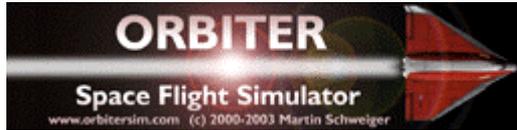
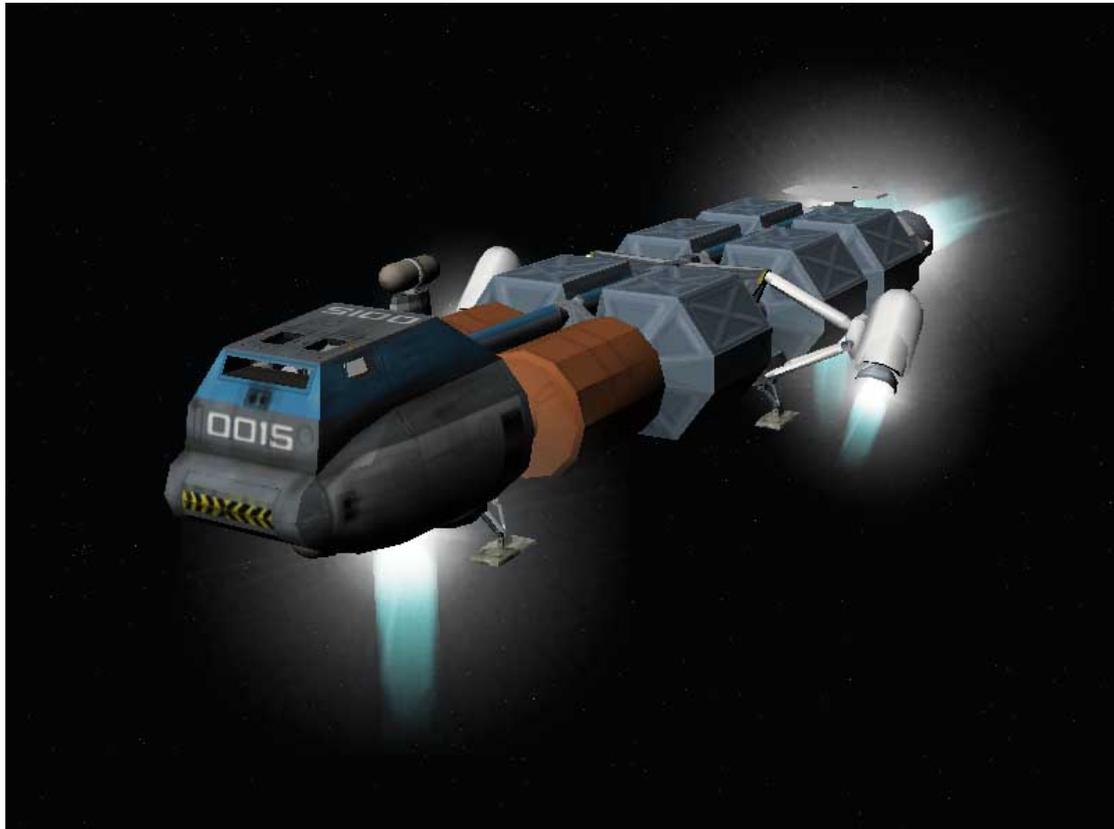


Shuttle-A Technical Manual



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www.medphys.ucl.ac.uk/~martins/orbit/orbit.html

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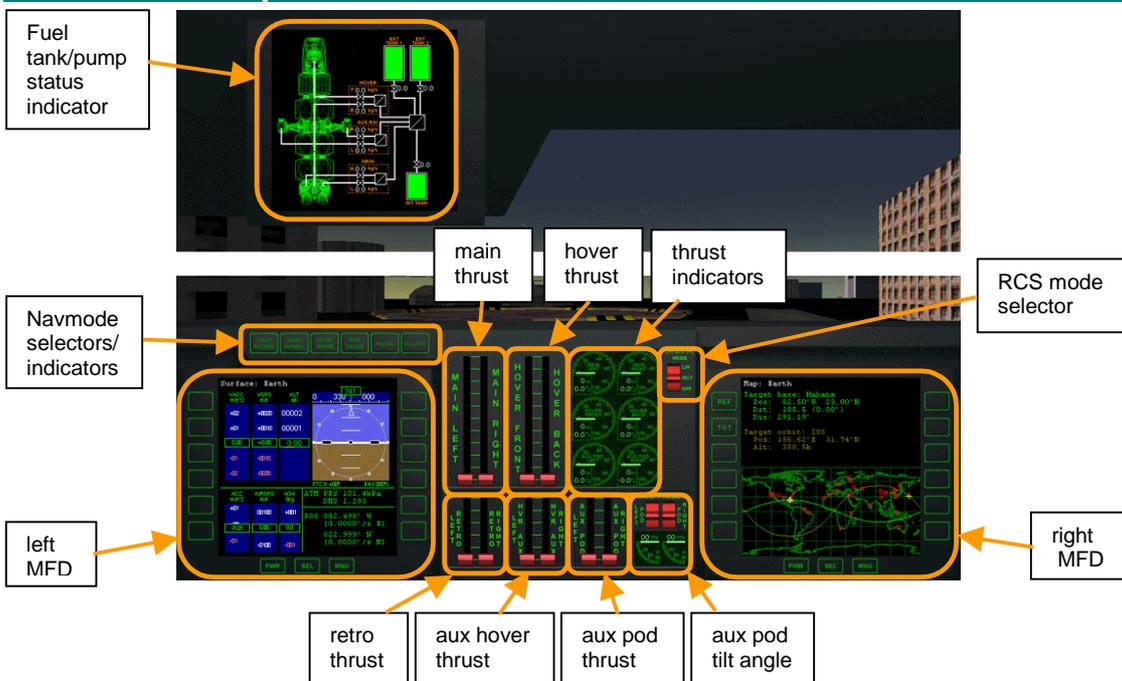
1 Introduction

