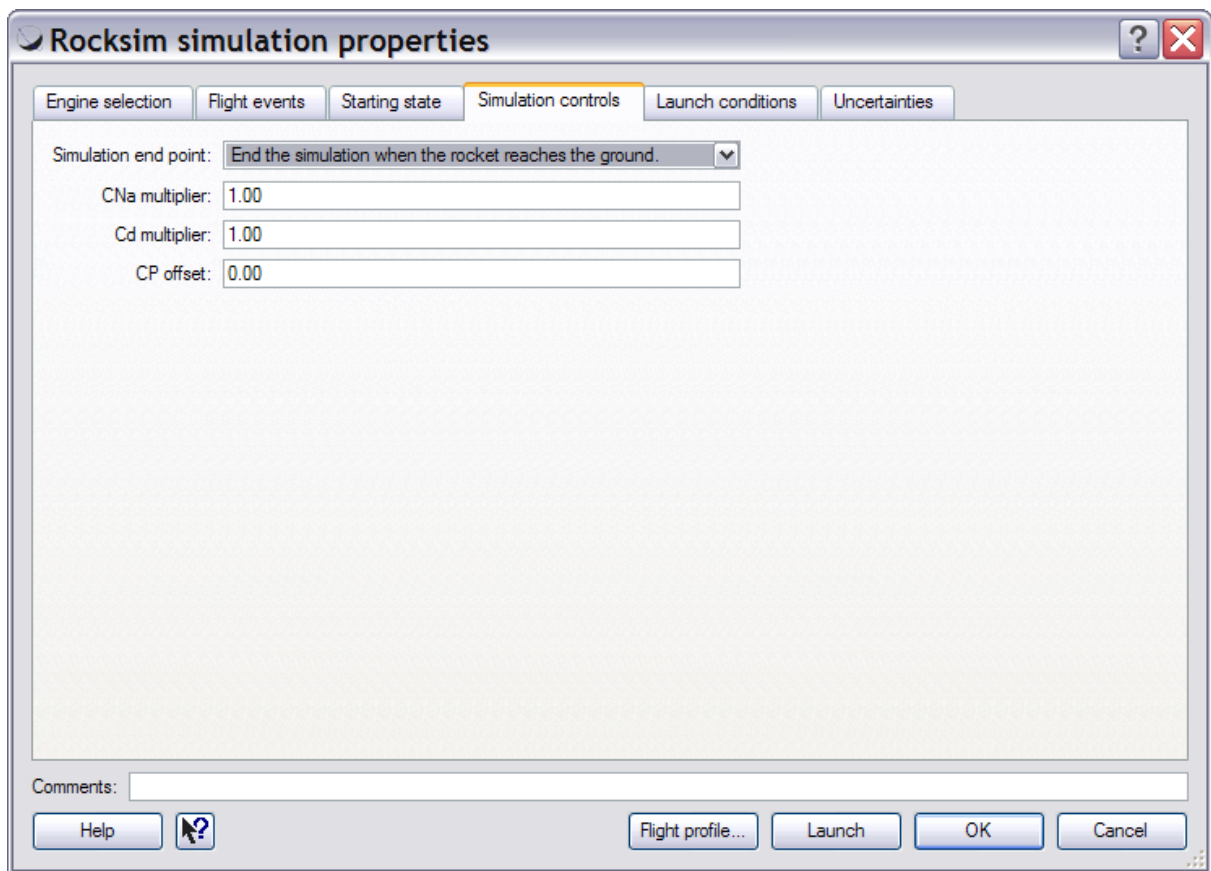
Flight events:



Starting state:



Simulation controls



Launch conditions

Rocksim simulation properties

Engine selection | Flight events | Starting state | Simulation controls | **Launch conditions** | Uncertainties

Altitude: 0.00 m

Landing zone altitude: 0.00000 Ft.

% Relative humidity: 50.00

Temperature: 15.00 Deg. C

Barometric pressure: 1013.00 MB

Latitude: 1.571 Deg.

Longitude: 0.000 Deg.

Wind settings:

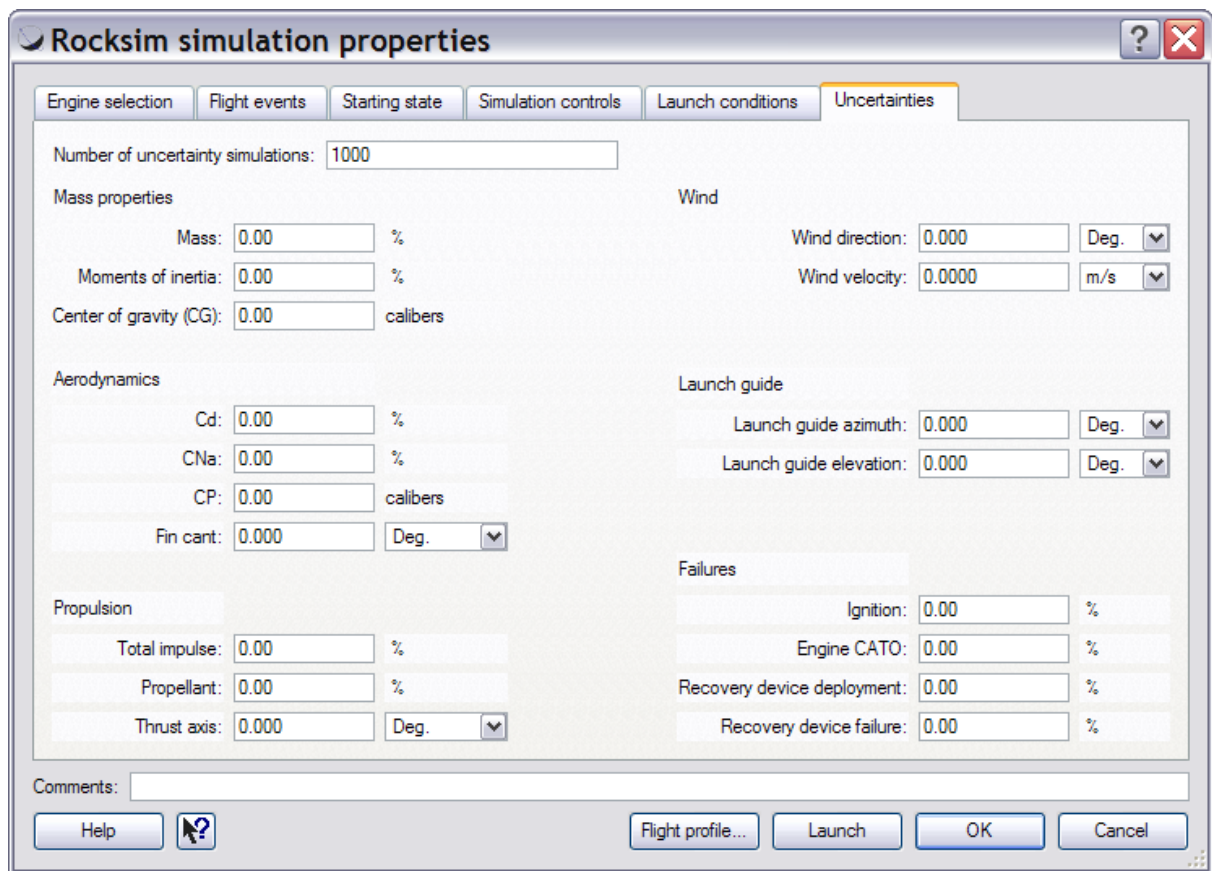
	Altitude m	Direction Degrees	Velocity KPH
1	100	0	1.2
2	230	120	4.5

Add wind entry Remove wind entry

Comments:

Help ? Flight profile... Launch OK Cancel

Uncertainties



5.2 Simulation graphs

5.2.1 Graph selection screen

Graph name

Specifies a unique name for the graph selections. This name can be used to recall the selections for later use.

X-Axis

Specifies the data element that will be displayed on the X-Axis of the graph. The usual selection here is Time, although you may choose any data element. (See: Simulation data elements).

Y-Axis 1 ... Y-Axis 4

Specifies from one to five data channels to be displayed on the Y-Axis of the graph. (See: Simulation data elements).

Colors

Specifies the color used to plot the data points on a particular axis.

Line style

Specified the line style used to plot the data points on a particular axis.

Start graph at

This determines the point in the flight where the graph begins. The choices shown below are all based on time into the flight.

The following choices are available:

at time = 0.0 – This is the beginning of the simulation data.
at the following flight time – This is a user defined start time.
when the rocket clears the launch guide.
when the rocket reaches maximum velocity.
when the rocket reaches maximum acceleration.
when final engine burnout occurs.
when the rocket reaches apogee.

End graph at

This determines the point in the flight where the graph ends. The choices shown below are all based on time into the flight.

at the end of the data – This is the end of the simulation data.
at the following flight time – This is a user defined end time.
when the rocket clears the launch guide.
when the rocket reaches maximum velocity.
when the rocket reaches maximum acceleration.
when final engine burnout occurs.
when the rocket reaches apogee.

Exit

Closes the graph selection screen. No graph is displayed.

Plot graph

Closes the graph selection screen, and displays the selected graph.

Note: If you are launching your rocket with a zero launch guide angle, and no wind, then it is of no use to plot any horizontal (x) data elements. The horizontal components of the data vectors will all be zero for these flights.

Also of interest:

Simulation data elements.

5.3 Flight profile

5.3.1 2D Flight profile

The 2D flight profile screen lets you visualize a simulated flight for your design. The simulation data that is generated when you run a simulation is used to create an animation of the rockets flight. There are two ways to activate the flight profile screen as illustrated below.

Flight time (Seconds):

This is the simulation flight time that is currently displayed on the screen. You can change the flight position manually by moving the slider or by clicking the play button. The slider control can be moved with the mouse or the keyboard. To move the slider with the mouse you click and drag the slider bar to the left or right. The left arrow, right arrow, Page Up, and Page Down keys provide the keyboard interface. Note that manually moving the flight time slider will stop automatic animation.

Start animation playback

Click this button to start the flight animation. The speed of the animation is determined by the **Animation time step** value. The animation can be stopped by clicking the stop button, moving the flight time slider, or displaying the flight profile preferences dialog.

Stop animation

Click this button to stop the flight animation.

Animation time step

The value selected in this combo box determines the animation playback speed. In order to understand how this value is used, you need to understand how the simulation data slices are stored. Each simulation data slice has a flight time stamp. These time stamps start at $t=0$ and end at $t=\text{max flight time}$. The animation time step value determines the sequence of simulation data slices that will be displayed in the animation.

If you choose Actual as the animation time step, then your system clock is used to determine the spacing between simulation data slices. This option gives you a close to real time representation of the rocket's flight.

Help

Click the Help button to display this page.

Preferences...

Click this button to display the flight profile preferences screen.

Details >>

Clicking the details button will show or hide the simulation details panel. If the size of the flight profile screen is such that displaying the details panel would place the details off screen, then the flight profile screen will be re sized to prevent this.

Cancel

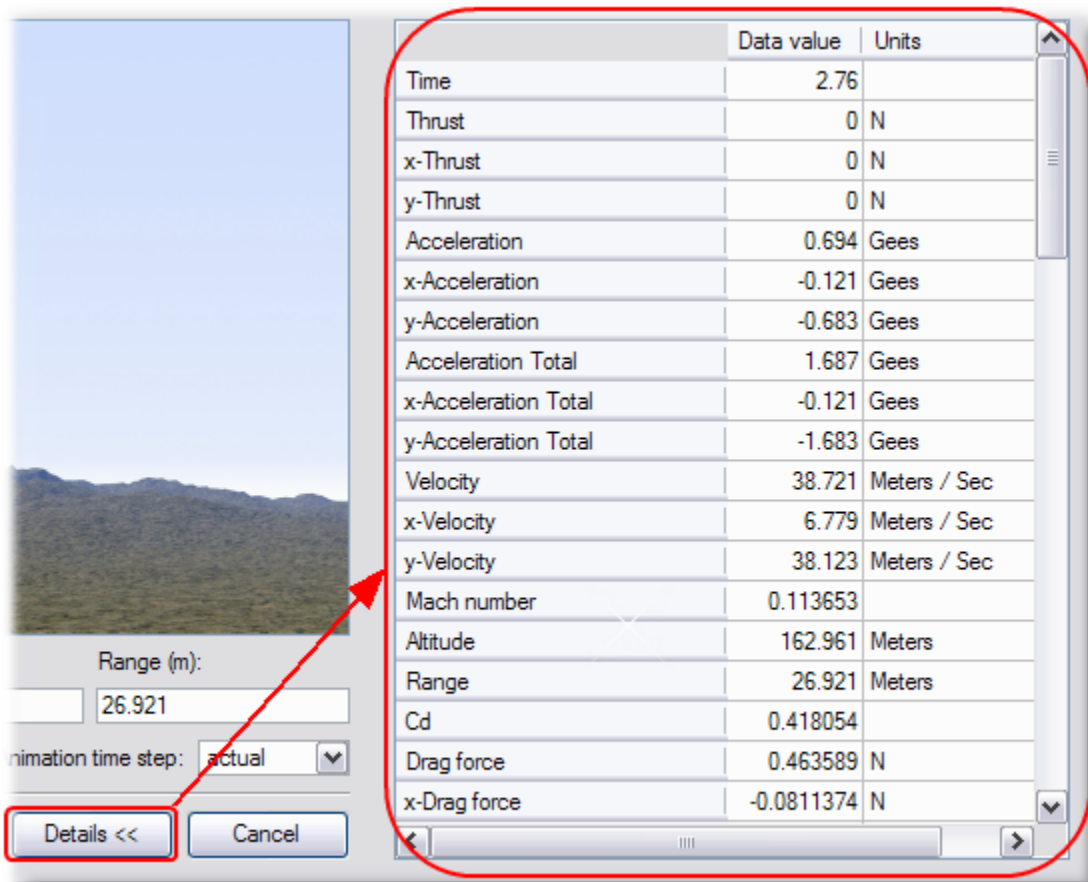
Exit the flight profile screen.

Tutorials:

2D Flight profile - Running simulation animations.

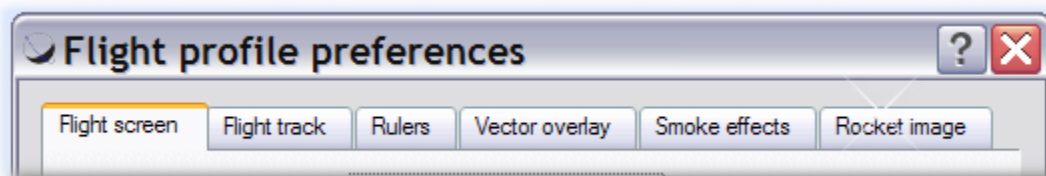
5.3.2 2D Details

The details panel on the 2D flight profile screen is displayed or hidden by the **Details >>** button on the flight profile screen.



5.3.3 2D Flight profile settings

The appearance of the flight profile screen is determined by the settings in this preferences dialog. The dialog divides the settings into logical groups. You can click on the tabs in the image below, use the links, or click Next for detailed information about these settings.



- Flight screen settings - Change the background image, sample resolution, and scrolling options.
- Flight track settings - Change flight track history options.
- Rulers settings - Change range ruler options.
- Vector overlay settings - Change force vector indicators.
- Smoke effects settings - Change smoke trail options.
- Rocket image settings - Change the rocket image options.

5.3.3.1 Flight screen settings

Allow scrolling the Range (Horizontal) axis.

Selecting this option will allow for horizontal scrolling of the flight animation.

The default scale factors for altitude and range are calculated to make the entire flight sequence fit on a single non-scrolling window. If you choose to allow range axis scaling, then the flight altitude is used to create the scale factor. This can often result in horizontal scrolling of the animation window.

Simulation sample count

This is the number of simulation data samples used to create the flight profile. This value determines the resolution of the flight animation. Higher numbers yield finer detail in the flight at the expense of memory and processing time. The default value is 3000 samples.

Background image file

If you wish to have an image displayed in the background of the flight animation window then you enter the image file name in this field. You can either enter the file name directly into this field or you can click the **Browse** button which is to the right of this field on the screen.

Scale the image to fit the screen

Select this option if you want the background image stretched to fit the size of the flight animation screen. If this option is selected, and the **Maintain the image shape** option is not selected, then the image is re sized without regard to retaining the image aspect ratio. This can cause distorted shapes in the image. For most generic landscape scenes this is not a problem. If you do not choose to scale the image, and it is smaller than the flight display window, then multiple copies of the image will be tiled onto the screen.

Maintain the image shape

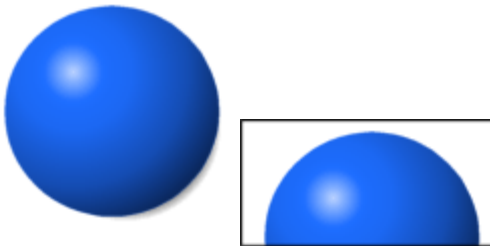
Select this option to preserve the original image shape. The image file has an initial width to height relationship. This relationship is called the image aspect ratio. When the image is scaled to fit the canvas the aspect ratio will remain the same if you select this option.

The pictures below will help illustrate the background image scale options. The original background image is a blue sphere 128 X 128 Pixels.

The screen into which the image is being placed is 128 X 64 pixels.

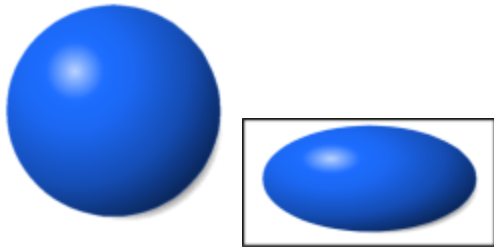
Using no image scaling:

(The background image is cropped)

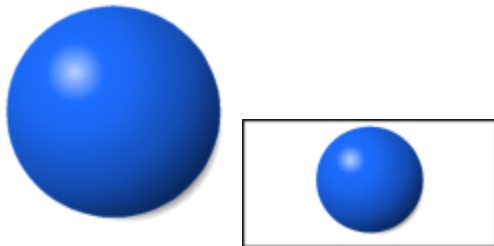


Scaling the image without regard for aspect ratio:

(The background image is stretched to fit)



Scaling the image and maintaining aspect ratio:
 (The background image is stretched and it's shape is retained)

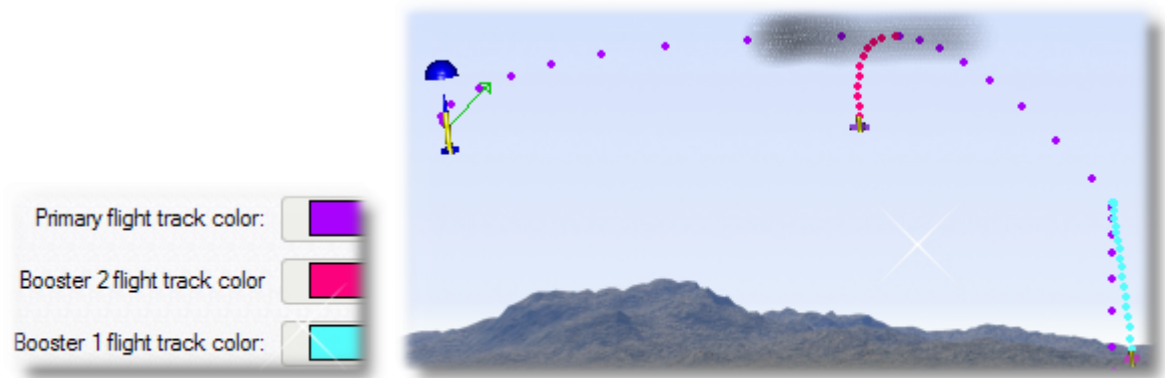


5.3.3.2 Flight track settings

Show flight track indicators

Select this option if you wish to display a persistent trail of dots behind the rocket image as it progresses through the animation sequence.

Primary flight track color, **Booster 2 flight track color**, and **Booster 1 flight track color** determine the color used for the three flight tracks. The illustration below shows use of these colors in the flight tracks of a three stage rocket.



Track point diameter

Track points are displayed as small circles on the flight screen. The diameter of these circles is specified here. The units are logical display units or pixels.

Track point interval

The spacing of the track points is time based. The track point interval is the elapsed flight time in seconds between points.

5.3.3.3 Rulers settings

Show rulers on the flight screen

Select this option if you want to have rulers displayed on the flight screen. The rulers are designed to help you visualize the distance traversed by the rocket in flight.

Ruler font

Click this button to select the font used to display the ruler values.

Ruler color

Click this button to select the color used to display the ruler tick marks and values.

Ruler divisions

This is the recommended number of divisions for the rulers. This value is used as a starting point in calculating the step size and placement of the tick marks.

Ruler tick length

This is the length in pixels of the tick marks displayed on the rulers.

5.3.3.4 Vector overlay settings

You can optionally display a force vector diagram on top of the rocket during the flight animation. The size of a force vector can either be fixed, or scaled to represent the forces on the airframe during flight.

Vector overlay selections:

Option	Description
None	Do not display the vector diagram.
Display vectors without scaling	Display fixed length vectors.
Display vectors with uniform scaling	Display vectors scaled to the actual forces.
Display vectors with non uniform scaling	Display vectors scaled to their own data ranges.

Vector length factor

The maximum length of a linear vector is calculated by multiplying the size of the rocket animation image by the Vector length factor. A value of 1 will result in vector arrows having their length equal to the width of the animation image.

Torque arm length factor

The torque arm length is calculated by multiplying the size of linear vectors by the Torque arm length factor. A value of 1 will result in the torque arm having its length equal to the maximum vector length.

Line style, Line width, Torque arc style, and Torque arc line width

These settings determine the display style of the vector diagram.

Thrust color, Drag color, Gravity color, Wind color, and Torque vector color

These settings determine the colors used in the vector diagram.

5.3.3.5 Smoke effects settings

Smoke trails can be added to the flight animation. Smoke trails are useful as a visualization aid for wind effects.

Show smoke trails

Select this option to turn on smoke trails.

Sustainer smoke name

The name of the smoke image that is displayed when the sustainer engines are burning.

Booster 2 smoke name

The name of the smoke image that is displayed when the second booster engines are burning.

Booster 1 smoke name

The name of the smoke image that is displayed when the first booster engines are burning.

