

# **Minuteman II ICBM**

for Orbiter Space Simulator

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by MajorTom



## Purpose

This document is the manual and guide to MajorTom's Minuteman II ICBM add-on, released in February 2009. It is to be used with Dr. Martin Schweiger's **Orbiter space simulator**. You will need a copy of Orbiter (2006-P1) installed on your PC in order to run this add-on.

Link to Orbiter Space Simulator:  
Link to this Minuteman II add-on:

<http://orbit.medphys.ucl.ac.uk/orbit.html>  
<http://www.orbithangar.com/searchid.php?ID=3797>

## Introduction

Back in the 1980's, when I was a high school student in the USA, my greatest fear (and constant worry) was that the world would come to a shockingly violent end as a result of a nuclear war fought between the USA and the USSR.

A major enabler of this nuclear nightmare was a class of solid-fueled intercontinental ballistic missiles (ICBM) that first appeared in the early 1960's that could be launched at a moment's notice, well before any detected enemy missiles arrived, making a *simultaneous* nuclear exchange probably more likely. By the 1970's there were so many nuclear weapons deployed, that a simultaneous nuclear exchange spelled "**Mutual Assured Destruction**." From these developments, one could easily conclude that the first time an ICBM flew in anger, it would mean the end of the world.

Why do such an add-on? I am of two minds. On one hand, to me it's a bad idea to create and release a realistic "weapon of mass destruction" add-on if all it does is give people nightmares. On the other hand, I've always thought that there is much to be learned by studying the history, facing the cold facts, and not shrinking away from them. After hesitating for several months, I decided to finally release this add on. As you will see, I chose not to simulate the nuclear explosion at the end. Call me chicken if you like, but I decided that simulating death and destruction was going too far.

## The Weapon System

The Minuteman II (which I will abbreviate MMII) is a good example of the instantly-ready weapon system described above. First deployed in 1965, it was retired in 1997. It carried just one warhead. The warhead, once separated from its third stage, would coast in a ballistic trajectory all the way from Canada (where the booster terminates its thrust) to its target in USSR.

### Note:

While the Minuteman II had just one warhead, the Minuteman III had three warheads, contained in multiple independent re-entry vehicles. These MIRVs each had attitude and booster rockets, and were capable of fine-tuning their trajectories and hitting different targets not too far separated from each other. If there is sufficient interest in this Minuteman II I might also do a Minuteman III.

There is at least one other Minuteman II add-on created for Orbiter, by Jim Williams. (See <http://www.orbithangar.com/searchid.php?ID=714>) I downloaded and used his

add-on for a while, and noticed a few features that I could improve. So I set out to make a completely new version of my own. (See the appendix for a list of differences between Jim's Minuteman II and mine.)

The real value with my add-on, as with all historical Orbiter Add-ons, is in learning through the use of a decent simulation. There may be some things here that surprise you. For example, the liftoff is so fast and aggressive, that you experience significant atmospheric heating from dynamic pressure, *on the way up*.

## **Installing the Add On**

- Designed and tested for use with Orbiter 2006-P1.
- Causes no modifications to standard Orbiter files.
- Simply unzip to your Orbiter directory, and run the scenario found in the Minuteman subdirectory.

## **Using the Add On**

I included just one scenario, and the instructions can be seen when you select the scenario from Orbiter. See the "Minuteman" folder within Orbiter's Scenario selection dialog, and click on the "Minuteman II launch from Silo" scenario. Then:

- Press k to open the silo door
- Press F3 and switch focus to the Minuteman II missile.
- Press P to launch the missile automatically.

While later ICBM types had steerable warheads, Minuteman II's guidance was less sophisticated. It was intended to fly North from North America, go over the North Pole, then approach its target on a Southerly heading.

The warhead's East-West aiming was controlled by steering the missile during powered flight toward the correct heading (azimuth) of the target. The North-South aiming was controlled by the velocity of the missile. The faster it went, the further downrange (South) it would go, and vice versa. Just like an artillery shell. Precise North-South aiming was achieved by cutting off the third-stage engine's burn with exact timing. The quenching of the solid-fueled third stage was done by bursting open the "shutdown ports" on the fuel casing, opening it to the vacuum of space. [See ref. below]

## Technical Details

The mesh polygon count is relatively low and should not cause issues even with video hardware from the early 2000's.