The Shuttle-A is a cargo vessel designed for a low gravity/low pressure operational environment. Its primary area of deployment is for transport duty between LEO (low Earth Orbit), the Moon, Mars, and potentially moons in the outer solar system. In its current configuration it is also capable of achieving orbit from Earth's surface, but this requires a precise ascent profile.

The engine layout consists of a set of two main engines, two hover engines, and two engines in central side pods which can be rotated for hover or retro duty. There are two different propellant systems for main and RCS engines.

The Shuttle-A contains a docking port and airlock below the habitat module which is protected by a hatch during atmospheric flight.

2 Instrument panels



2.1 Main panel

The main panel provides access to the manual engine controls on the middle console, and two multifunctional displays (MFD) on the left and right.

Main, hover and auxiliary thrusters can be operated individually, by engaging the throttle controls separately, or in pairs, by clicking and dragging between throttle sliders.

The thrust levels for the 6 principal engines are shown via the gauges on the middle console.

The RCS operation mode (linear, rotational, disengaged) can be selected by the switch on the top right of the middle console.

Navmode selectors/indicators are located above the left MFD.

Auxiliary engine controls

The controls at the bottom of the middle console operate the auxiliary engines located in two side pods in the central section of the vessel. They can be used for providing a mixture of retro and hover thrust.

The left pair of sliders controls retro thrust, the slider pair to the right of it controls hover thrust. If only retro thrust is requested, the pods rotate into horizontal position. If only hover thrust is

requested, the pods rotate into vertical position. If a mixture of both is requested, the pods rotate into an intermediate position.

WARNING: Due to the engine design, it is not possible to provide full retro and full hover thrust simultaneously. If the pilot increases hover so far that the total thrust request exceeds 100%, the retro component is automatically reduced accordingly, and vice versa.

Instead of mixing hover and retro levels, the auxiliary engines can also be operated in direct mode. The slider pair to the right of the aux. hover controls operate the thruster levels directly. The pair of switches to the right can be used to manually select a tilt angle for the thruster pods. The current tilt angle is indicated by two gauges.

2.2 Overhead panel

Located on the left of the overhead panel is the propellant status indicator. It contains readouts for current tank fill status, and mass flow rates for the main fuel pumps.

The panel also contains switches and indicators to operate the docking hatch and airlocks. (Note: The inner airlock is not yet operational in this release)

3 Vessel-specific keyboard functions

In addition to the generic keyboard functions, Shuttle-A class vessels respond to the following keyboard commands:

	Operate docking hatch mechanism
	Open/close outer airlock door

4 Technical specifications

4.3 Engine specifications

Main engines (2)

Thrust rating: 193.52 kN per engine

Isp: $3 \cdot 10^4$ m/s

Hover engines (2)

Thrust rating: 135.45 kN per engine

Isp: $3 \cdot 10^4$ m/s

Auxiliary retro/hover engines (2)

Thrust rating: 60.0 kN per engine

Isp: $3 \cdot 10^4$ m/s

Engines are located in pods which can be rotated for retro/hover thrust.

Reaction Control System

Thrusters located in crew module, main engine module and side pods.

Linear modes: 5 kN thrust for each translation axis

Rotational modes, torque:

Pitch: 75 kNm

Bank: 30 kNm

Yaw: 75 kNm

Isp: $3 \cdot 10^4$ m/s

4.4 Propellant resources

Two external tanks in the forward cargo holds (capacity: $6.4 \cdot 10^3$ kg each) and one internal tanks in the aft module (capacity: $3.2 \cdot 10^3$ kg) provide fuel for the main, hover and auxiliary engines.

A separate tank in the central module (capacity: 700 kg) provides fuel for the Reaction Control System.

4.5 Docking port

The docking port is located in the front module. During flight it is covered by two panels, which can be folded back to expose the docking mechanism.

Docking port reference position:

0, 0, 18.32 (aligned with longitudinal vessel axis)

Docking approach direction:

0, 0, 1 (forward)

4.6 Physical parameters

Empty mass: $22 \cdot 10^3$ kg

Length: 35.0 m

Height: 6.98 m

Width: 15.4 m

Cross sections: 132.2 m^2 , 237.9 m^2 , 42.4 m^2

Principal moments of inertia (PMI), mass-normalised:

86.6 m^2 , 89.8 m^2 , 5.5 m^2

Atmospheric resistance coefficients (c_w):

0.2 (longitudinal), 1.5 (vertical), 1.5 (transversal)

Rotation drag coefficients:

0.7 (yaw), 0.7 (pitch), 0.3 (bank)

5 Credits

Special thanks to Roger "Frying Tiger" Long for his excellent model of the Shuttle-A.