Smoke puff distance

This is the distance between smoke puffs. During the flight simulation calculations this distance is used to calculate the initial location of the individual smoke puffs that make up the smoke trail effect. Once a smoke puff is created, it will drift with the wind that exists at it's location.

Smoke expansion time

Each smoke puff will expand over a period of time from it's initial size to it's maximum size. This expansion time is specified in seconds.

Smoke life span

The number of seconds that a smoke puff will be tracked by the simulator. Once this time span has passed, the smoke puff is removed from the animation. The primary reason that this was done was to reduce the memory requirements of the animation.

If you make changes to either Smoke puff distance or Smoke life span, then the simulation calculations for the flight animation need to be run again. This can be a time consuming process.

Anatomy of smoke animations:

The smoke image files are stored in the RockSim/Media/Decorations folder.

The smoke image files are selected by their base name.

This base name forms the basis for the smoke animation definition file, and the individual images that make up the animation sequence. The file names that are created use the following naming conventions:

SMK_basename.xml - This is the smoke animation definition file.

SMK_basename_0000.png - This is the first associated image file.

SMK_basename_nnnn.png - This is the last associated image file.

The contents of the definition file dictate the number of images files that are created.

5.3.3.6 Rocket animation settings

The rocket image that you see during a flight animation is determined by the settings on this tab. There is a set of default images that can be used for all animations. You can also generate a set of images from any of your designs.

Use the current rocket design to create the animation images

Select this option if you wish to generate a set of images for your rocket. The settings for this set of images are stored with your design.

Image file prefix

This text forms the base name for the images files that will be created. Each of the file names will have this prefix followed by encoded image type information. If you do not specify a prefix then one will be created from the name of the RockSim design file.

Image file path

This is the storage location for the animation image files. You can enter a value directly in this field or you can click the **Choose path** button. If you do not specify a path for the animation image files, then they will be stored in the same folder as their associated design file.

Choose path

Click this button to display the standard choose path dialog.

Image width

This is the width in pixels for the animation image.

Image dimensions of 128 X 128 are a good starting point.

The actual size of the image on the animation screen will always be slightly smaller than this value.

Image height

This is the height in pixels for the animation image.

Image dimensions of 128 X 128 are a good starting point.

The actual size of the image on the animation screen will always be slightly smaller than this value.

Image angle step size

A series of images is created for each stage configuration. The purpose of this is to render the images at various angles from 0 to 360 degrees. This angle step size determines the number of images created for each stage configuration. Values between 5 and 10 degrees are a good starting point. Smaller angle step values produce more realistic flight animations at the expense of memory and increased load times.

Example: An angle step size of 5 degrees will result in the creation of $(360 - \text{angleStepSize}) / \text{angleStepSize}$ images or 71 images per stage configuration.

Generate rocket image data

Click this button to generate the specified rocket animation images. A small display window will be created, and you will see the series of images as they are created. Do not interrupt this process.

5.4 Optimal mass prediction.

5.4.1 Optimal mass prediction.

Automatic mode operation**Automatically calculate optimal mass**

Selecting this option enables the automated prediction of the optimal mass value. Several simulations will be run and the golden section algorithm will be used to zero in on the mass that will yield the highest altitude.

If you choose not to use automatic calculations, then you will need to supply the following data:

Starting sustainer mass

Ending sustainer mass

Mass increment

See Manual mode operation below.

Manual mode operation**Starting sustainer mass**

The starting mass used for the sustainer in the simulations. Note that this mass does not include the mass of the engines loaded into the rocket, it is therefore acceptable to use a mass of zero here.

Ending sustainer mass

The final sustainer mass used in the simulations. Note that this mass does not include the mass of the engines loaded into the rocket.

Mass increment

This is the amount of mass to add to the sustainer for each iteration of the prediction process.

Starting and Stopping the simulations (Both manual and automatic modes)

Start the simulations

Press this button to begin the optimal mass prediction process. Once the simulations are started, the End the simulation button will activate.

Stop simulations

Press this button to end an optimal mass prediction process that is running.

Optimal mass prediction results

The results of the series of simulations are displayed here.

Current sustainer mass

This is the mass of the sustainer as specified by the design.

Peak altitude

This is the altitude that would be obtained if the sustainer mass equals the Optimal altitude mass.

Optimal mass

This is the sustainer mass that will enable your design to reach maximum altitude.

Graph colors

This section specifies the colors that will be used on the simulation results graphs. To change a color, click on the button under the label.

Plot graph

Press this button to display a graph of the optimal mass prediction results. Note that graph data is only available after running a series of simulations in either automatic or manual mode. Checking the Generate graph data option makes this data available.

NOTES

This series of simulations may take a while, depending on the speed of your machine, the current setting of **Simulation resolution in samples per second**, and the current prediction tolerance.

The sustainer mass values displayed in the results are the "Unloaded" values. These mass values DO NOT INCLUDE the mass of the engines loaded into the rocket.

There are some rocket configurations for which an optimal mass cannot be calculated. In these the configurations, the mass of the engines exceeds the mass required for optimal performance. The best you can do in these cases, is to simply make the airframe as light as possible.

5.5 Exporting data

5.5.1 Exporting data

File name

Specifies the name of the output file that will contain the exported data.

Browse

Displays the standard file save as dialog box. From here you can select the name of the export file.

Export

This selection determines what simulation data will be exported. You can choose either **Export** *all simulation data*, or **Export** *only the data elements selected below*. There is a list of available simulation flight data displayed below the Export selection entry. You can select one or more entries for export from this list.

Export the data...

Writes out the specified data export file.

Cancel

Closes the export screen.

Top Level Intro

This page is printed before a new
top-level chapter starts

Part



6 Database files

6.1 Materials database

Specifications

Material

This is a list of all of the materials currently stored in the database. Selecting an entry from this list will display the attributes of the selected material in the fields described below.

Material name

This is the name of the material. This name will be displayed on the various design screens in the Material selection field.

Units

This selection specifies the units used to specify the material density. The following units are available:

Volume: kg/m³ kg per cubic meter.

Volume: lb/ft³ pounds per cubic foot.

Volume: g/cm³ grams per cubic centimeter

Linear: g/cm grams per centimeter (Shock cords and shroud lines only)

Linear: g/mm grams per millimeter (Shock cords and shroud lines only)

Linear: oz/in ounces per inch (Shock cords and shroud lines only)

Area: g/cm² grams per square centimeter

Area: oz./in² ounces per square inch

Low density

Specifies the low density in a range of density values for the material.

High density

Specifies the high density in a range of density values for the material.

Average density

Specifies the average density. This value is automatically calculated whenever you change the low density or high density values.

Database I/O and control buttons

Save

Saves the currently displayed material to the database. This can be an update to material selected from the materials list or a new material.

Clear

Pressing this button clears all data entry fields and deselects the selected entry on the materials list.

Delete

Pressing this button will delete the currently selected material from the database.

Cancel

Exit the material maintenance screen.

Material usage designation

Available for use in rocket components

Checking off this option makes the material available for selection in rocket component design screens. The material is still subject to the designation filters shown below. If this option is not checked off, then the material

will never be displayed on a component design screen, regardless of the filter settings.

Select all

Push this button to make the material available for all design screens.

Clear all

Push this button to make the material unavailable for all design screens.

The filter selections shown below designate which rocket components will have the material available for use.

Body tubes

Bulkheads

Centering rings

Engine blocks

Fin sets

Launch lugs

Nose cones

Parachutes - (Canopy material)

Cords & Lines (Shock cords and parachute shroud lines)

Streamers

Sleeves

Transitions

Tube couplers

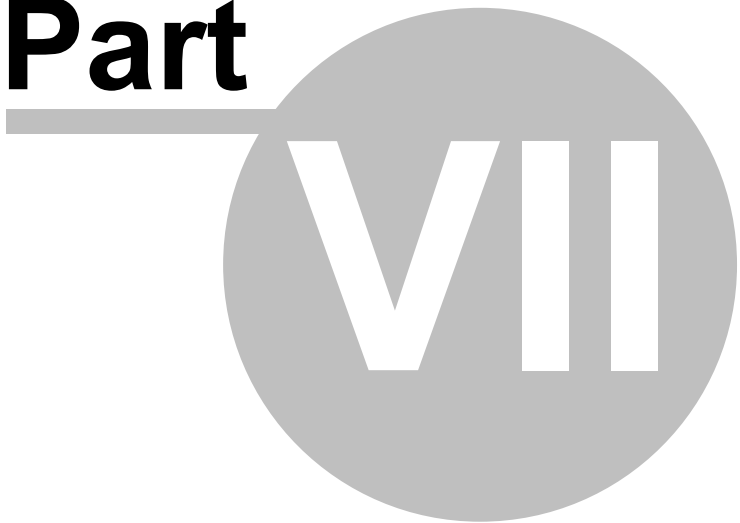
6.2 Rocket component data files

RockSim uses a series of comma delimited files to store component data. The Appendix contains a description of these data files.

Top Level Intro

This page is printed before a new
top-level chapter starts

Part



7 Printing

This section outlines the various printing options available in RockSim.

Clicking on the File Print... option will display the print selection screen. From here you can decide what parts of the current design file you wish to print.

7.1 Print selections

The print selection screen lets you decide what aspects of your rocket design and simulation information you wish to print. The selections which you make on this screen are retained between RockSim sessions.

Rocket information

Select this option to enable printing rocket specific information. If this option is selected then the following items can be printed:

- Drawings
- Parts list report
- Construction templates

Drawings

Select this option to print 2D drawings of the design.

Note: The drawings will only print if the **Rocket information** option is also selected.

Parts list

Select this option to print the parts list for the design.

Note: The parts list will only print if the **Rocket information** option is selected.

Templates

Select this option to print construction templates for selected components.

A list of the design component that can produce templates is displayed in this group. You must select the specific components from which you want templates printed.

Note: The templates will only print if the **Rocket information** option is also selected.

Template selections

Select the components from which you want to print cutting templates. The list of components that you select here will be stored with your design file.

Note: The templates will only print if the **Rocket information** option and the **Templates** options are also selected.

Simulation information

Selecting this option enables the simulation data for printing.

Simulation summary

Prints a report of simulation results. The format of this report is similar to the [Simulation ListAPP_SIM_LIST](#) shown on the top of the main display screen.

All simulations

Selecting this option prints information for all simulations.

Selected simulations

Selecting this option only prints information from the currently selected simulations.

Detailed report

Prints a detailed report for each simulation. This report is the same as the Simulation details screen which is accessed from the simulation menu.

Graphs

Prints a graph of simulation results. The settings for the graph are the same ones you used the last time you generated simulation graphs.

Additional settings

This tab displays some settings that govern the appearance of you printed output.

Templates are printed as outlined 2D drawings with an optional fill color, and registration marks for templates that span multiple pages.

Template outline color

Click this button to change the color of the outline pen used to draw templates.

Template fill color

Click this button to change the color of the fill brush used to draw templates.

Template hole fill color

Click this button to change the color of the fill brush used to represent drilled holes in centering ring templates.

Template registration mark color

Click this button to change the color of the pen used to draw registration marks on multi-page templates.

Template registration mark size

This is the size of the registration marks that will be drawn on multi-page templates.

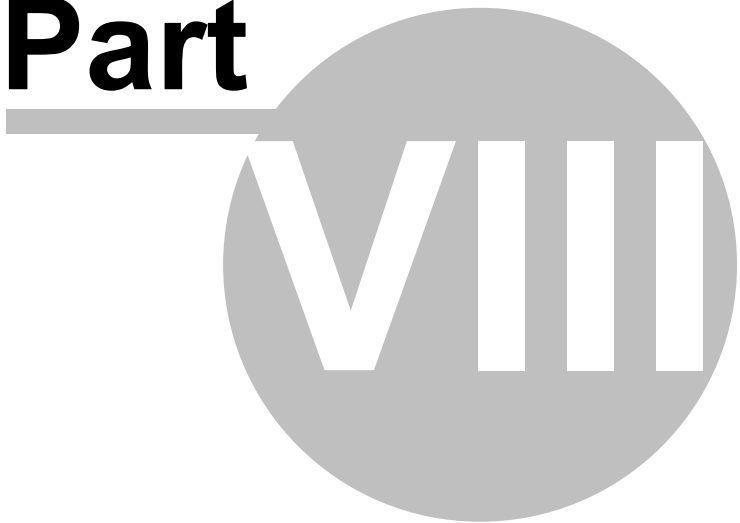
Margin size

This specifies the width border around the edge of the printed page.

Top Level Intro

This page is printed before a new top-level chapter starts

Part



8 Tutorials

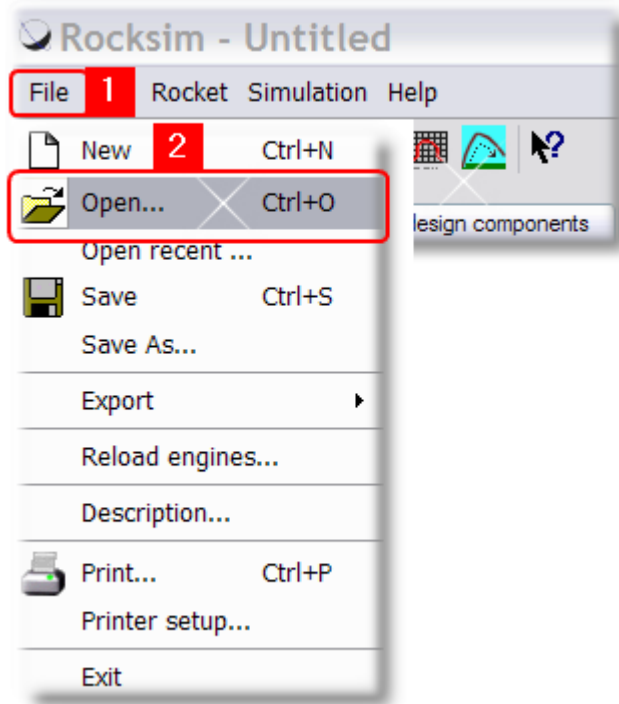
8.1 Basic operations

The tutorials in this section deal with basic operations of the RockSim program.

8.1.1 Opening a design file (copy)

This simple tutorial walks you through the process of opening an existing design file.

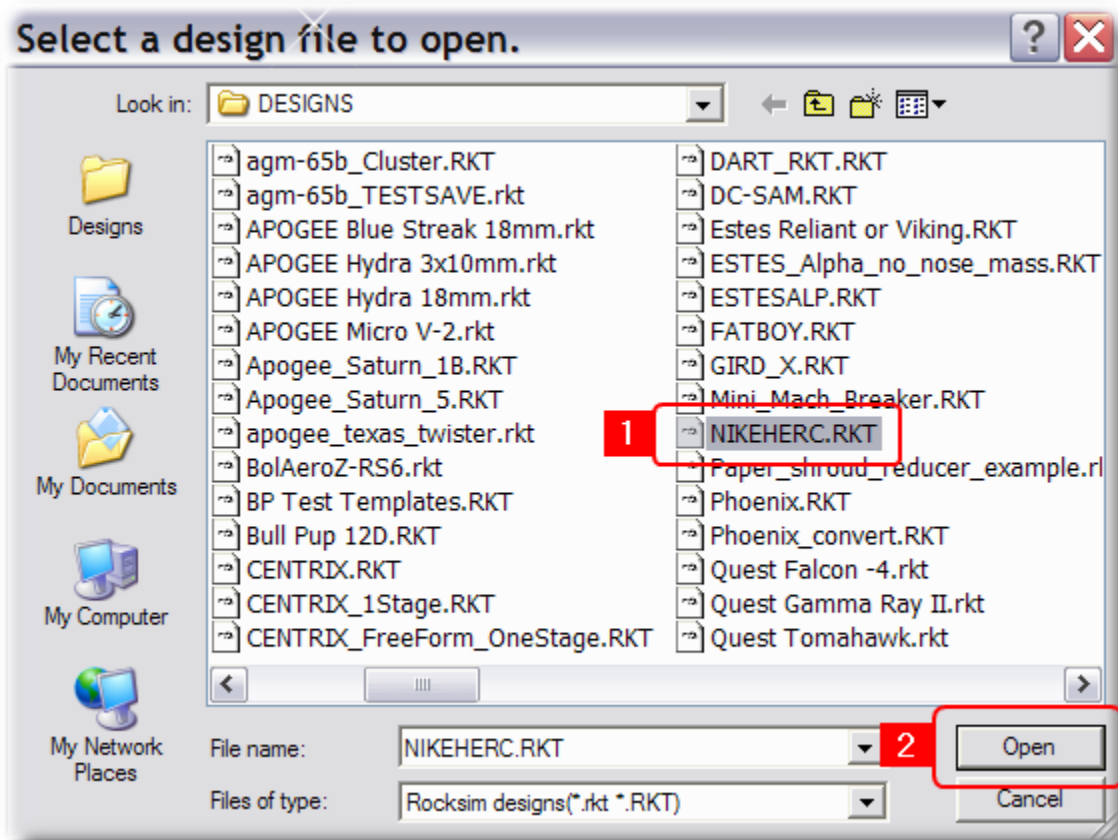
Selecting the file open menu item:



1 Click the File menu. The drop down menu will be displayed.

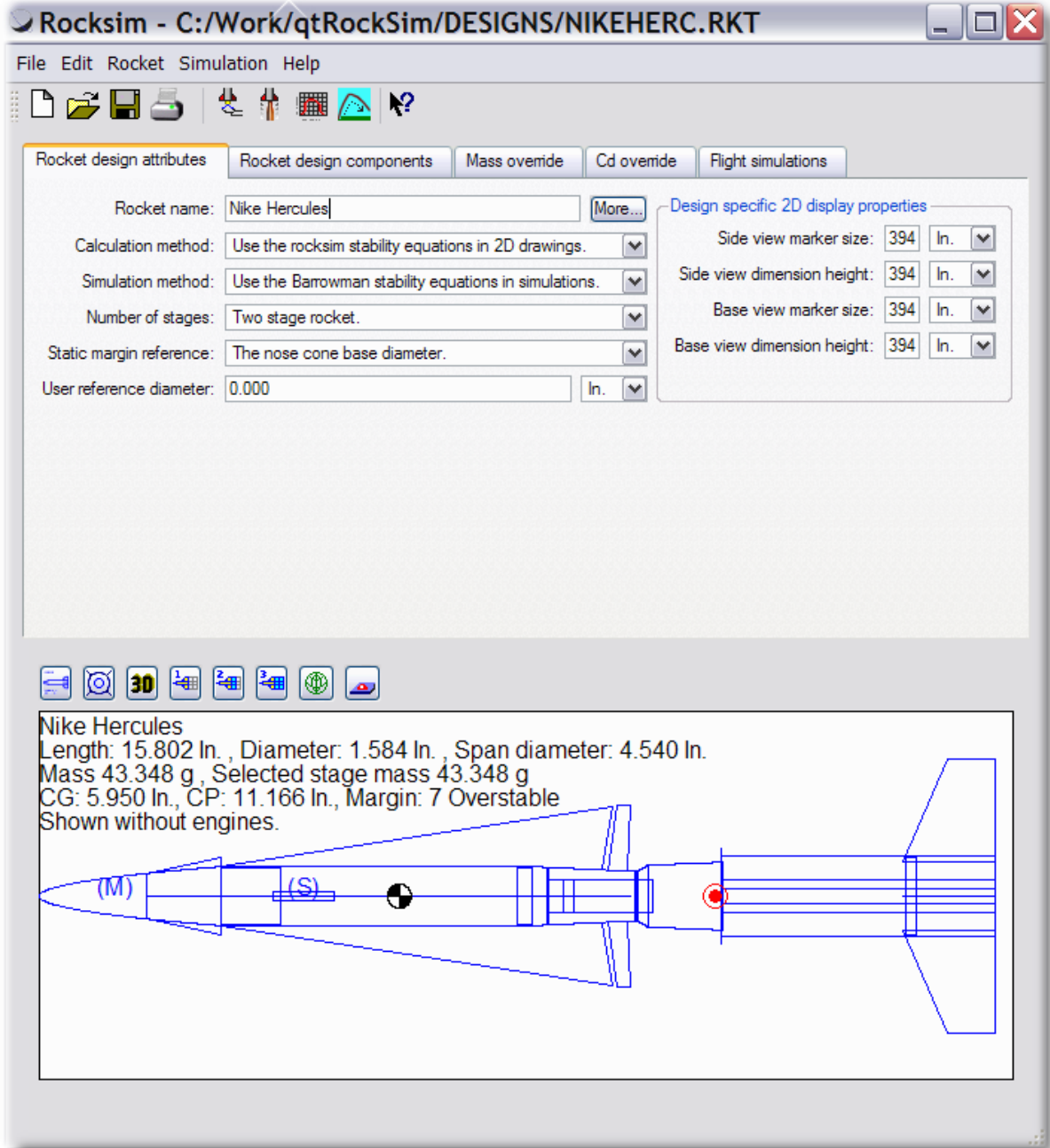
2 Click the Open... menu item. The standard file open dialog will be displayed.

Choosing a design file to open:



- 1 Click on the design file name that you wish to open.
- 2 Click the Open button. The design will then be loaded from disk.

The design is displayed on the screen:

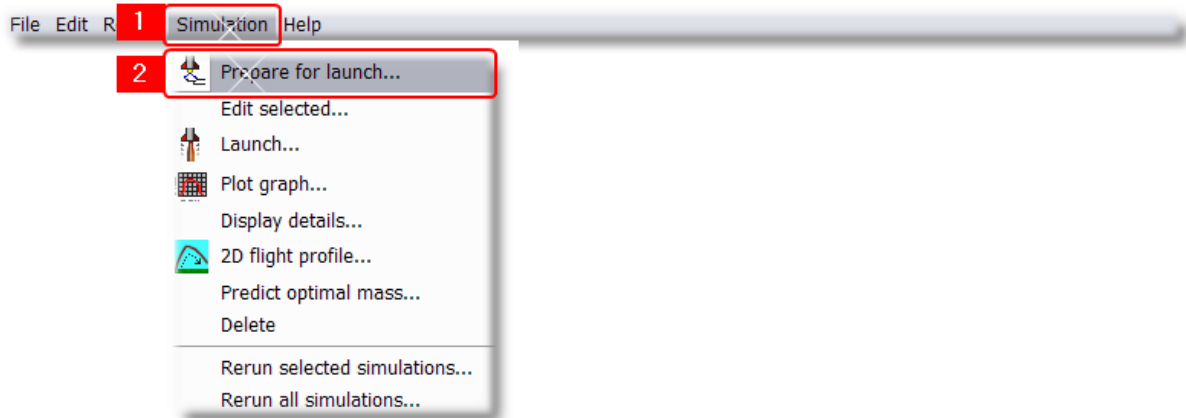


8.2 Simulation related

The tutorials in this section deal with all aspects of flight simulation.

8.2.1 Creating a new simulation

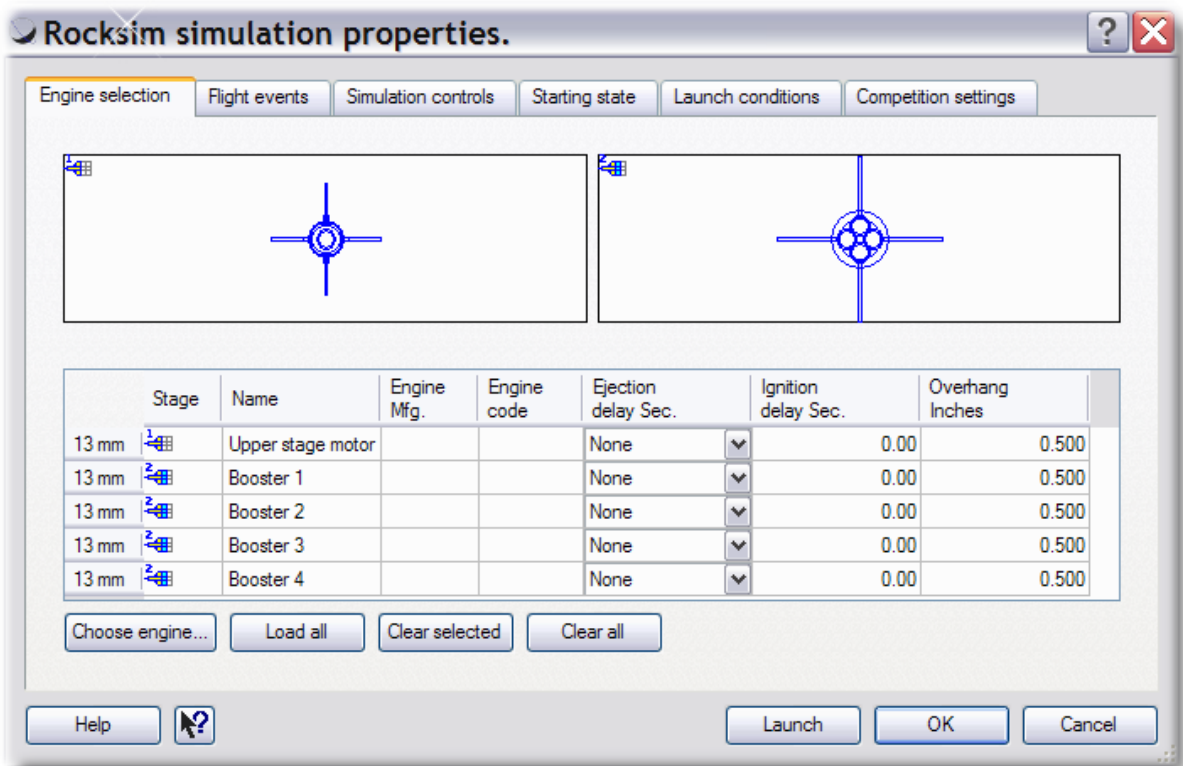
Displaying the simulation properties for a new simulation:



1 Click on the Simulation menu.

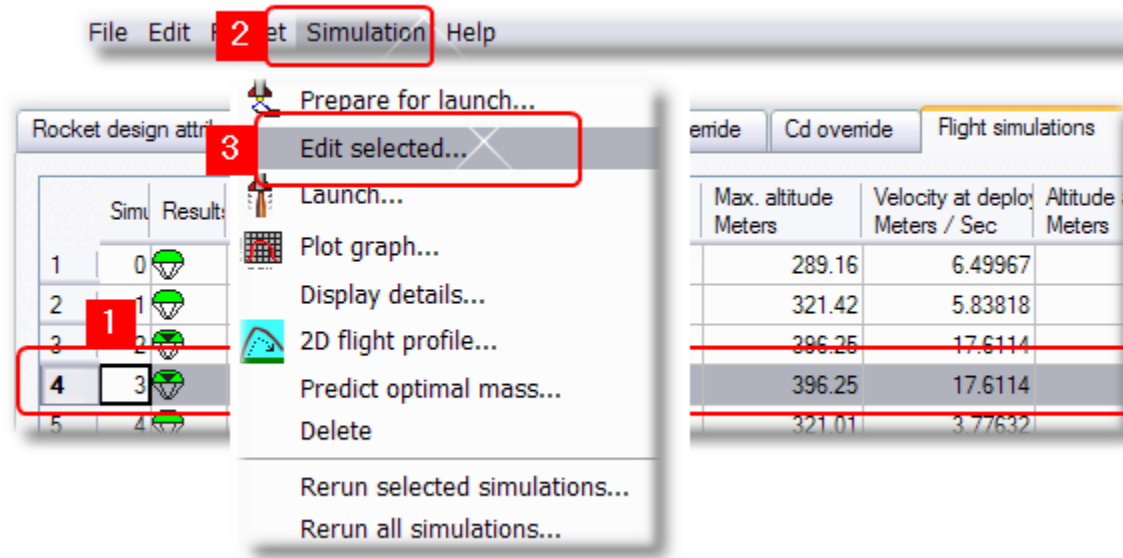
2 Click on the Prepare for launch option.

The simulation properties screen is displayed.



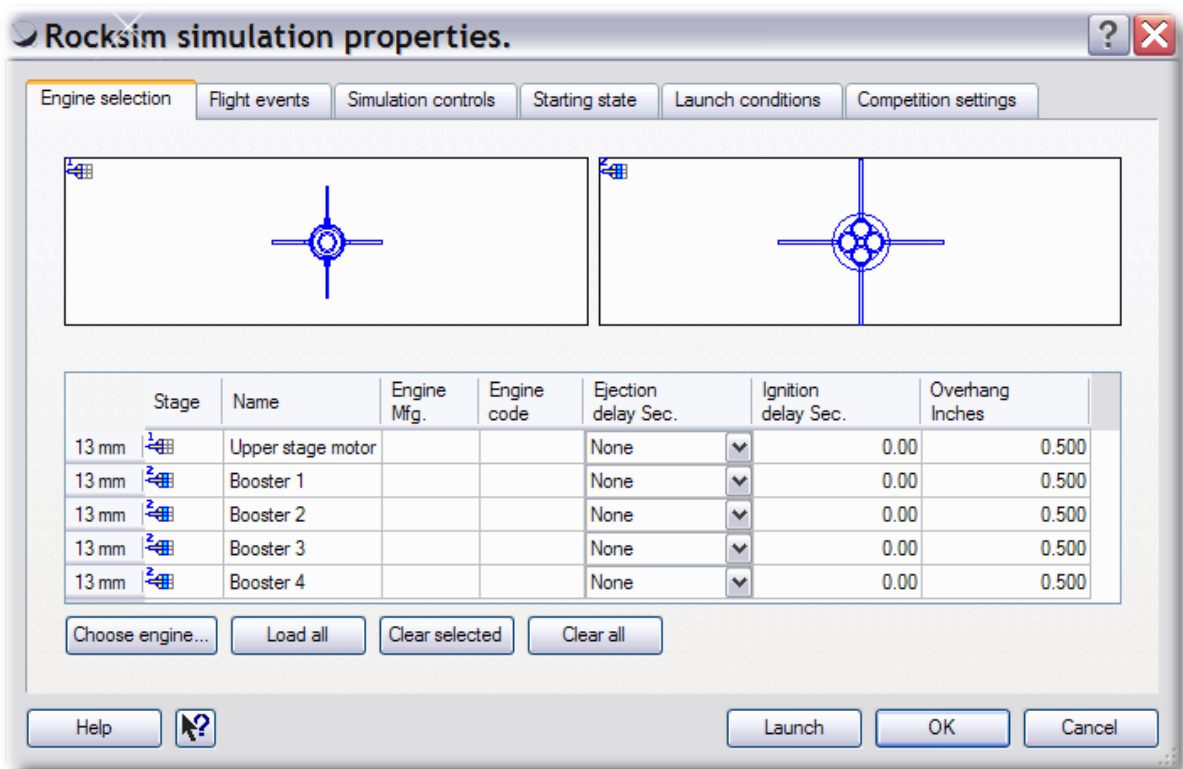
8.2.2 Changing an existing simulation

Displaying the simulation properties for an existing simulation:



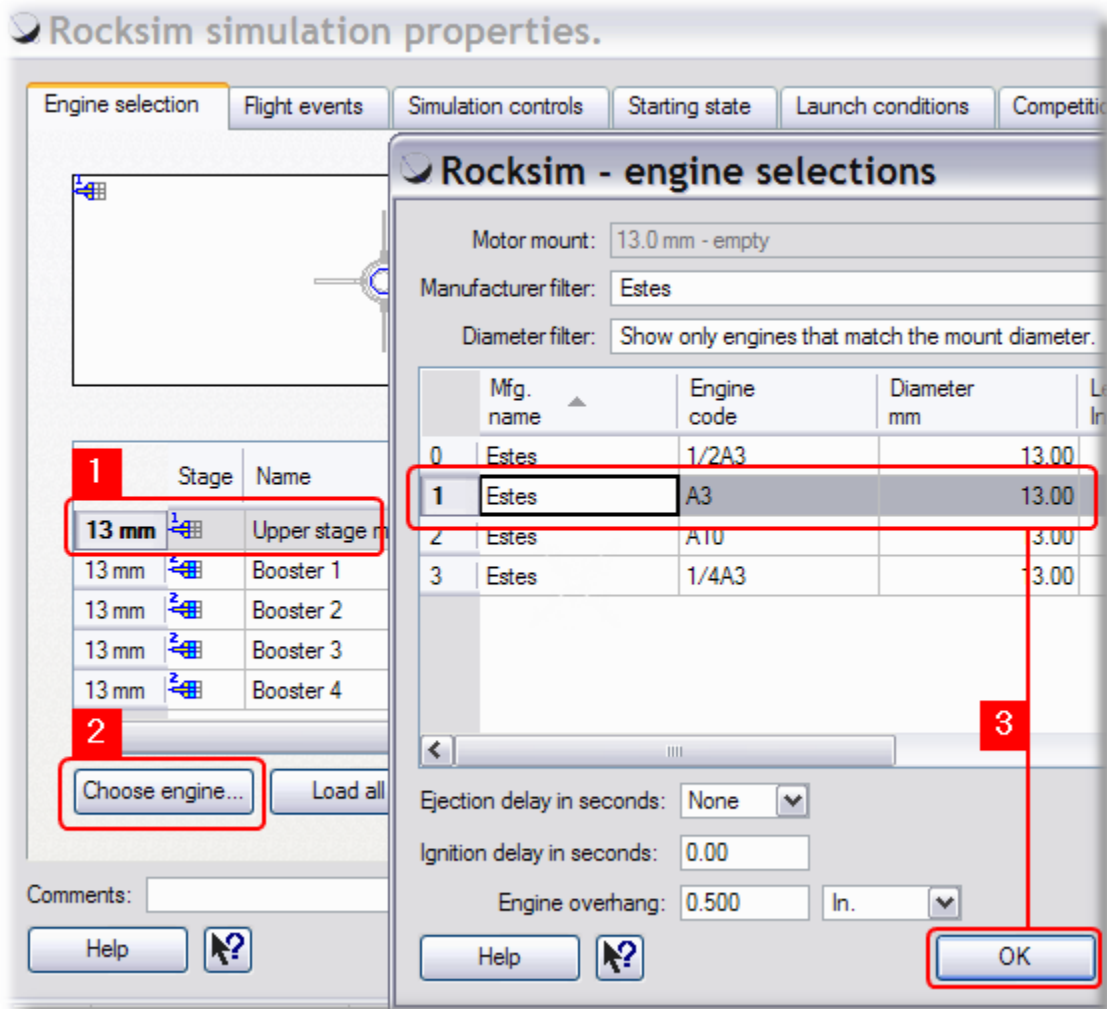
- 1 Select the simulation whose properties you wish to edit.
- 2 Click on the Simulation menu.
- 3 Click on the Edit selected... menu item.

The simulation properties screen is displayed.



8.2.3 Adding a new engine.

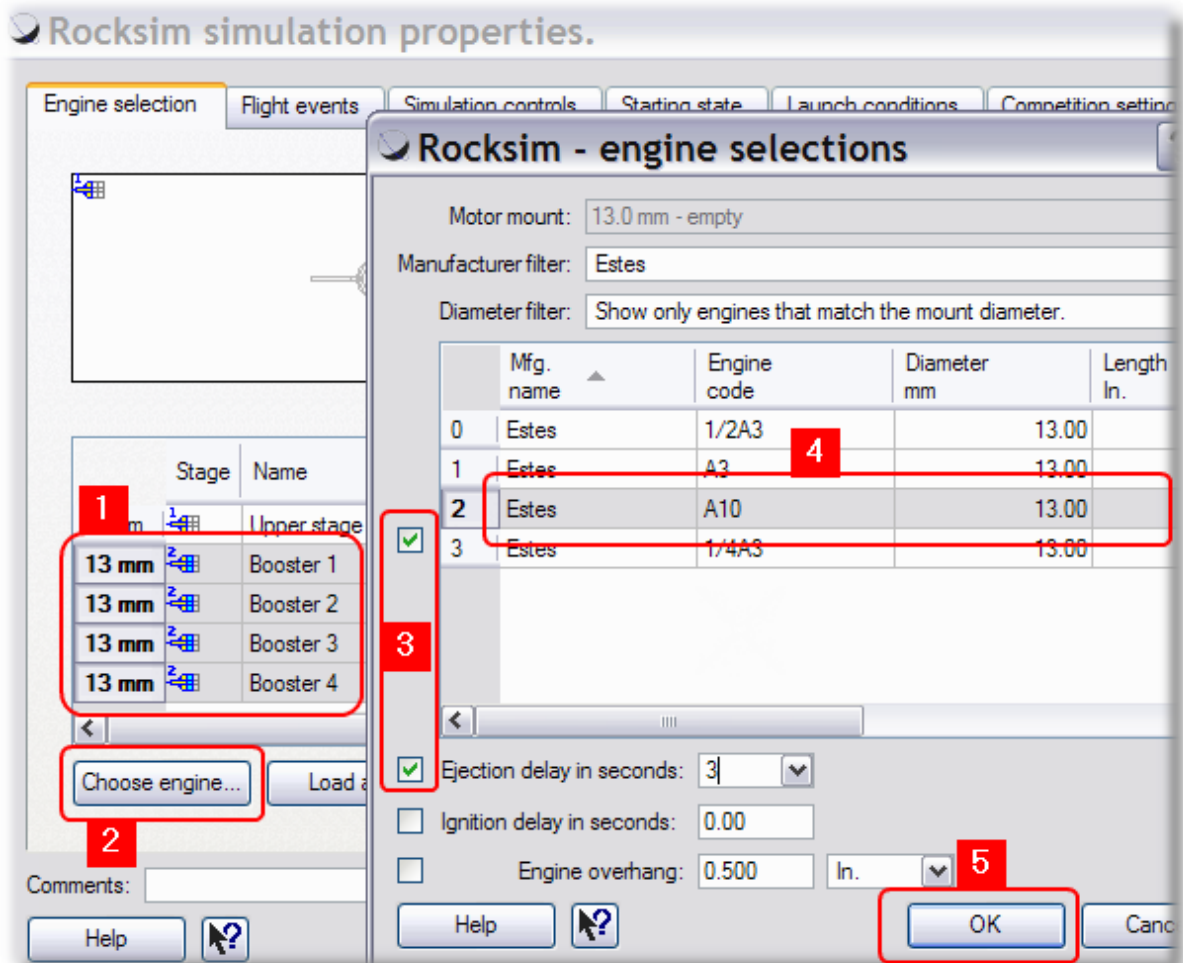
The procedure for loading a single engine into a motor mount is illustrated below.



- 1** Select the motor mount that you wish to load by clicking on the table row. Note that you can double click on the row to bypass step 2.
- 2** Click the Choose engine... button to display the engine selection dialog.
- 3** Double click the desired engine row, or click the engine row and then click the OK button.

8.2.4 Adding multiple engines

The procedure for loading multiple engines or changing the properties of multiple engines:



- 1** Select the set of motor mounts into which you wish to load engines.
- 2** Click the Choose engine... button.
- 3** Check the engine settings that you wish to use. Only the checked off items will be loaded into the previously selected motor mounts.
- 4** Select the engine that you wish to install.
- 5** Click the OK button.

In this example the engine code and the ejection delay are the only data items that will be loaded into the selected motor mounts.

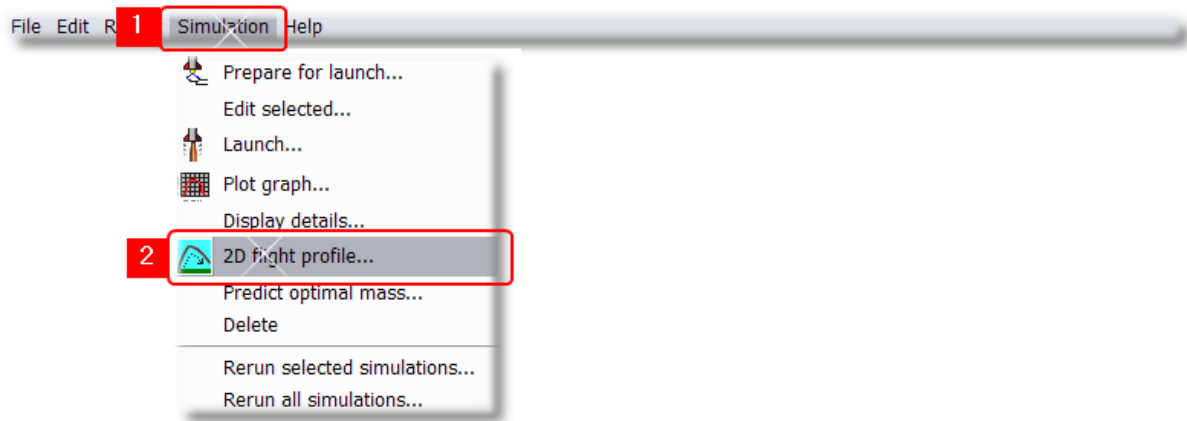
8.2.5 2D Flight profile

This tutorial guide your through the process of displaying flight animations. Here is what you can learn about.

Starting the flight profile session.

8.2.5.1 Starting the flight profile

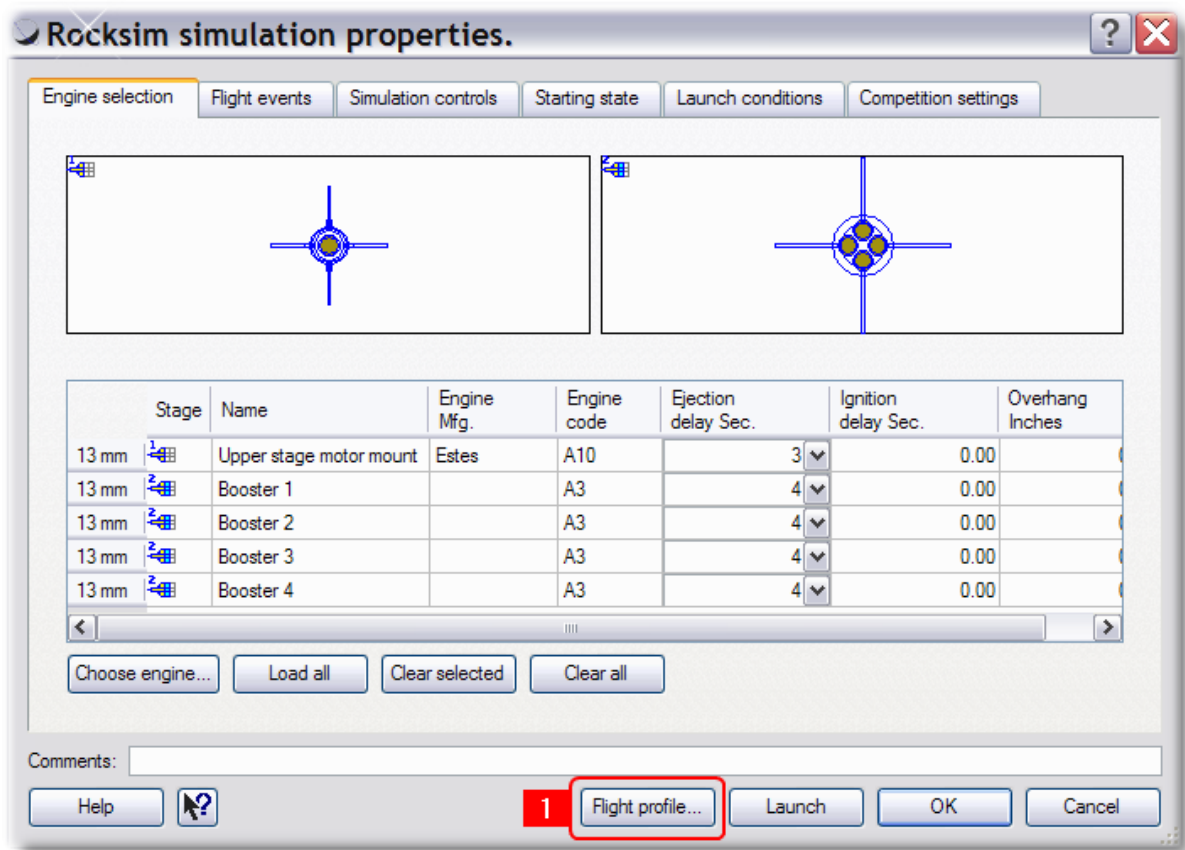
Starting the flight profile from the menu:



1 Click on the Simulation menu.

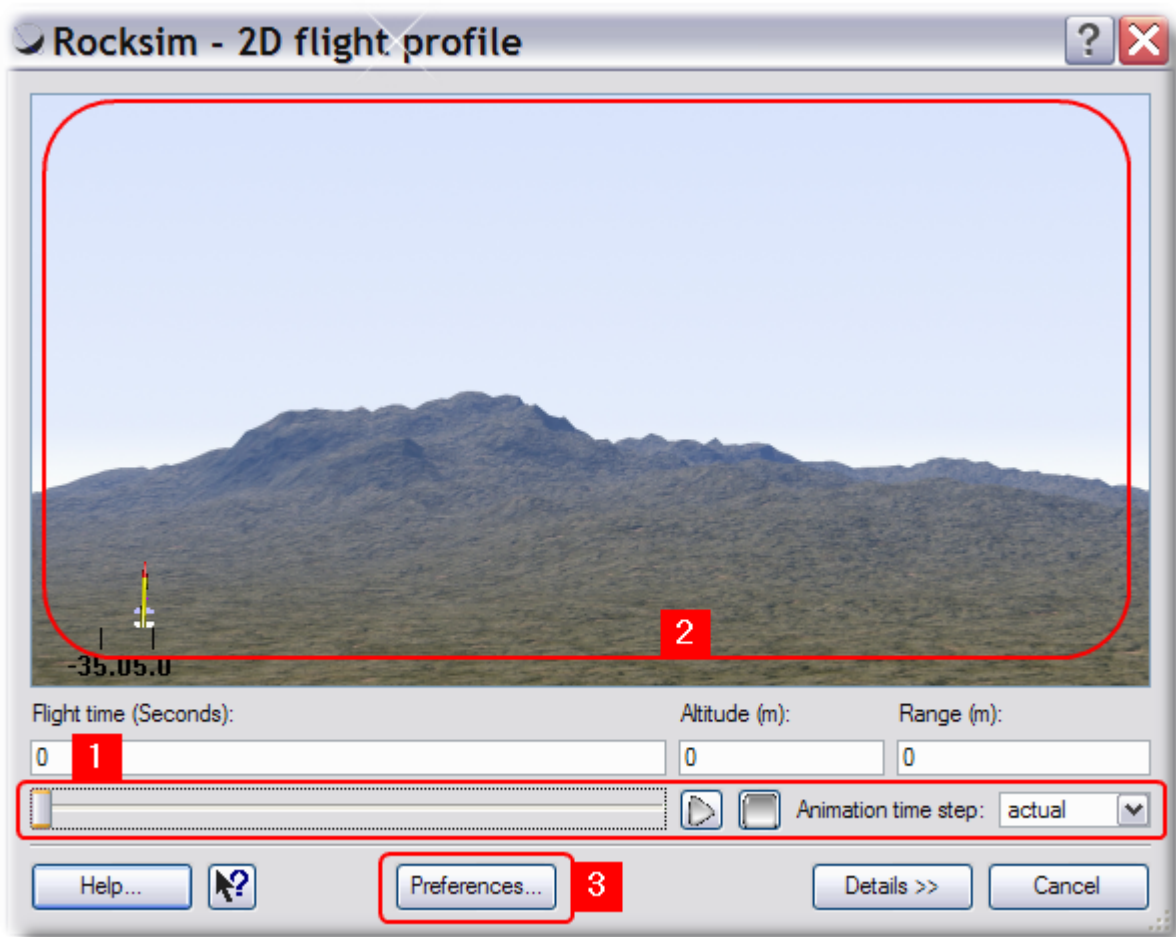
2 Click on the 2D flight profile menu item.

Starting the flight profile from the Simulation properties screen:



1 From the simulation properties screen, click on the Flight profile... button

The flight profile screen is displayed:



- 1** These are your playback controls.
- 2** This is the animation display panel.
- 3** This button will allow you to change the playback display settings.

8.3 Design

The tutorials in this section deal with all aspects of the design process within RockSim.

8.3.1 Creating a rocket design

This tutorial will guide you through the steps to create a new rocket design. The design presented here is a very simple single stage rocket.

Steps:

Setting up the design parameters.

Adding the nose cone.

Adding the main body tube.

Adding the motor mount tube.

Adding a centering ring.

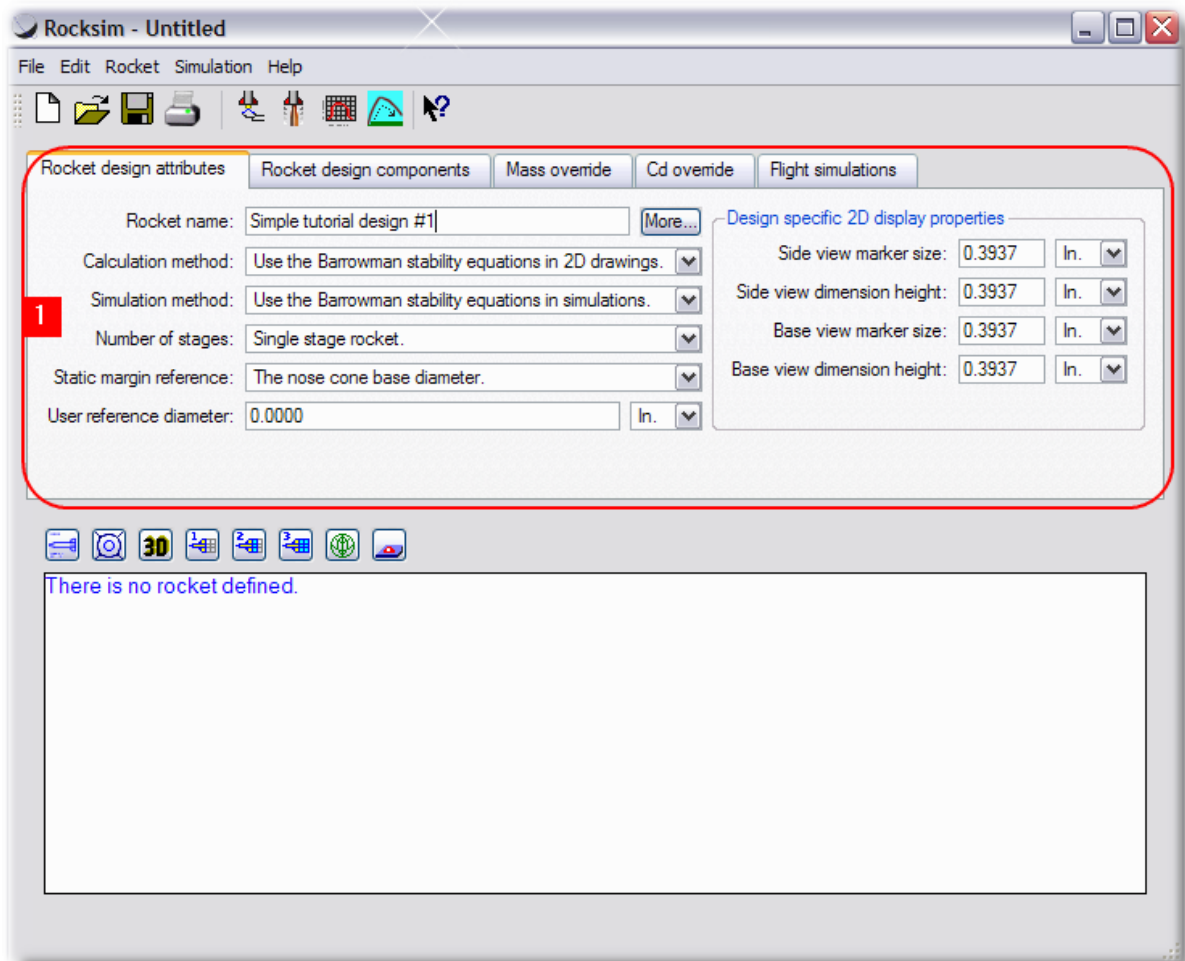
Making another centering ring.

Adding fins.

Adding a streamer.

8.3.1.1 Setting up the design parameters

[Next: Creating the nose cone]



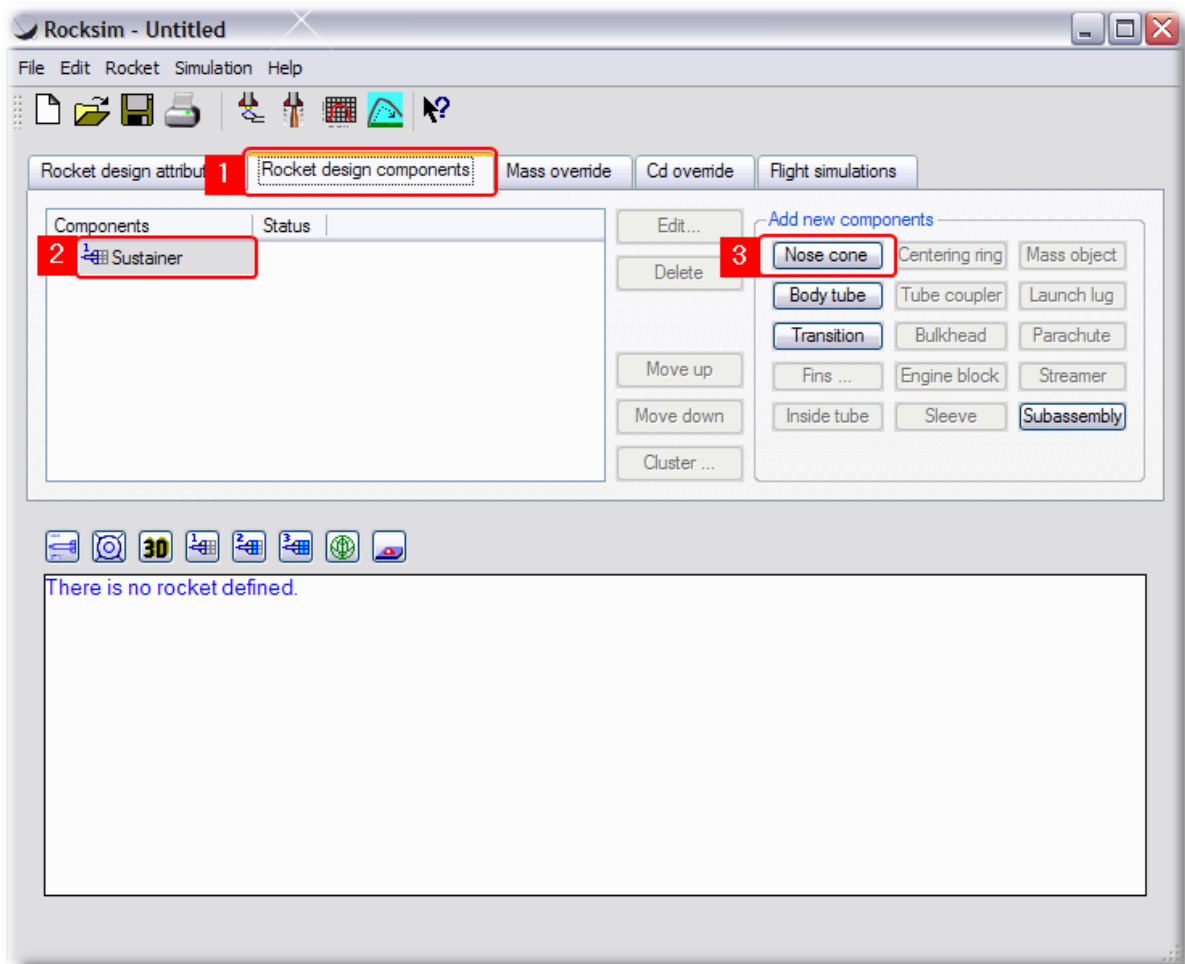
1 For this design we leave most of the settings in their default state. This will result in a single stage rocket design. The only data that is entered is the name of the design.

[Next: Creating the nose cone]

8.3.1.2 Adding the nose cone

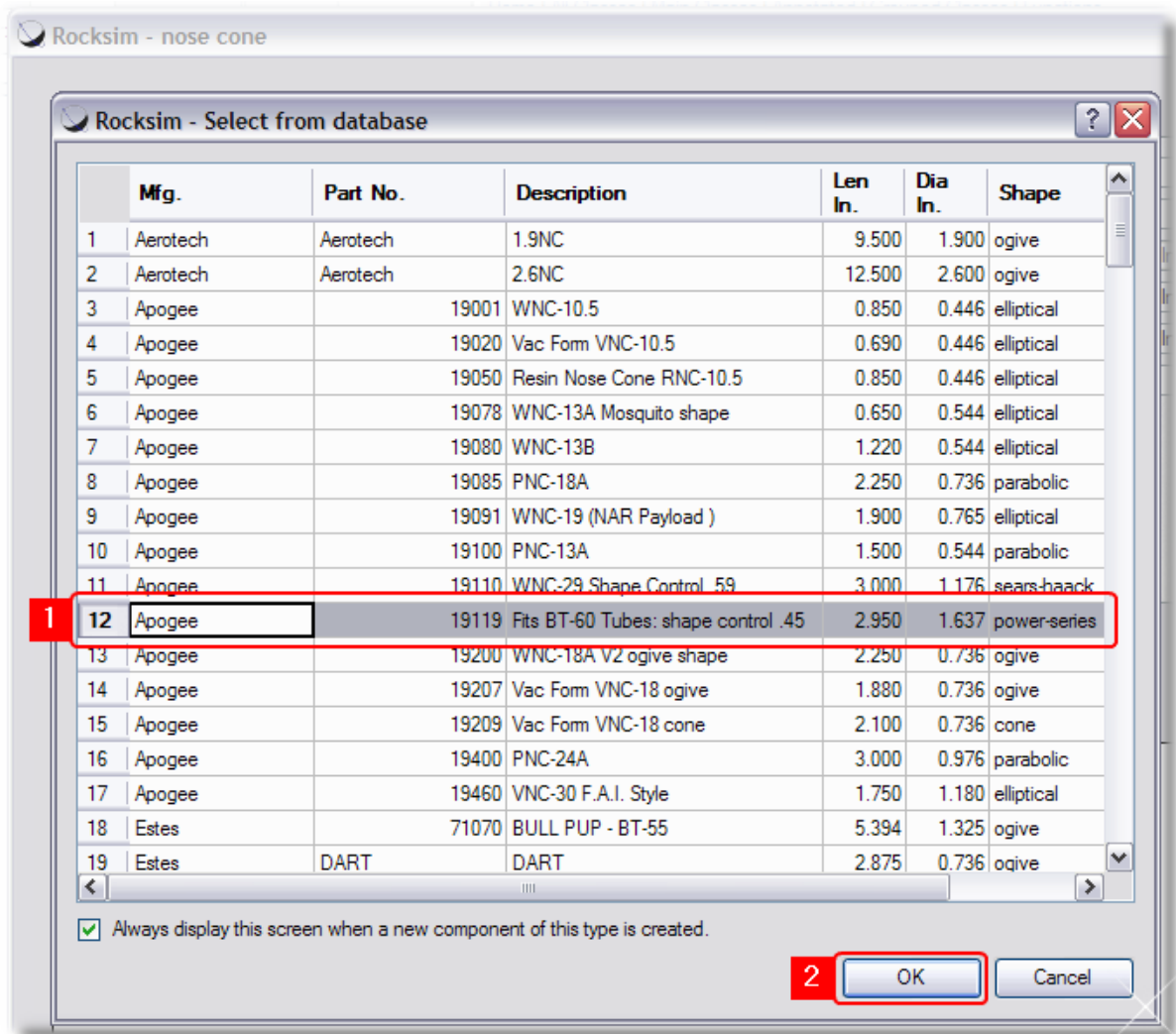
[Previous: Setting up the design parameters] - [Next: Adding the body tube]

Inserting a new nose cone into your design.



- 1 Click on the Rocket design components tab.
- 2 Click on the upper stage or sustainer root node in the component tree.
- 3 Click the add Nose cone button.

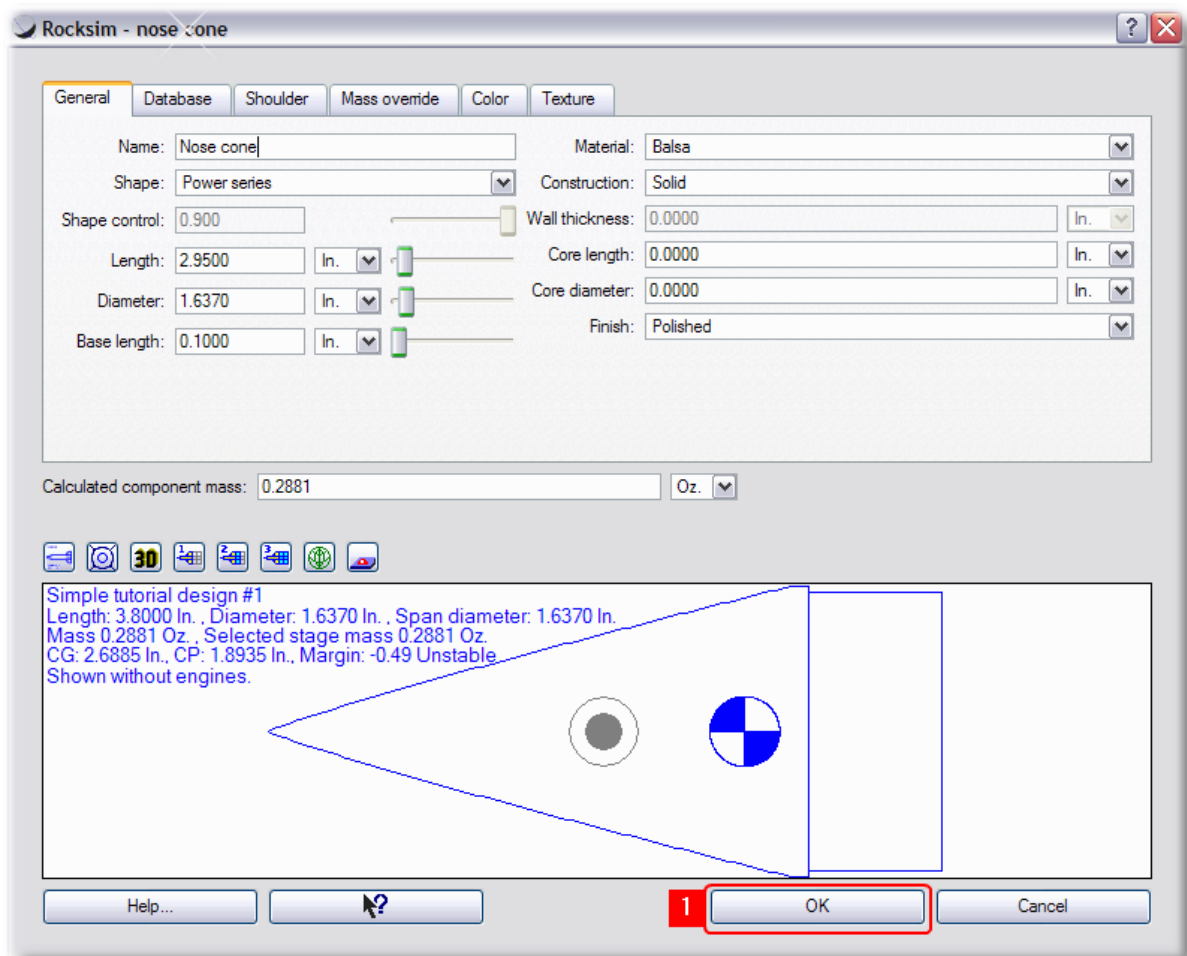
Choosing the nose cone from the parts database.



1 Click on the nose cone that you wish to add.

2 Click the OK button. Note that you can also double click on the component entry in the table instead of clicking the OK button.

Close the nose cone editor screen.



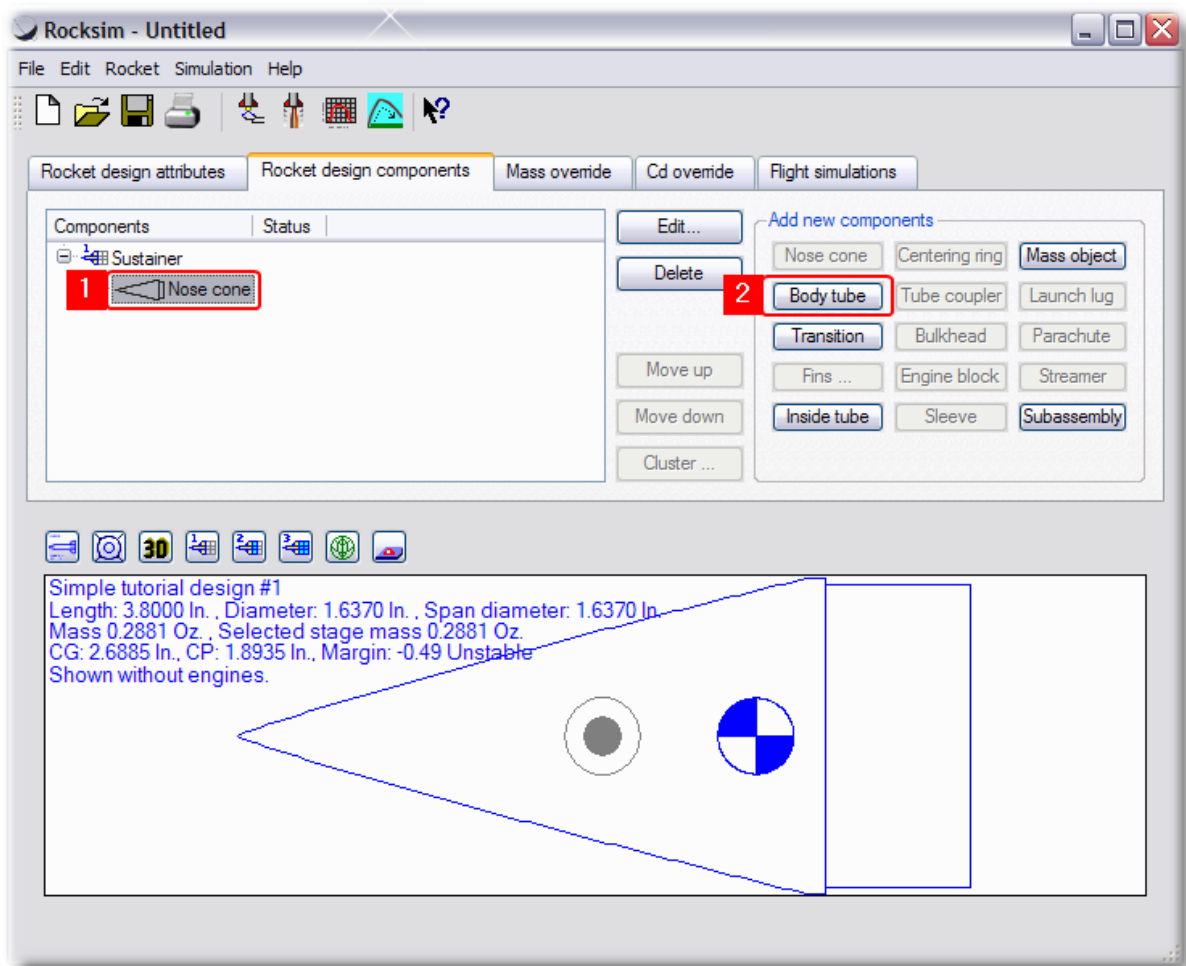
1 Click the OK button on the nose cone editor.

[Previous: Setting up the design parameters] - [Next: Adding the body tube]

8.3.1.3 Adding the main body tube

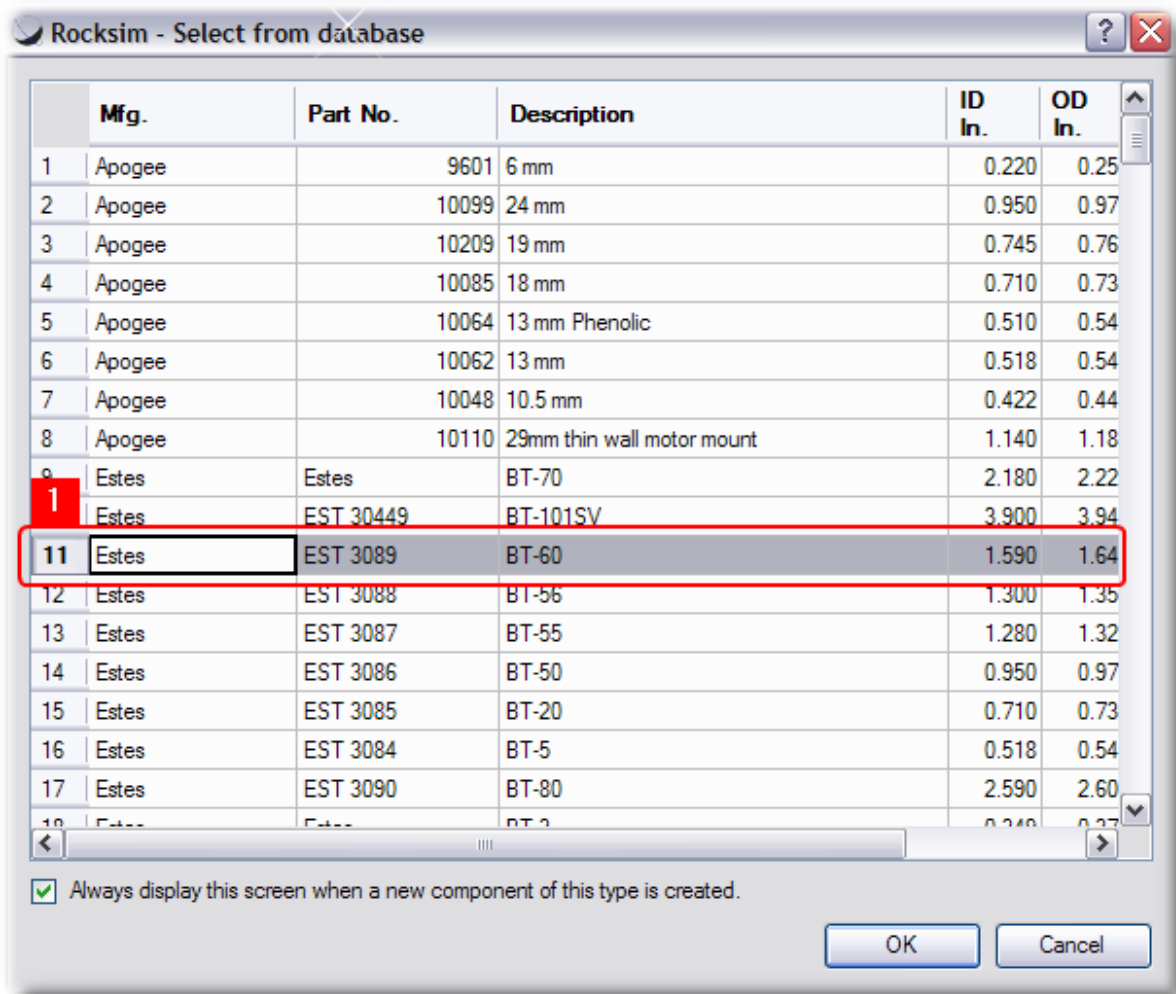
[Previous: Adding the nose cone] - [Next: Adding the motor mount tube]

Inserting a new body tube into your design.



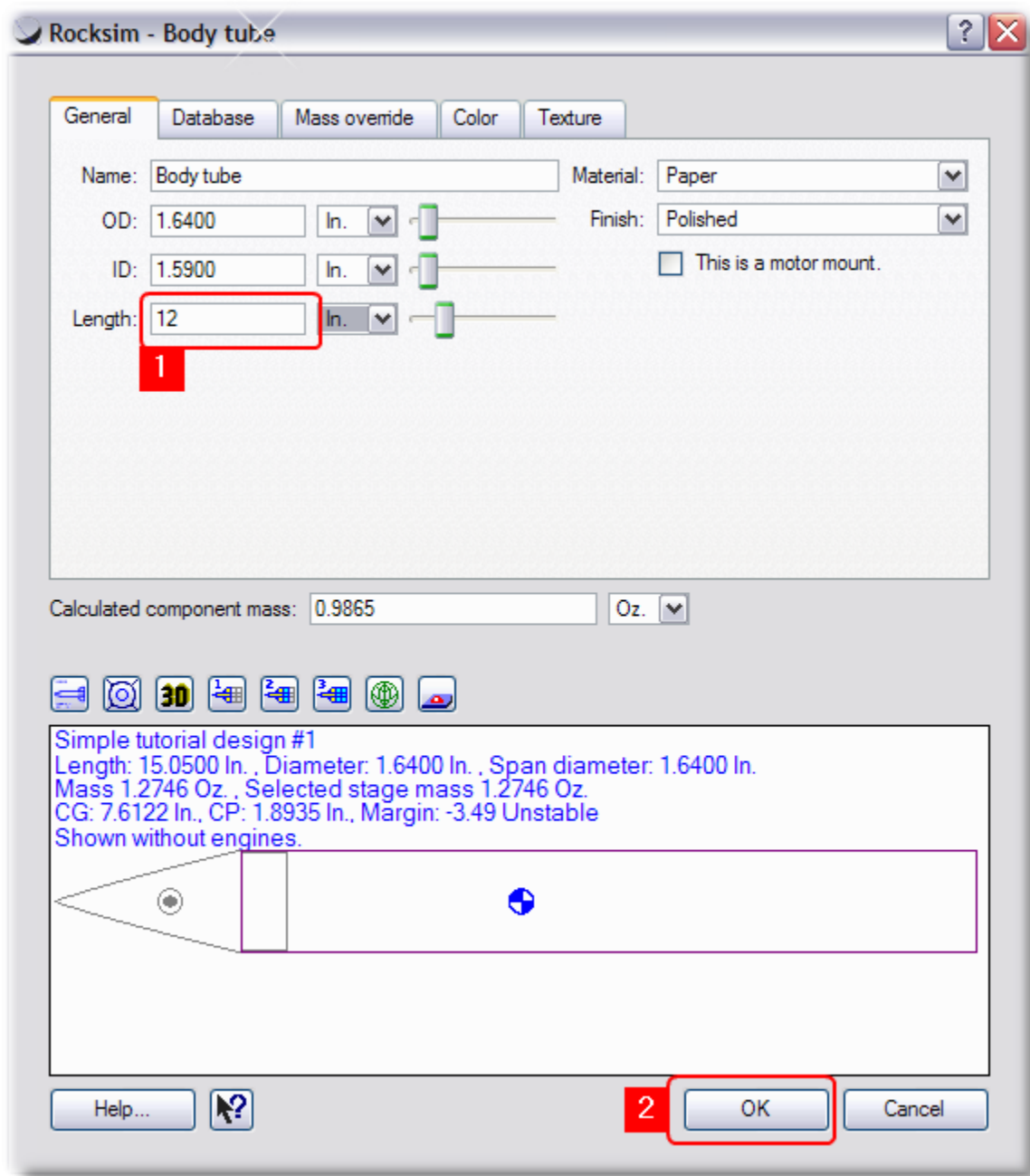
- 1** Click on the Nose cone entry in the component tree.
- 2** Click the Body tube button.

Choosing the body tube from the parts database.



1 Double click on the BT-60 body tube.

Setting the final body tube length.



1 Enter a different length for the body tube. When body tubes are first loaded from the parts database, their default length is the standard length supplied by the manufacturer.

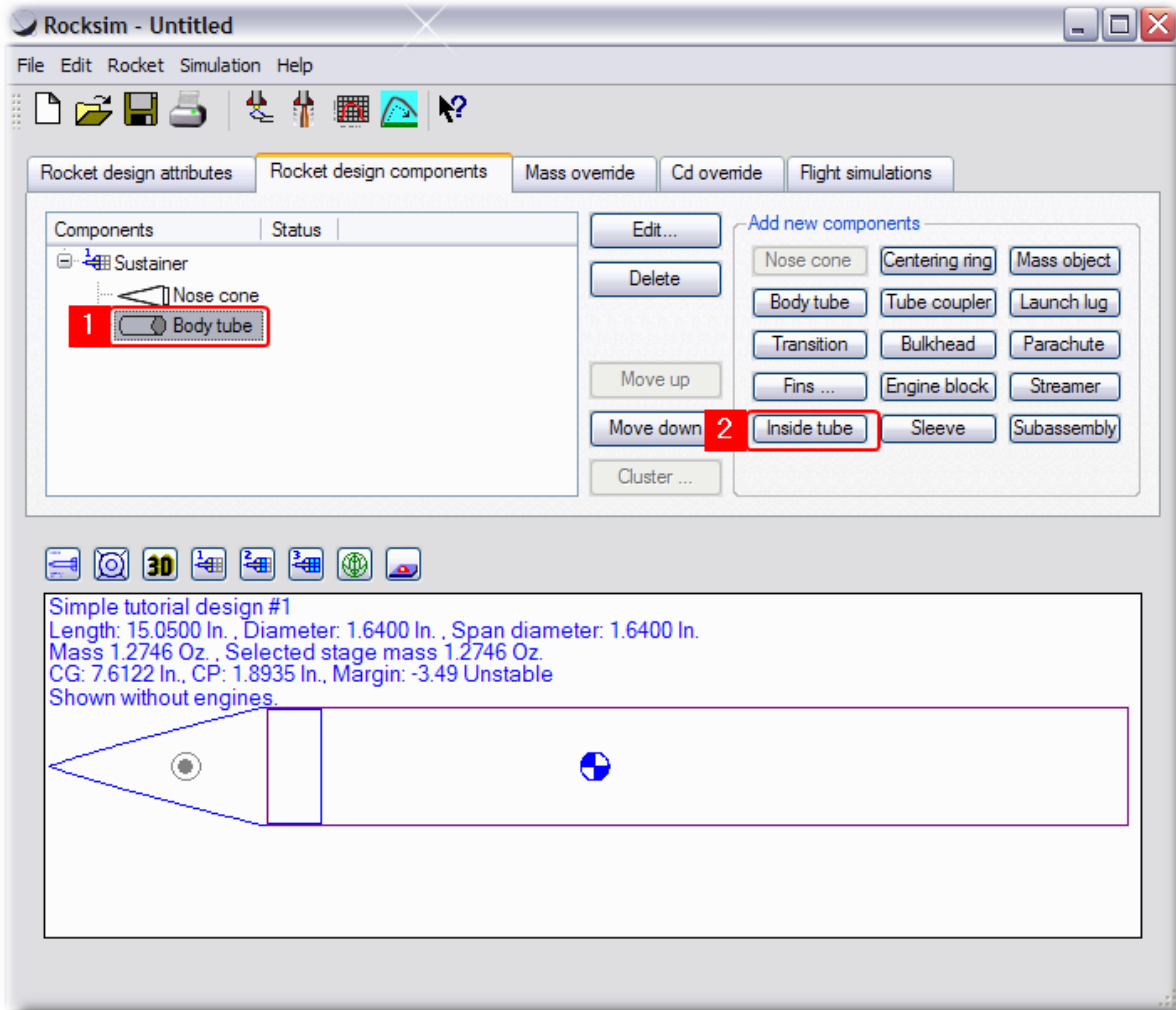
2 Click the OK button to close the body tube editor window.

[Previous: Adding the nose cone] - [Next: Adding the motor mount tube]

8.3.1.4 Adding the motor mount tube

[Previous: Adding the main body tube] - [Next: Adding centering rings]

Inserting a new inside tube into the design.

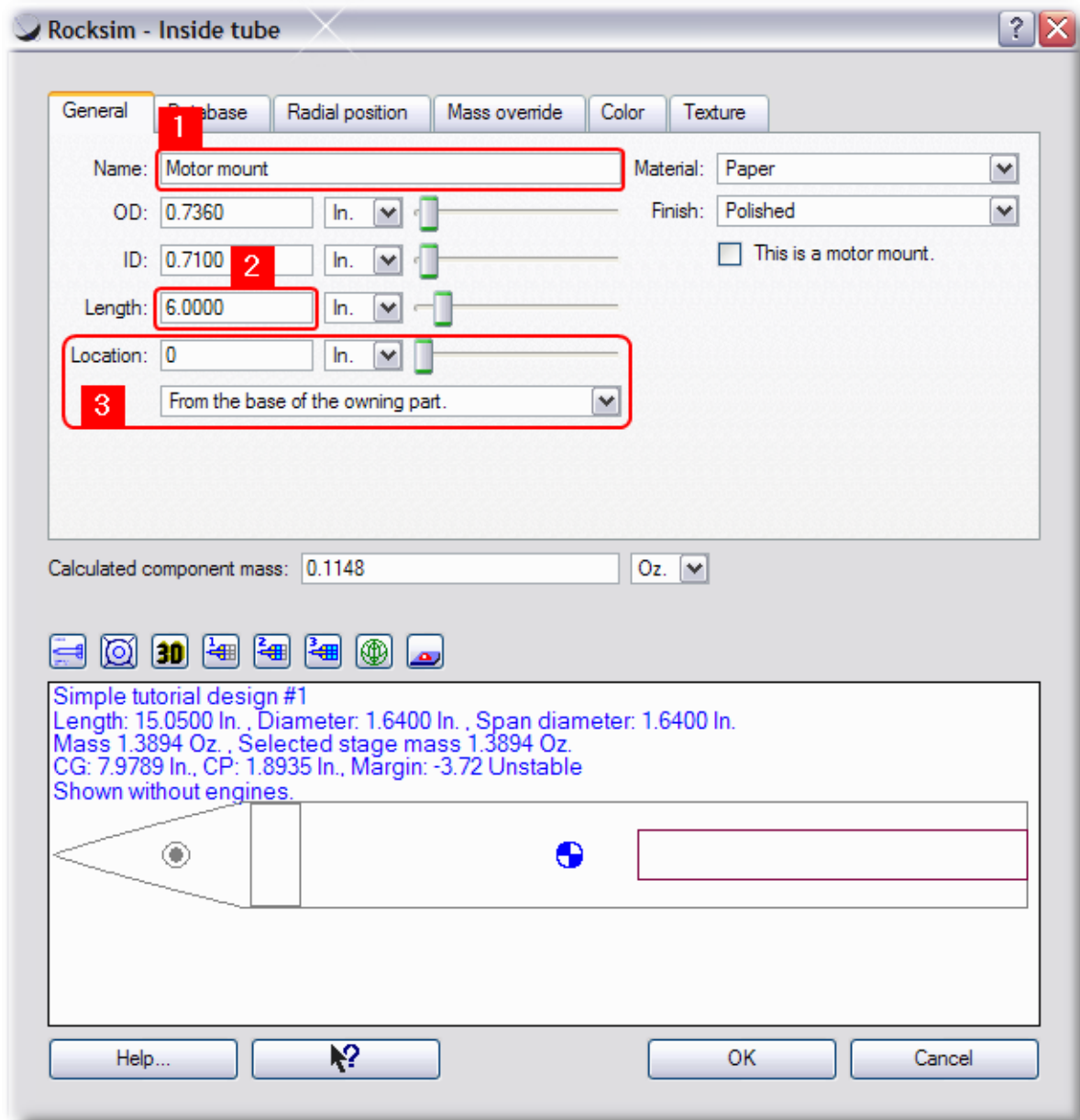


1 Click on the Body tube in the component tree.

2 Click the Inside tube button.

Changing the name, length, and location of the new inside tube.

Note: The screen shot of the parts database selection screen has been omitted to keep the tutorial simpler.

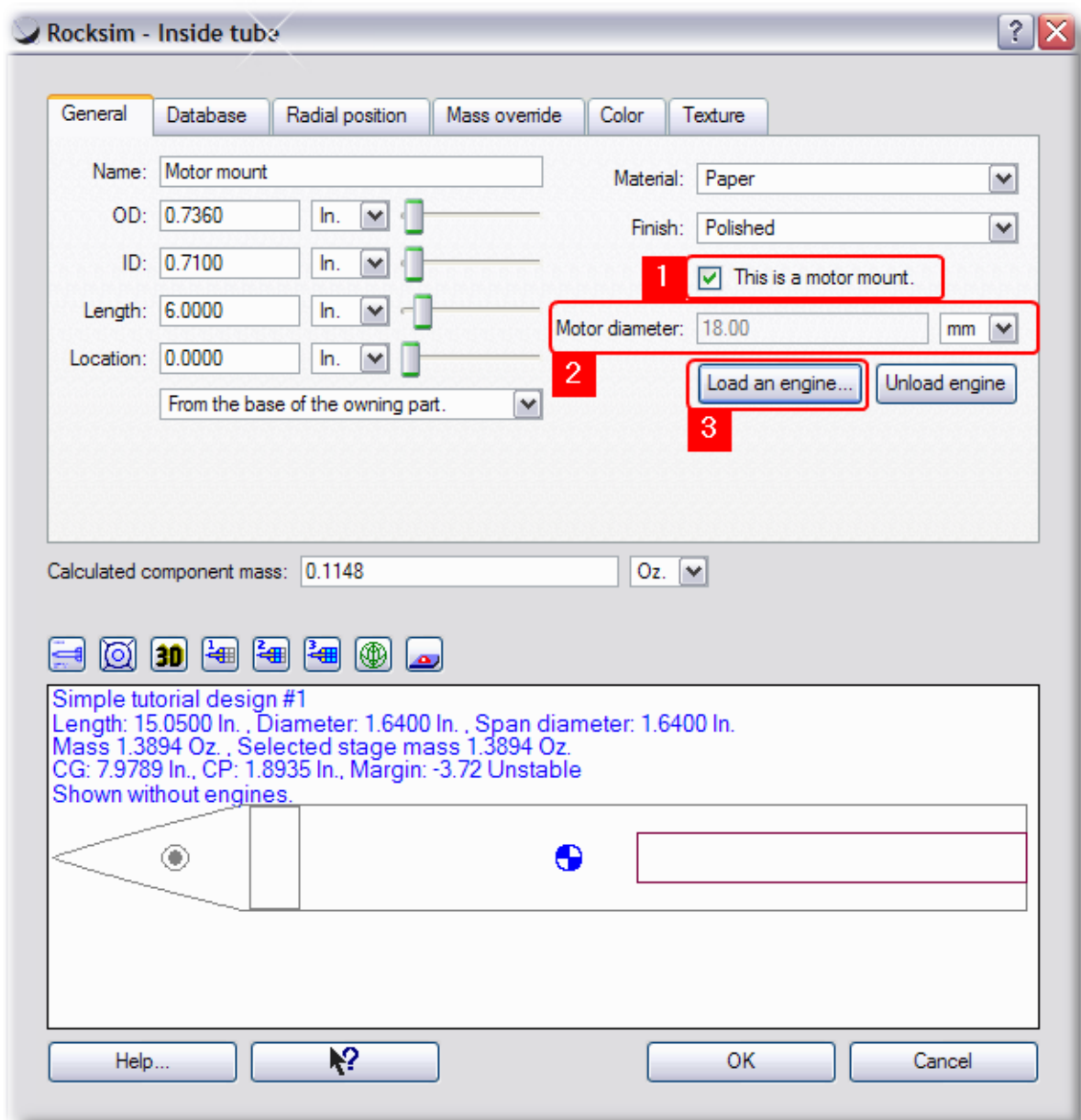


1 Change the name of the new inside to "Motor mount". This makes it easier to identify the tube in the component tree and on the parts list report.

2 Change the length of the motor mount tube to 6 inches.

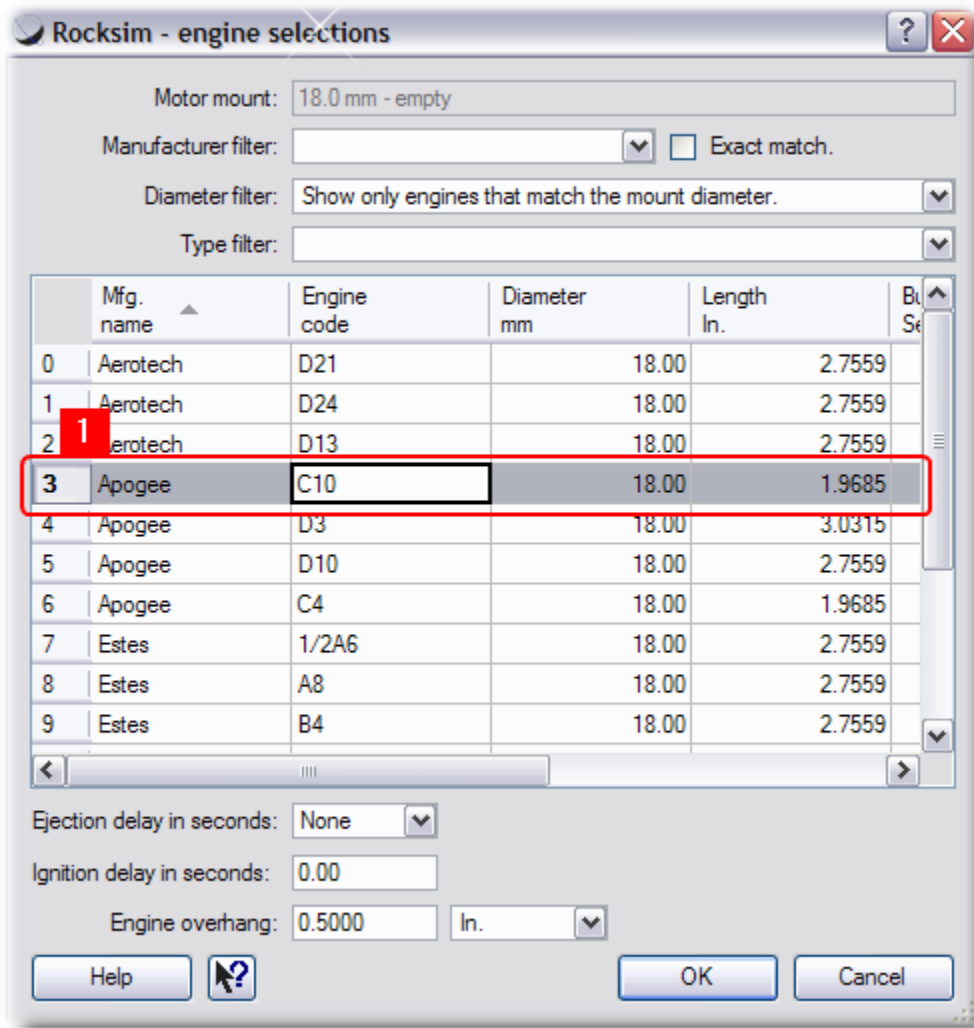
3 Change the location of the motor mount to zero inches from the base of the owning part. Locating the motor mount relative to the base of the owning part will always place the motor mount in alignment with the base of the rocket.

Designating the new inside tube a motor mount, and loading an engine into the design.



- 1** Click on the This is a motor mount option.
- 2** Note: The motor diameter is calculated based on the inside diameter of the motor mount tube.
- 3** Click the Load an engine... button. An engine is loaded into the design early on in order to monitor the CP/CG relationship of the design. You do not need to load an engine into the design at this point in the design process. Engines can be loaded when you run simulations as well.

Choosing a sample engine for the design.



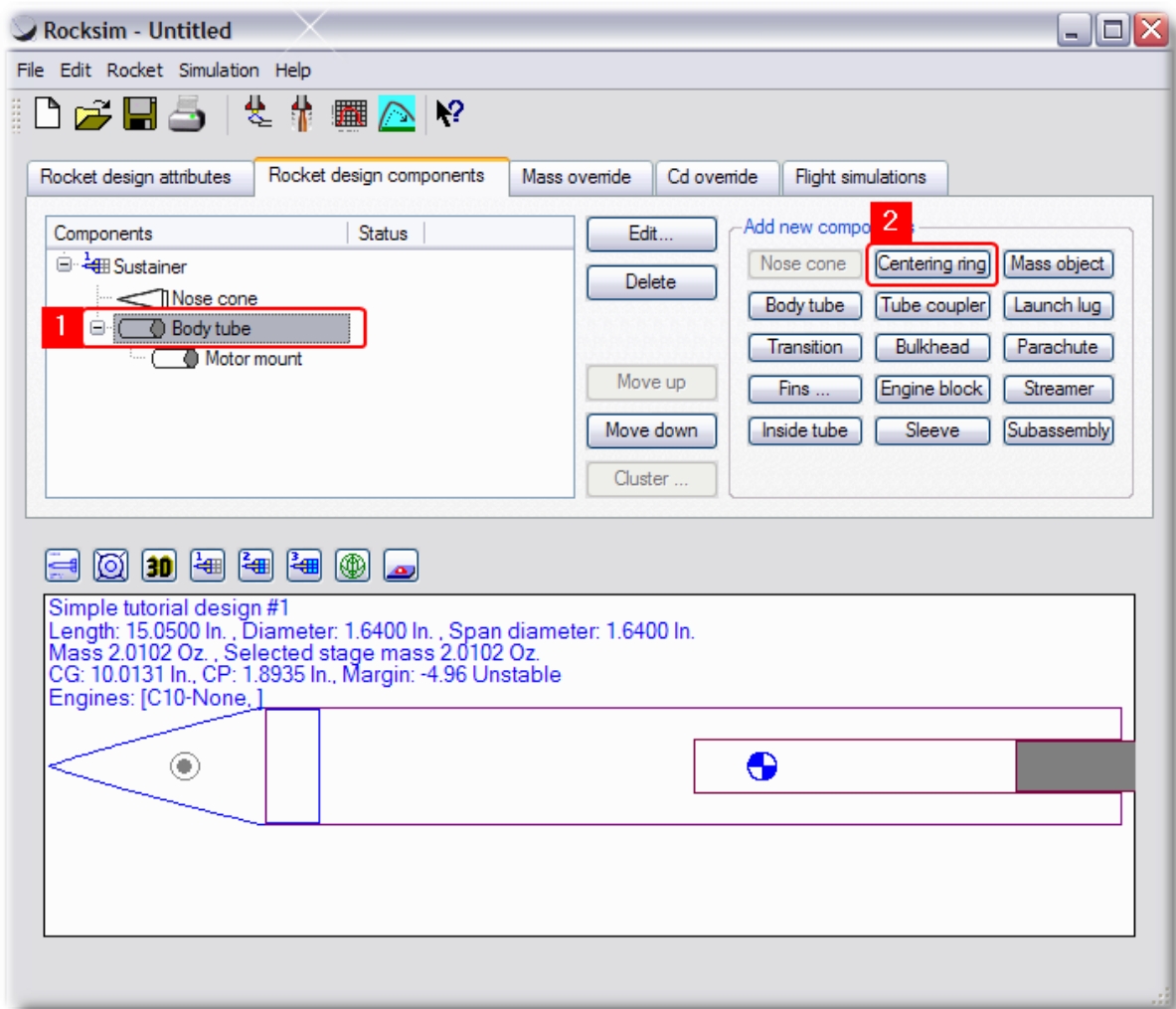
1 Double click on the engine that you wish to load into the motor mount tube.

[Previous: Adding the main body tube] - [Next: Adding centering rings]

8.3.1.5 Adding a centering ring

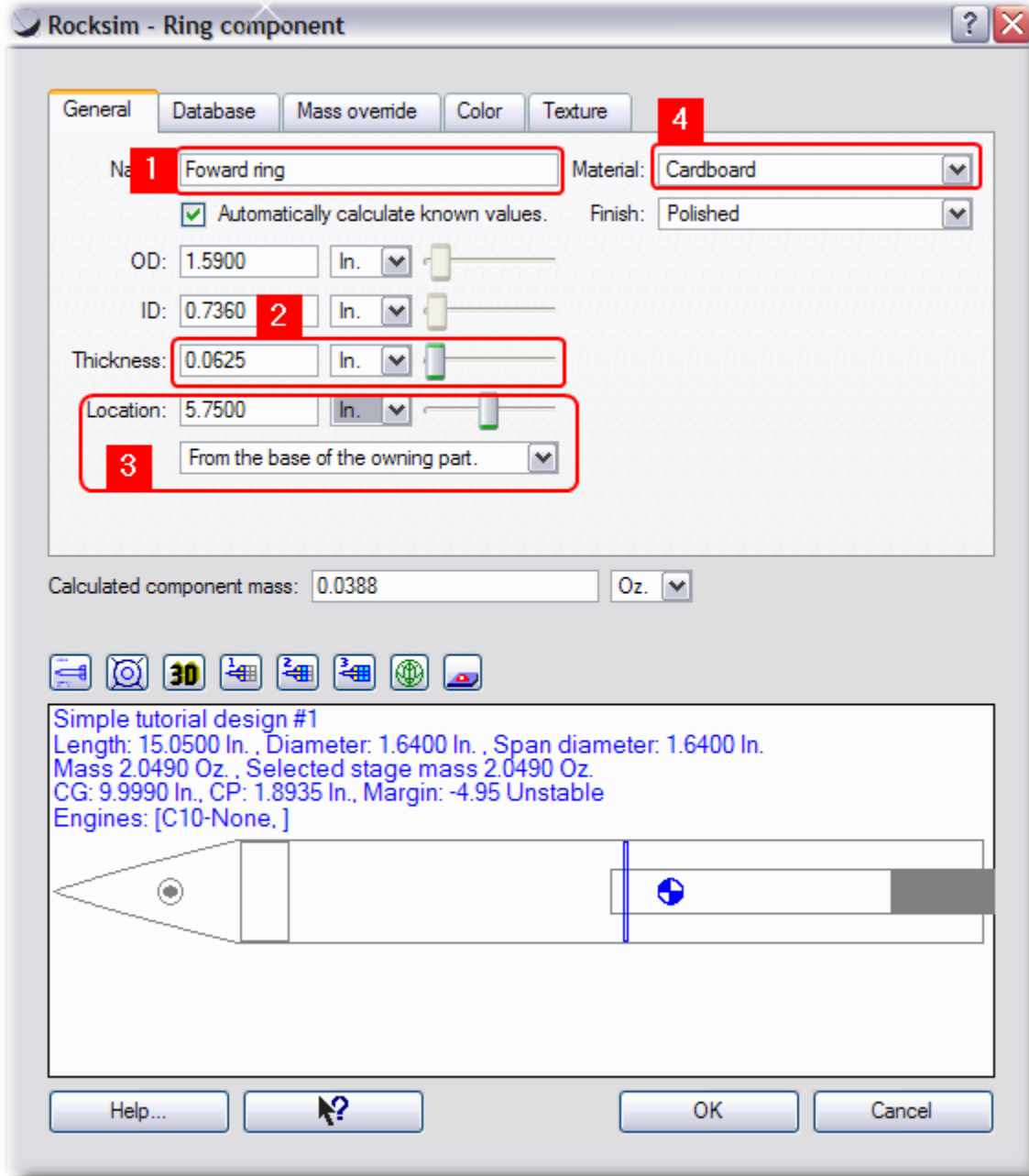
[Previous: Adding the motor mount tube] - [Next: Making a copy of the centering ring]

Inserting a new centering ring into the design.



- 1** Click on the outer Body tube on the component tree.
- 2** Click the Centering ring button.

Setting the location of the first centering ring.



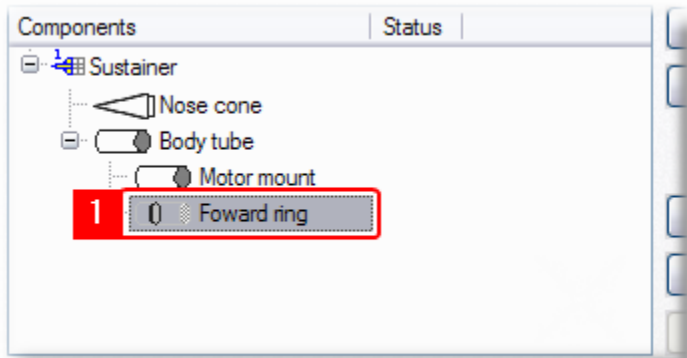
- 1** Assign a meaningful name for the centering ring.
- 2** Set the desired thickness.
- 3** Set the location relative to the base of the outer body tube.
- 4** Set the material.

[Previous: Adding the motor mount tube] - [Next: Making a copy of the centering ring]

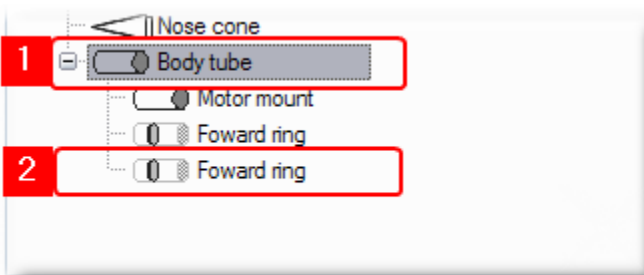
8.3.1.6 Making another centering ring

[Previous: Adding a centering ring] - [Next: Adding fins]

Making an exact copy of the first centering ring.

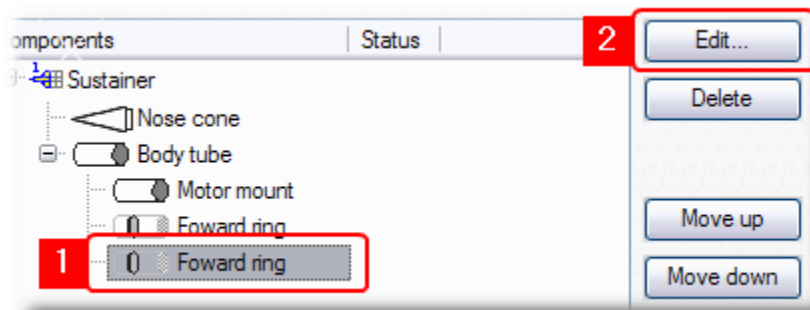


1 Click on the centering ring that was just created. And then press the clipboard copy keyboard combination.
 On windows: Press Ctrl+C
 On Mac OS X: Press Apple+C

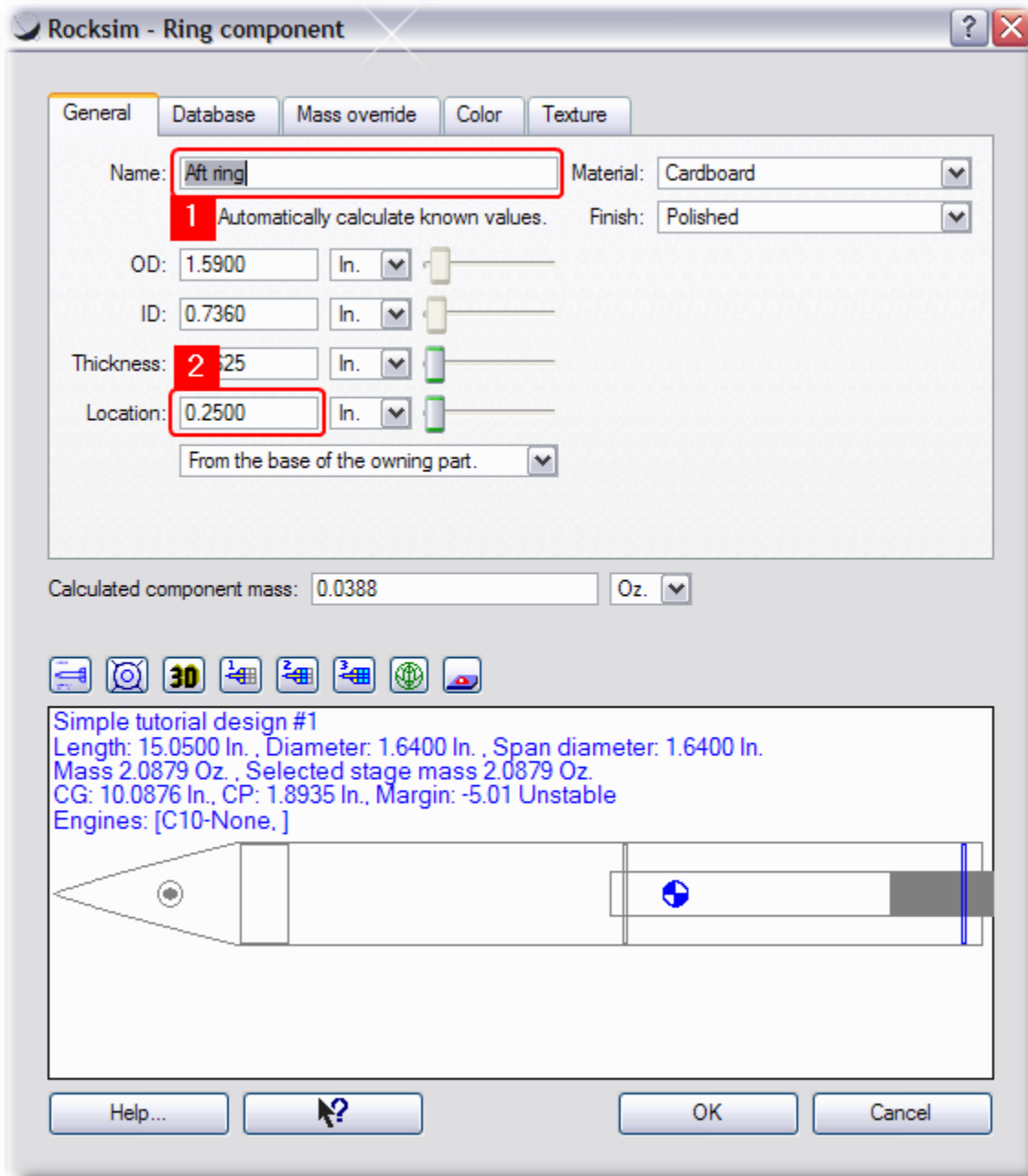


1 Click on the body tub that will own the new centering ring.
2 Press the clipboard copy keyboard combination.
 On Windows: Press Ctrl+V
 On Mac OS X: Press Apple+V
 An exact copy of the first centering ring is inserted into the design.

Changing the name an location of the new centering ring.



- 1 Click on the centering ring in the component tree.
- 2 Click the Edit button. Note: You can also double click the component in the tree display to display it's associated editor window.



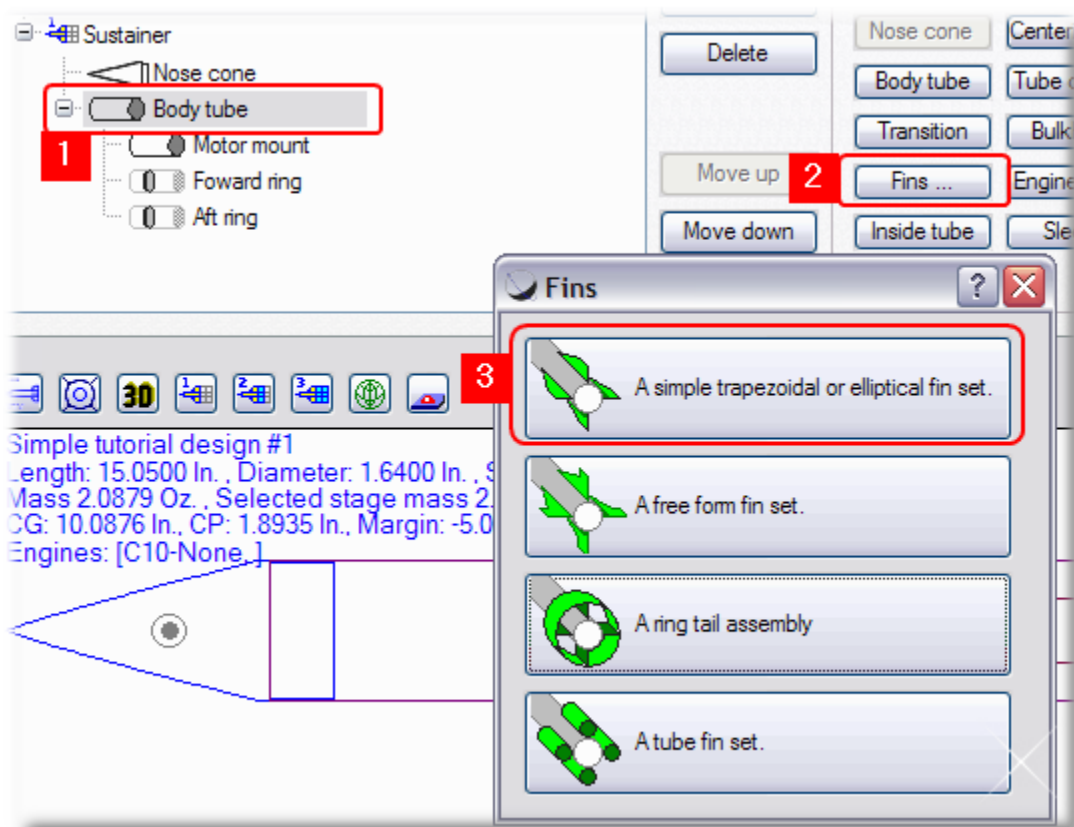
- 1 Change the name of the centering ring.
- 2 Change the location of the centering ring.

[Previous: Adding a centering ring] - [Next: Adding fins]

8.3.1.7 Adding fins

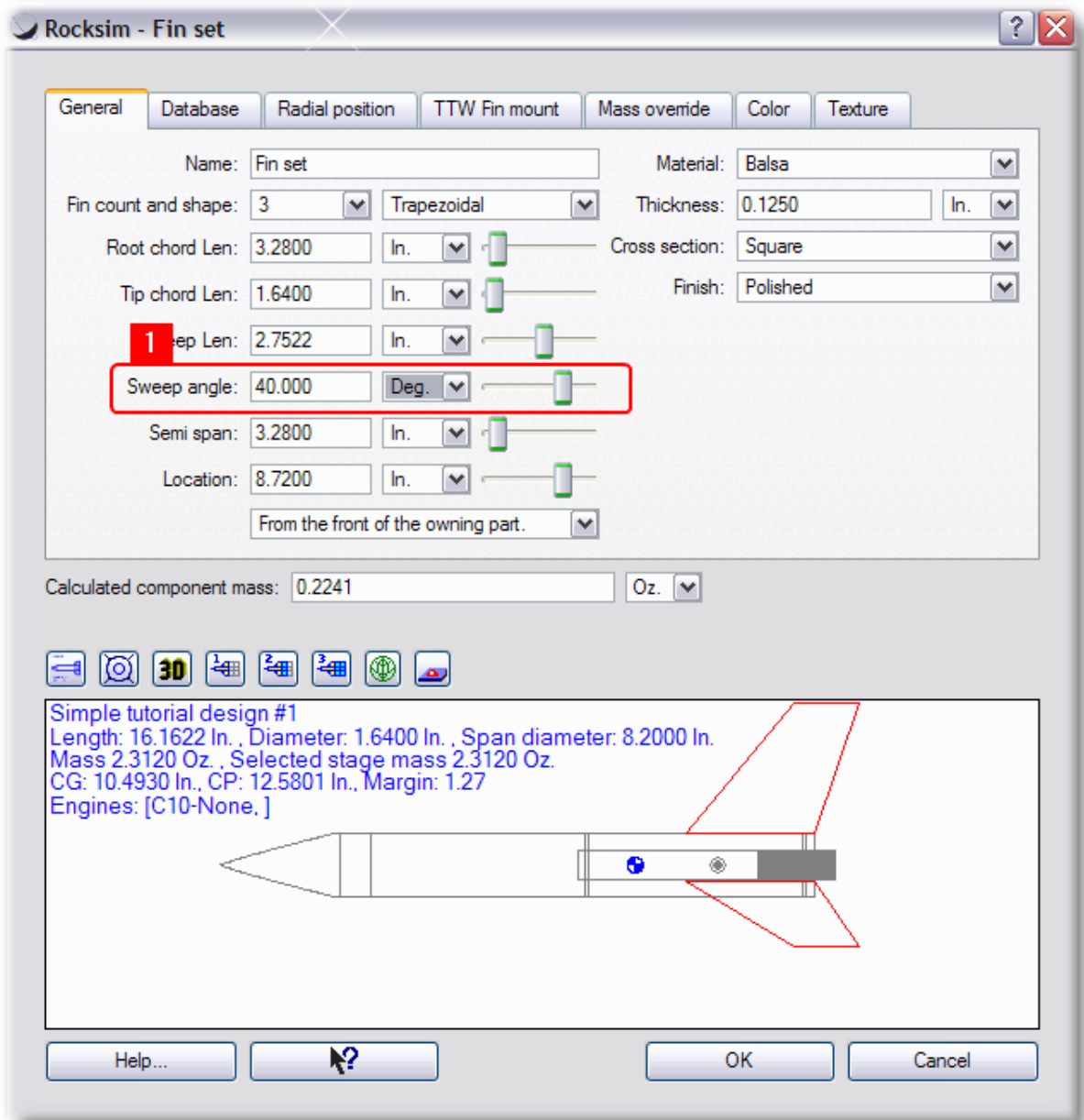
[Previous: Making another centering ring] - [Next: Adding a streamer]

Inserting a simple set of fins into the design.



- 1** Click on the outside body tube of the design.
- 2** Click on the Fins... button. The fin selection window will be displayed.
- 3** Click on the A simple trapezoidal or elliptical fin set button. Click cancel if the Fin Set database screen is displayed.

Changing the fin shape



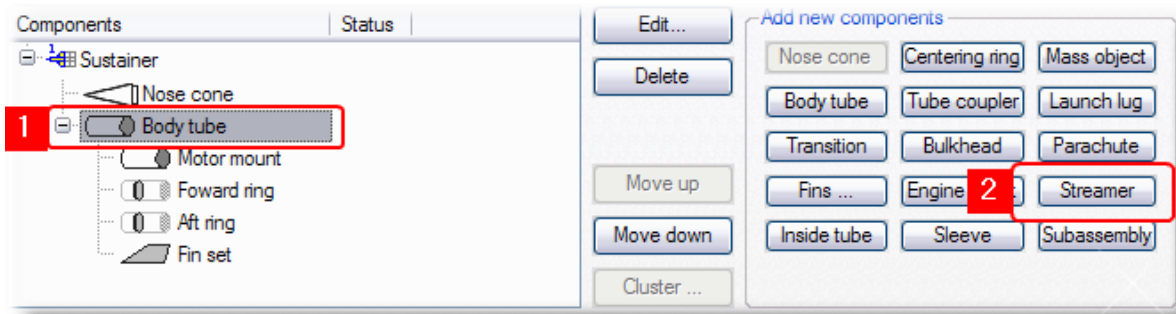
1 Change the sweep angle to 40 Degrees.

[Previous: Making another centering ring] - [Next: Adding a streamer]

8.3.1.8 Adding a streamer

[Previous: Adding fins]

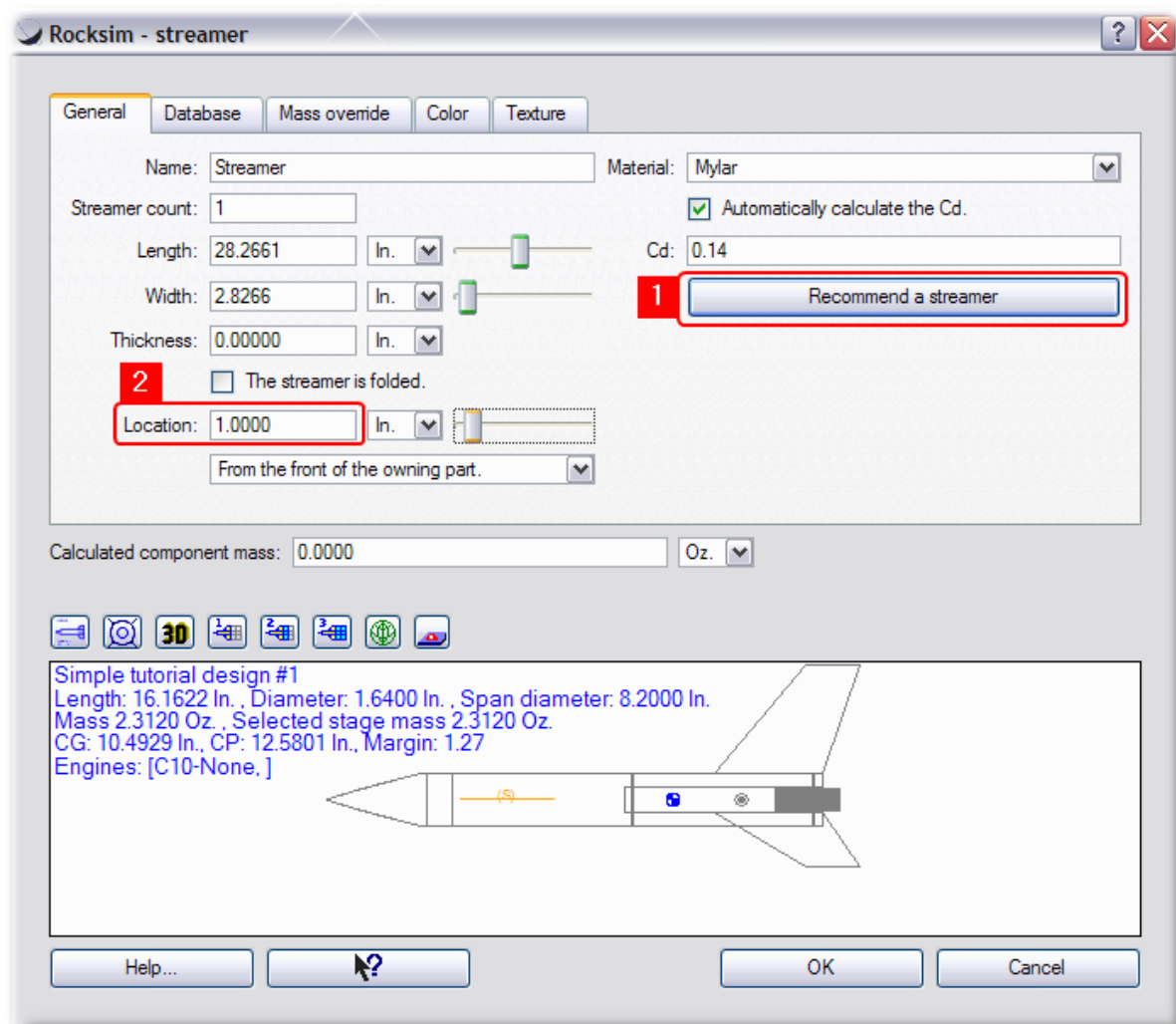
Inserting a streamer into the design.



1 Click on the outside body tube. This is tube that will contain the streamer.

2 Click the Streamer button.

Define the size of the streamer and locate it within the body tube.



1 Click the Recommend a streamer button

2 Change the location in the outer body tube so that the streamer clears the nose cone shoulder.

[Previous: Adding fins]

8.3.2 Creating tube clusters

This tutorial presents the steps required to create tub clusters in a rocket design. The simple design created in the Creating a rocket design tutorial is used as a starting point for this tutorial.

Steps:

Starting cluster wizard.

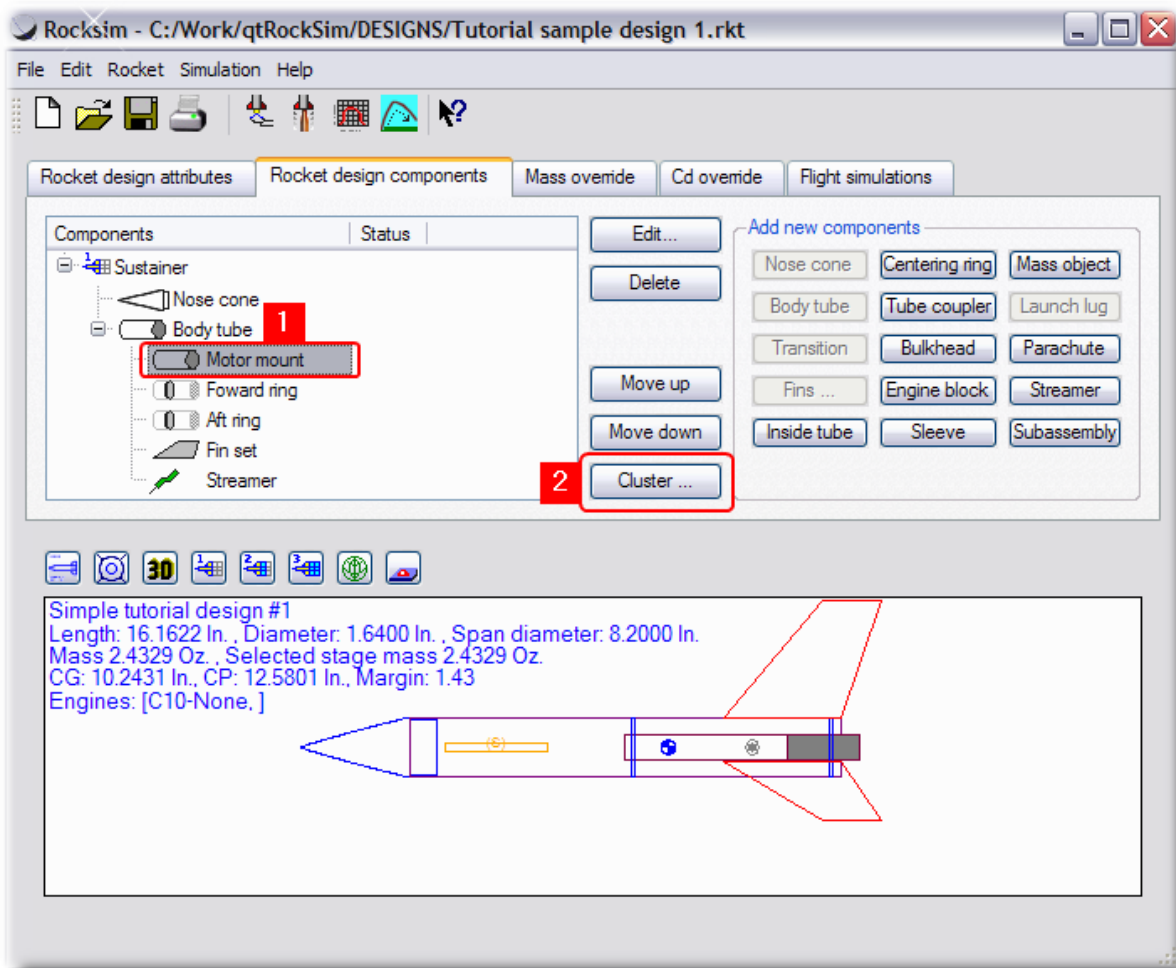
Choosing a cluster pattern.

Create the cluster pattern.

8.3.2.1 Starting the cluster wizard.

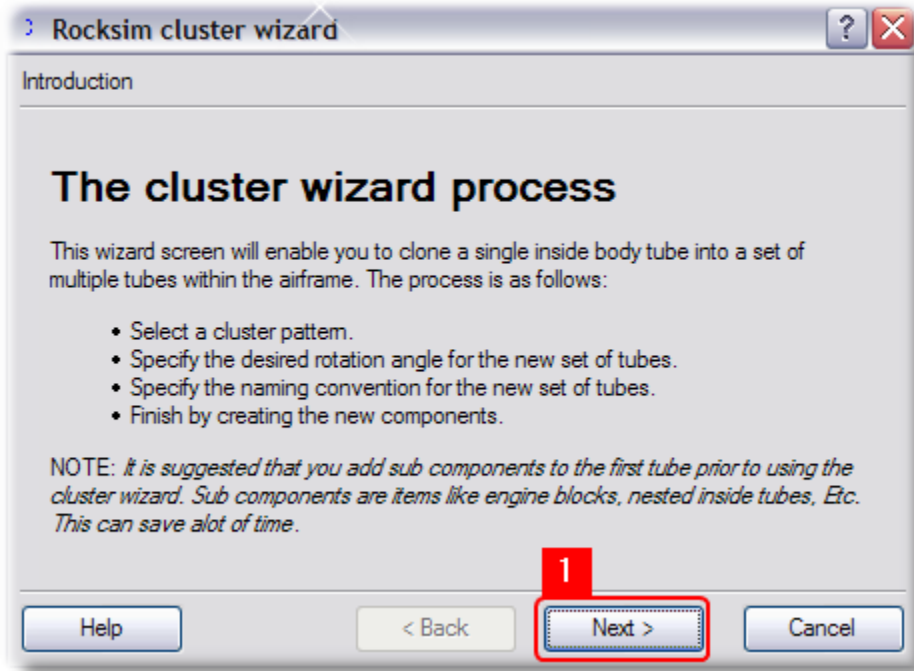
[Next: Choosing a cluster pattern]

Choosing the inside tube to be converted into a cluster pattern, and start the cluster wizard.



- 1 Click on the motor mount tube that is to be converted to a cluster of tubes.
- 2 Click the Cluster... button.

The Cluster Wizard screen is displayed.



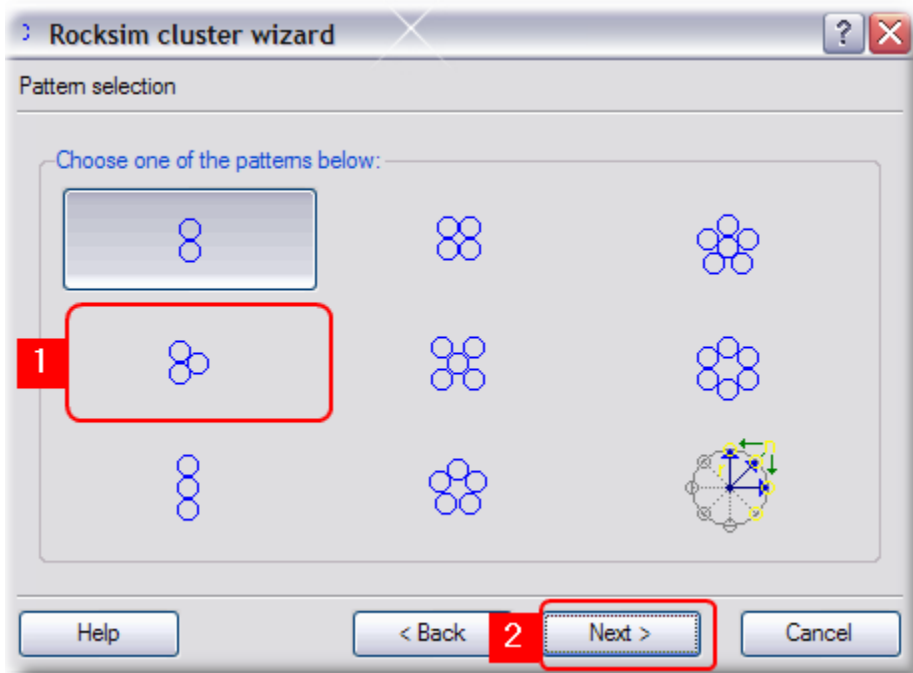
1 Click the Next > button.

[Next: Choosing a cluster pattern]

8.3.2.2 Choosing a cluster pattern.

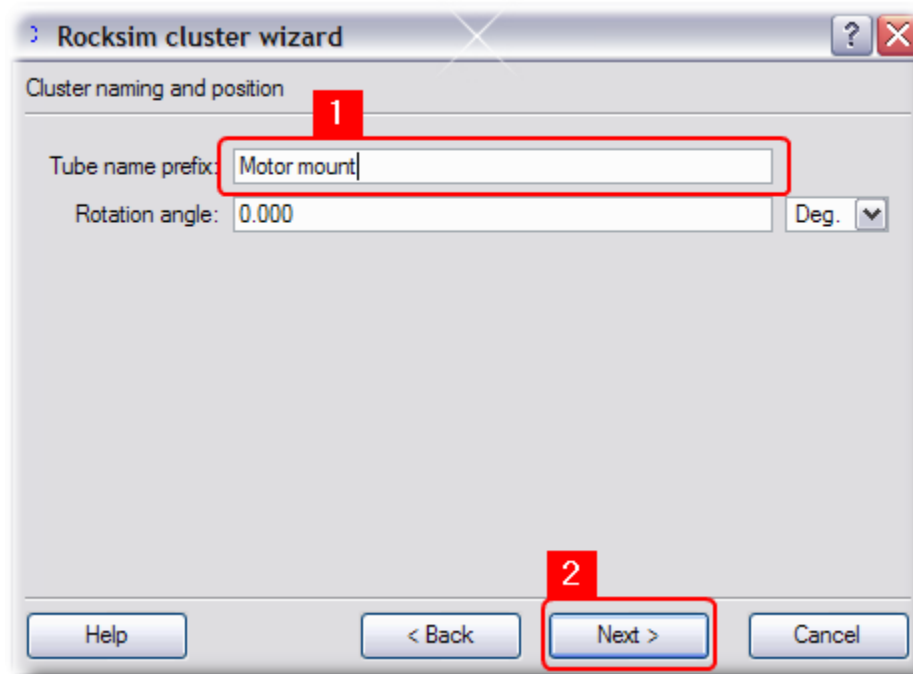
[Previous: Choosing a cluster pattern] - [Next: Create the cluster pattern]

Select the desired tube pattern.



- 1 Click a pattern button.
- 2 Click the Next > button.

Choose a name prefix for the new motor mount tubes.



1 Enter a name prefix for the new motor mounts.

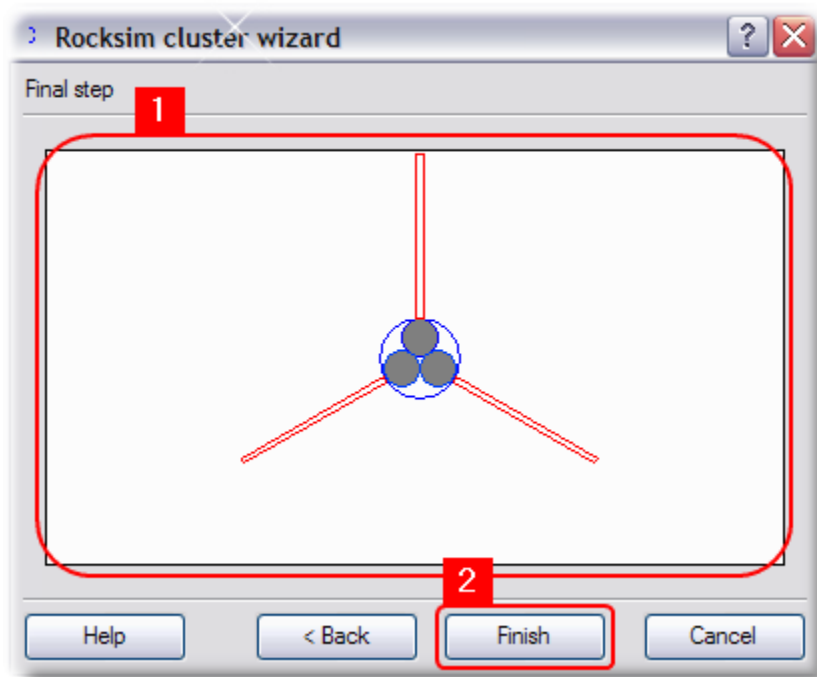
2 Click the Next > button

[Previous: Choosing a cluster pattern] - [Next: Create the cluster pattern]

8.3.2.3 Create the cluster pattern

[Previous: Choosing a cluster pattern]

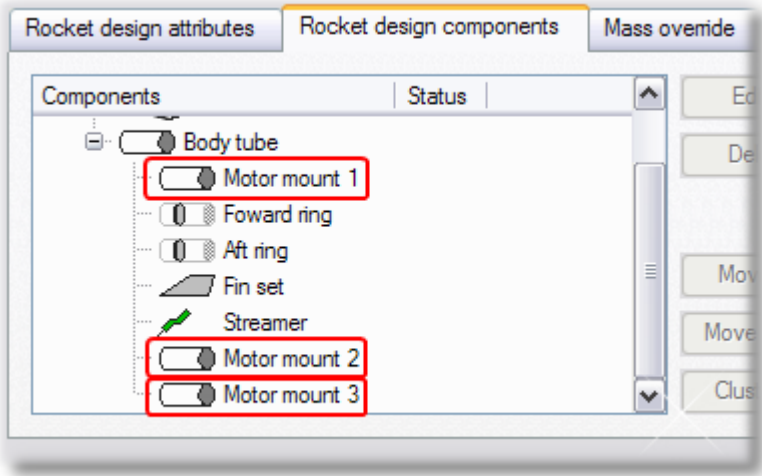
Verify pattern and placement of the new inside tubes, and create the components.



1 Verify the placement of the cluster pattern.

2 Click the Finish button to create the new tubes.

The new motor mount tubes are inserted into your design.



[Previous: Choosing a cluster pattern]

Top Level Intro

This page is printed before a new top-level chapter starts

Part



9 Appendices

9.1 Supported platforms

RockSim 8.0 has been redesigned to run on multiple operating systems. For the most part, the behavior of the RockSim programs is identical on all platforms. There are, however, a handful of exceptions to this rule. These exceptions are noted in this guide.

Currently supported platforms:

Microsoft Windows XP, 2000, NT 4, Me/98
Mac OS X Panther or later.

Future platforms: (Dependent on resources and customer requests)

Linux, Solaris, HP-UX, IRIX, AIX
embedded Linux

9.2 Simulation data

There are several data points that are tracked for each time slice of a simulation. The list below gives a brief description of the data points. Formulas are given for each of the data points where space permits.

Coordinate conventions:

+x == To the right.

-x == To the left.

+y == Up.

-y == Down.

Thrust is the magnitude of the total engine thrust in newtons.

x Thrust is the horizontal component of the thrust vector in newtons

$$T_x = \sum T_{\text{engine}}$$

y Thrust is the vertical component of the thrust vector in newtons.

$$T_y = \sum T_{\text{engine}}$$

Drag is the magnitude of the drag force on the rocket in newtons.

x Drag is the horizontal component of the drag force on the rocket in newtons.

$$D_x = \frac{1}{2} \rho V_x^2 A_{\text{ref}} C_d$$

y Drag is the vertical component of the drag force on the rocket in newtons.

$$D_y = \frac{1}{2} \rho V_y^2 A_{\text{ref}} C_d$$

Acceleration is the magnitude of the rocket's acceleration.

x Acceleration is the horizontal component of the rocket's acceleration.

$$A_x = (T_x + D_x) / M$$

y Acceleration is the vertical component of the rocket's acceleration.

$$A_y = (T_y + D_y) / M - g$$

Velocity is the magnitude of the rocket's velocity.

x Velocity is the horizontal component of the rocket's velocity.

$$V_x = A_x \Delta \tau$$

y Velocity is the vertical component of the rocket's velocity.

$$V_y = V_y + A_y \Delta\tau$$

Altitude is the altitude above ground level.

$$Alt = Alt + V_y \Delta\tau$$

Mass is the current mass of the rocket.

$$M = M_{rocket} + \sum M_{engine}$$

Range is the horizontal distance of the rocket from the launch pad.

$$R = R + V_x \Delta\tau$$

Flight angle is the rocket's relative angle to the horizontal plane in degrees. A flight angle of zero degrees is horizontal flight along the +X axis.

$$\theta = PR \Delta\tau$$

Wind angle of attack is the wind induced angle of attack in degrees. This is the difference between the current flight path and the relative wind path.

Cd is the drag coefficient of the rocket. This value can either be calculated for each time slice or hard wired to a fixed value.

CG is the location of the rocket's center of mass/gravity relative to the tip of the nose cone. This value changes as engine propellant burns off, and when the rocket changes stage configurations.

CP is the location of the rocket's center of pressure relative to the tip of the nose cone.

Angular acceleration is the rocket's pitch rotation rate in radians/sec/sec.

$$AA = (\Gamma / I_L) - CDF$$

CDF is the "corrective damping effect".

$$CDF = (C_2 * PR) / I_L$$

Corrective moment coefficient

$$C_1 = \frac{1}{2} \rho V_2 A_{ref} C_{N\alpha} (X_{N\alpha} - CG)$$

Damping moment coefficient

$$C_2 = (\frac{1}{2} \rho V_2 A_{ref} \sum (C_{N\alpha part} (X_{N\alpha part} - CG)^2)) + C_{jet}$$

Where:

$C_{N\alpha part}$ == the Normal force coefficient of an airframe component. (Nose, Fin, Transition, ...).

$X_{N\alpha part}$ == the Location of an airframe component CP.

C_{jet} == the jet damping coefficient. This is currently approximated as (propellant mass / burn time).

Longitudinal moment of inertia

$$I_L = \sum I_{L,part}$$

This is the moment of inertia for the rocket calculated using a reference axis passing through the rocket's current CG, and perpendicular to the rocket's longitudinal axis.

Radial moment of inertia

$$I_R = \sum I_{R,part}$$

This is the moment of inertia for the rocket calculated using the rocket's longitudinal axis as the reference axis.

Nat. Freq. at zero roll rate

Defined as: $\sqrt{C1 / I_L}$;

Damping Ratio

Define as: $C2 / (2 \sqrt{C1 I_L})$

Prec. Freq.

Defined as: $(I_R W2) / I_L$

Nat. Coupled Freq.

Defined as: $\sqrt{C1 / (I_L + I_R)}$

Coupled Damping Ratio

Defined as: $C2 / (2 \sqrt{C1 * (I_L + I_R)})$

Torque

$\Gamma = Nf (X_{N\alpha} - CG)$

Pitch rate

$PR = PR + (AA \Delta\tau)$

Pitch force

This is the rotational force applied to the rocket.

$Nf = \frac{1}{2} \rho V_{X2} A_{ref} C_{N\alpha} \alpha$

Cross wind drag

This is the drag force created by a cross wind blowing across the rocket's airframe.

Cross wind lift

This is the small lift force created by a cross wind acting on the rocket's airframe. (*The simulator currently ignores this factor.*)

Some terms used in the above descriptions:

α == the angle of attack

$\Delta\tau$ == delta time == $1 / (\text{simulation samples per second})$

g == the acceleration due to gravity

ρ == the air density (kg/m^3)

A_{ref} == the cross sectional area of the rocket

V == the velocity of the rocket

$C_{N\alpha}$ == the normal force coefficient of the rocket. (Output from the Barrowman equations.)

$X_{N\alpha}$ == the location of the rocket's CP (Center of aerodynamic pressure)

CG == the location of the rocket's CG. (Center of mass)

$C1$ == the corrective moment coefficient

$C2$ == the damping moment coefficient

I_L == the longitudinal moment of inertia

I_R == the radial moment of inertia

Also of interest:

Graph data selection screen.

Simulation export screen.

9.3 Simulation atmosphere model

RockSim uses the 1976 U.S. Standard Atmosphere model.

The calculations at standard conditions have been validated against published tables.

Corrections have been added to account for the following parameters:

Launch conditions:

Altitude relative to sea level.

Temperature.

Atmospheric pressure.

Humidity.

Limitations on the 1976 standard atmosphere:

The maximum simulation altitude is

86,000 meters

or

282,152 feet

9.4 Nose cone and transition mathematics

The various nose cone and transition shapes supported by this software are based on mathematical formulas.

These formulas are presented here in a form that yields a radius based on a specified offset from the front of the component.

y == The radius.

x == The offset from the front of the component.

R == the component base radius.

D == the component base diameter.

L == the component length.

K == the shape control parameter.

$\text{sqrt}(z)$ == The square root of z .

Typical formula: $y = f(x)$

Conical

$$y = x (R / L)$$

Ogive

$$a = (D / 4) + (L^2 / D)$$

$$b = (D / 2) - a$$

$$d = \text{sqrt} (a^2 - (L - x)^2)$$

$$y = d + b$$

Parabolic

$$a = R / \text{sqrt}(L)$$

$$y = a \text{sqrt}(x)$$

Elliptical

The elliptical shape is actually a Prolate Hemi-Spheroid.

$$y = R \sqrt{1 - ((L - x)^2 / (L^2))}$$

Power series

$$y = R ((x / L)^K)$$

For a cone: Set $K = 0$

For a $1/2$ Power Nose: Set $K = 1/2$.

For a $3/4$ Power Nose: Set $K = 3/4$.

Parabolic series

$$X_n = x / L$$

$$y = R ((2 X_n) - (K X_n^2)) / (2 - K);$$

For a $1/2$ Power Parabolic Nose: Set $K = 1/2$.

For a $3/4$ Power Parabolic Nose: Set $K = 3/4$.

For a Parabolic Nose: Set $K = 1$. (This creates a circular arc.)

Sears-Haack

$$X_n = x / L$$

$$X_i = \arccos(1 - (2 X_n))$$

$$y = R (1 / \sqrt{\pi}) * \sqrt{X_i - (1/2 \sin(2 X_i)) + (K * \sin^3 X_i)};$$

For a Von-Karman Nose: Set $K = 1$.

9.5 Static stability calculations

The RockSim program can be configured to use a proprietary method of static CP determination. This method is an extension of the Barrowman equations that enables RockSim to estimate the static CP location for rocket configurations that are not supported by the traditional Barrowman equations.

The extensions to the Barrowman equations are summarized below.

* KBT / KB(F) interference factor is included in the fin calculations.

This is the correction factor for the body in the presence of the fins. Barrowman chose to leave this out of his original formulas in order to keep the equations simpler.

* Non-trapezoidal fin plans are correctly handled.

* Fins with root edges fully or partially attached to transition sections are correctly handled.

* Symmetrical fin sets with any number of fins are supported. The Barrowman equations only support symmetrical fin sets with 3, 4, or 6 fins.

RockSim supports any number of fins between 1 and 8 per set.

* Fins can be positioned radially around the airframe at any angle. The Barrowman equations require that all symmetrical fin sets have their first fin aligned at the same angle around the airframe.

Additional details of this stability calculation method are contained in an R&D report available from Apogee components.

9.6 References

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9.7 Command line operation

RockSim can also run without it's traditional graphical user interface. A separate program called rocksimc is installed in the RockSim/Program folder.

Using RockSim on the command line:

```
rocksimc file_specification switches
```

Where:

file_specification is either the name of a single RockSim design file, or a search specification for multiple files.

switches are:

-simulations

-s

This parameter will rerun all of the simulations stored in the design files, and then save the results.

-conversion convert_to

-c convert_to

This parameter will convert each of the design files into the file types specified by the *convert_to* parameter.

convert_to is a '|' separated list or conversion targets.

Available conversion targets are:

AeroCFD or A - RockSim designs are saved as AeroCFD data files. The naming convention is RockSimName.txt.

Examples:

Rerun all of the simulations in a specific file:

```
rocksim.exe agm-65b.rkt -s
```

Rerun all of the simulations in all files:

```
rocksim.exe C:\RockSim\Designs\*.rkt -s
```

SOME PLATFORM SPECIFIC NOTES:

Windows (95, 98, 98SE, ME, NT, 2000, XP):

In console mode, RockSim displays it's results in a separate console window.

If you are running RockSim in a shell script (Like Cygnus Bash), or in a DOS Batch file, you should run it using the following command:

```
start /WAIT rocksim.exe file_specification switches
```

9.8 File formats

9.8.1 RockSim XML format

A RockSim design file stores you rocket design information as well as simulation results. Beginning with version 5.03 of RockSim, these design files are stored in XML format.

RockSim 8.0 cannot read design files created in the old binary format. This is due to the fact that the program is no longer built with proprietary Microsoft libraries.

There is a file called **RockSim_Xml_Doc.txt** installed in the RockSim folder at install time. This file is generated by a Perl script at the time RockSim is built. It contains a complete list of all the possible elements in every RockSim XML file.

The general structure of a RockSim XML file is as follows:

```
<RockSimDocument>
<FileVersion>1</FileVersion>
<DesignInformation>
<RocketDesign>
... The rocket design data is here ...
<Stage3Parts>
... Sustainer components are here ...
</Stage3Parts>
<Stage2Parts>
... Booster components are here ...
</Stage2Parts>
<Stage1Parts>
... Booster components are here ...
</Stage1Parts>
</RocketDesign>
</DesignInformation>
<SimulationResultsList>
<SimulationResults>
... Simulation results for simulation #1 are here ...
</SimulationResults>
<SimulationResults>
... Simulation results for simulation #2 are here ...
</SimulationResults>
</SimulationResultsList>
</RockSimDocument>
```

9.8.2 General description of the database files

The RockSim database files all share the same general format. This format is described below.

- * All of the database files are comma delimited ASCII files.
- * The line terminator is <CR><LF> (CR == 0x0D , LF = 0x0A)
- * There is one record per line.
- * The first line in each file is a header record.

Component database files:

The first four columns of all the component database files are the same.

Column 0 == Manufacturer name.
 Column 1 == Manufacturer part number.
 Column 2 == Description of the component.
 Column 3 == <units>

Where:

<units> == <inches>|<feet>|<millimeters>|<centimeters>|<meters>
 <inches> == in | in. | us
 <feet> == ft | ft.
 <millimeters> == mm | metric
 <centimeters> == cm
 <meters> == m

Materials database files:

T.B.D.

9.8.3 Nose cone database file

Column 4 == The nose cone length in <units>
 Column 5 == The nose cone base diameter in <units>
 Column 6 == The shape control parameter - unitless
 Column 7 == The length of the nose cone shoulder in <units>
 Column 8 == The OD of the nose cone shoulder in <units>
 Column 9 == The thickness of the nose cone wall in <units> (Applies to hollow nose cones)
 Column 10 == The <shape> of the nose cone. (See below).
 Column 11 == The <configuration> of the nose cone (See below).
 Column 12 == The nose cone material.
 Column 13 == The nose cone center of gravity (This is the mass override value) in <units>, as measured from the tip of the nose cone.
 Column 14 == <mass units>
 Column 15 == The nose cone mass in <mass units> (This is the mass override value).
 Column 16 == The nose cone base extension length in <units>

Where:

<shape> == <ogive>|<cone>|<parabola>|<ellipse>|<power series>|<parabolic series>|<sears-haack series>
 <ogive> == o | ogive
 <cone> == c | cone
 <parabola> == p | parabolic
 <ellipse> == e | elliptical
 <power series> == ps | power-series
 <parabolic series> == pbs | parabolic-series
 <sears-haack series> == sh | sears-haack

<configuration> == <solid> | <hollow>
 <solid> == s | solid
 <hollow> == h | hollow

<mass units> == <ounces> | <grams>
 <ounces> == oz | oz. | us
 <grams> == g | metric

9.8.4 Transition database file

Column 4 == The length of the forward shoulder in <units>.
 Column 5 == The OD of the forward shoulder in <units>.
 Column 6 == The forward diameter of the transition in <units>.
 Column 7 == The length of the transition in <units>.
 Column 8 == The rear diameter of the transition in <units>.
 Column 9 == The core diameter in <units>. This is the diameter of a hole drilled through the length of the transition.
 Column 10 == The length of the rear shoulder in <units>.
 Column 11 == The OD of the rear shoulder in <units>.
 Column 12 == The wall thickness for hollow transitions in <units>.
 Column 13 == The construction <type>.
 Column 14 == The transition material.
 Column 15 == The transition center of gravity (This is the mass override value) in <units>, as measured from the front of the transition.
 Column 16 == <mass units>
 Column 17 == The transition mass in <mass units> (This is the mass override value).
 Column 18 == The <shape> of the transition. (See below).
 Column 19 == The shape control parameter. unitless

Where:

<shape> == <ogive>|<cone>|<parabola>|<ellipse>|<power series>|<parabolic series>|<sears-haack series>
 <ogive> == o | ogive
 <cone> == c | cone
 <parabola> == p | parabolic
 <ellipse> == e | elliptical
 <power series> == ps | power-series
 <parabolic series> == pbs | parabolic-series
 <sears-haack series> == sh | sears-haack

<type> == <solid> | <hollow>
 <solid> == s | solid
 <hollow> == h | hollow

<mass units> == <ounces> | <grams>
 <ounces> == oz | oz. | us
 <grams> == g | metric

9.8.5 Simple fin set

Column 4 == CR (Root cord) in <units>.
 Column 5 == CT (Tip cord) in <units>.
 Column 6 == S (Semi-span) in <units>.
 Column 7 == XR (Sweep angle, or distance. See column 12)
 Column 8 == Thickness in <units>.
 Column 9 == <shape type> (See below)
 Column 10 == <tip shape> (See below)
 Column 11 == The fin material.
 Column 12 == <sweep mode>

Where:

<shape type> == <trapezoidal> | <elliptical>

<trapezoidal> == t | trapezoid
 <elliptical> == e | elliptical

 <tip shape> == <square> | <rounded> | <airfoil>
 <square> == s | square
 <rounded> == r | rounded
 <airfoil> == a | airfoil

 <sweep mode> == <angle> | <distance>
 <angle> == 0
 <distance> == 1

9.8.6 Free form fin set

Column 4 == CR (Root cord) in <units>.
 Column 5 == CT (Tip cord) in <units>.
 Column 6 == S (Semi-span) in <units>.
 Column 7 == XR (Sweep angle, or distance. See column 12)
 Column 8 == Thickness in <units>.
 Column 9 == reserved s/b blank.
 Column 10 == <tip shape> (See below)
 Column 11 == The fin set material.
 Column 12 == The number of vertex points which follow.
 Column 13 == <vertex 1>
 Column 14 == <vertex 2>
 .
 .
 .
 Column 140 == <vertex 128>

Note 1: Columns 4 though 7 are optional, and can be set to zero. They are in place for backward compatibility.

Note 2: There are a maximum of 128 vertex points supported. These points do not include the data points required to fit the root edge of the fin along curved sections of the airframe.

Where:

<tip shape> == <square> | <rounded> | <airfoil>
 <square> == s | square
 <rounded> == r | rounded
 <airfoil> == a | airfoil

Note: The '|' in the <vertex list>

<vertex> == <x>|<y>
 <x> == An x-axis location in <units>. The x-axis is along the rocket airframe.
 <y> == A y-axis location in <units>. The y-axis is perpendicular to the rocket airframe.

x=0 , y=0 is defined as the leading / forward most point of the fin root cord.

The first point is always located at the trailing edge of the root cord.
 The points are specified in a counter clockwise direction until the leading edge of the root cord is reached.

Example:

A one inch, air foiled, square fin. Made from 1/8" basswood.
There are four vertex points required.

DIY, NoPartNo, NoPartDesc, in., 0, 0, 0, 0, 0.125, airfoil, basswood, 4, 1|0, 1|1, 0|1, 0|0

Index

- 2 -

- 2D
 - Color selection 56
- 2D drawing
 - Color selection 28
 - Pen style 28
 - Scale type 28

- 3 -

- 3D
 - Color and surface specifications 56
- 3D drawing
 - Resolution 30
 - Variable resolution parts 30
- 3D View
 - camera controller 19
 - joystick vs. trackball mode 17
 - mouse interface 19
 - movement style 17
 - normal vs. red/blue mode 17
 - solid vs. wireframe 17

- A -

- Angle
 - Location of parts around the circumference of the airframe. 35
- Atmosphere
 - launch conditions 70
 - model 137
 - simulation altitude limit 137

- B -

- Batch mode
 - Parameters 140
- Body tube
 - Specifications 37
- Bulkhead
 - Specifications 46

- C -

- Cd
 - Analysis screen 63
 - Constant values or automated prediction 7
- Centering ring
 - Specifications 47
- Clipboard
 - paste components 8
- Clusters
 - Cluster wizard button 8
 - Cluster wizard screen 55
- Color
 - 2D Component 56
 - 3D Component 56
 - Component selection 56
- Command line
 - Parameters 140
- Component
 - textures 58
- Components
 - Body tube 37
 - Bulkhead 46
 - Centering ring 47
 - delete 8
 - Engine block 50
 - Free form fins 42
 - Inside tube 38
 - Launch lug 51
 - Mass object 54
 - Nose cone 36
 - Parachute 53
 - Ring tail 46
 - Simple fin 41
 - Sleeve 48
 - Streamer 52
 - Sub assembly 51
 - Transition 39
 - Tube coupler 49
 - Tube fins 46

- D -

- Database
 - materials maintenance 90
 - saving a component 62

Database files

- Free form fin set (CFDATA.CSV) 144
- general description 141
- Nose cone (NCDATA.CSV) 142
- Simple fin set (FSDATA.CSV) 143
- Transition (TRDATA.CSV) 143

Design

- Cd override 9
- Cluster wizard screen 55
- common component edit features 34
- default construction and finish 35
- Design 8
- Drag analysis screen 63
- mass override 9
- or delete components 8
- Setting default units 27

Dimensions

- Units 27

Drag coefficient

- Analysis screen 63

Drag/Drop

- moving components 8

Drawing

- 2D display settings 28
- 3D display settings 30

- E -

Editors

- Common features 34
- Component 34
- Editors 34

Engine block

- Specifications 50

Export

- 3D model 12

- F -

File formats

- XML 141

Flight profile

- 2D screen 79

Formulas

- Atmosphere 137
- Nose cone 137
- Simulation data 134

Transition 137

Free form fins

- drawing preferences 45
- drawing screen 44
- editor 44
- Specifications 42

- G -

Graph

- selection screen 78
- Stability analysis 63

- H -

Humidity

- launch conditions 70

- I -

Inside tube

- Specifications 38

- L -

Launch guide

- angle 70
- launch angle 70
- launch guide position 70

Launch lug

- Specifications 51

- M -

Main menu

- Edit 12
- Export 12
- File 11
- Help 14
- Rocket 13
- Simulation 13
- View 12

Mass object

- Specifications 54

Motor mount

- creation 37, 38

- N -

Nose cone
 Formulas 137
 Specifications 36

- O -

Opacity
 Setting 3D component opacity 56
Optimal mass
 screen 86
Overview 4

- P -

Parachute
 Specifications 53
Plot
 selection screen 78
 Stability analysis 63
Printing
 option screen 94

- R -

Ring tail
 Specifications 46
Rocket designer
 Setting 7
Rocket name
 Setting 7

- S -

Settings
 2D drawing 28
 3D rendering 30
 Default units 27
 Menu option 12
 Overview 24
 Simulation 25
Simple fin
 Specifications 41
Simulation

Graph selection screen 78
Accuracy 25
Air start delays 67
 atmospheric model 137
Barometric pressure 70
Competition settings 72
Data description 134
Ejection delays 67
End at apogee 70
End at landing 70
End at recovery device deployment 70
End point selection 70
Engine choices 73
Engine selection list 73
exporting data 87
Humidity 70
Ignition delays 67
Integration type 25
Launch conditions 70
Launch guide angle 70
Loading engines 67
Overview 66
Parachute deployment 69
Preparation 66
Recovery device deployment 69
Resolution 25
Results summary screen 10
Starting altitude 70
Streamer deployment 69
Summary display columns 25
Temperature 70
Wind speed 70
Simulation data
 Exporting 12
Sleeve
 Specifications 48
Stage count
 Setting 7
Static stability
 or Cardboard cutout 7
Streamer
 Specifications 52
Sub assembly
 Specifications 51
Supported platforms 134
Surfaces
 3D Component 56
 3D Rendering 56

- T -

Temperature
 launch conditions 70

Texture
 3D 58

Thermals
 Competition settings 70
 Thermals 70

Transition
 Formulas 137
 specifications 39

Tube clusters
 Wizard screen 55

Tube coupler
 Specifications 49

Tube fins
 Specifications 46

Tutorial
 Adding a new engine 103
 Adding multiple engines 104
 creating a new simulation. 101
 Creating a rocket design 107
 Editing an existing simulation 101
 Starting a 2D flight profile 105
 Tube clusters 126

Tutorials
 Simulation 100

- U -

Units
 Changing default display units 27

- V -

View screen
 2D Side view 16
 3D 17

- W -

Wind
 Angle plot 63
 launch conditions 70

- X -

XML
 File format 141

Endnotes 2... (after index)

Back Cover