This add-on is powered by Vinka's **spacecraft3.dll** (patched), **stage.dll** and **multistage2.dll** modules and their associated cfg files (these are INCLUDED with this add-on). These files, along with detailed documentation, can also be downloaded from Vinka's website, <http://users.swing.be/vinka/>.

## Files and Directories Included with this Add-On

- \Config
  - Stage.cfg
  - \Minuteman
    - MinutemanII.cfg
    - MinutemanII.ini
    - MinutemanII\_Guidance.txt
  - \Spacecraft
    - MMII-silo.ini
    - MMII-Warhead.ini
    - Spacecraft3.cfg
- \Doc
  - MinutemanII.pdf (the file you're reading now)
- \Meshes
  - \Minuteman
    - MMII-S1.msh
    - MMII-S2.msh
    - MMII-S3.msh
    - MMII-silo.msh
    - MMII-WH.msh
- \Modules
  - spacecraft3.dll
  - multistage2.dll
  - Stage.dll
- \Scenarios
  - \Minuteman
    - Minuteman II launch from Silo.scn
- \Sound
  - \Vessel
    - klaxon.wav
- \Textures
  - MinutemanGC.dds
  - MMII.dds

## Credits

- Original meshes, textures and research by MajorTom.
- Thanks to Vinka for his endlessly versatile Multistage2 and Spacecraft3 dll's.
- Thanks to Jim Williams for the original Minuteman II idea.

## References

For the launch vehicle, I had done numerous web searches and compared thrust, masses, ISPs and burn time values for the stages. Much of the data was incomplete and/or incorrect, which I determined by applying the data to the rocket equation. (Note to rocket simulation designers: you can check for data integrity by running all your researched data through the rocket equation. If the calculated ISP is unrealistic, then the data is probably wrong somewhere.)

However, finally I ran across the following document that included not only complete data on all Minuteman stages, but also, tellingly, the data passed the ISP check (see above) with flying colors:

<http://www.nukestrat.com/us/afn/Minuteman.pdf>

More information on the program, and also some of the pictures used for this manual and also to base the textures on, were from this Wikipedia page:

[http://en.wikipedia.org/wiki/LGM-30\\_Minuteman](http://en.wikipedia.org/wiki/LGM-30_Minuteman)

## Appendix

List of Differences between JimW's Minuteman II and this one:

- **Meshes** – I believe mine to be dimensionally accurate (scale and geometry), while Jim's, while looking mostly correct in terms of proportion, seem incorrect in scale.
- **Textures** – Although I could not find a good image of an in-silo MMII, I believe that my texture may be more correct, i.e., no pretty decorations or SAC logos on it. I figure, if nobody is ever going to actually *see* this hardware, why bother with any paint or markings other than the minimum required to service and handle the missile? What would one paint on a real WMD, "Have a nice day?"
- **Scenarios** – Jim's MMII takes off from a default Orbiter pad at Cape Canaveral, then heads toward the USSR. Mine is launched from a hopefully realistic looking concrete silo from somewhere in the Dakotas.
- **Specifications** – This is the greatest difference. I assembled reliable and complete performance data: all the stage masses, solid propellant Isp, thrust levels and burn times. (Please see the references for details.) As I usually find when I succeed in creating a realistic launch vehicle, the better the data, the more realistic the flight in Orbiter. My MMII does its job without my having to resort to any tweaking. However, Jim's performance data contains some dubious values, such as a payload mass of 1 gram, or a stage 3 with a burn time of 18s, thrust of 25 kN, and a fuel mass of ~64 kg (therefore an unrealistically high Isp) Maybe he did not have access to sufficiently detailed data.
- **Payload** – Jim goes ahead and gives his Minuteman II a nuclear bomb warhead, made by Dave Rowbotham. This is OK, as it carries the simulation to its logical extreme. However, for my part, I chose to carry my simulation only as far as getting the warhead down to the surface at approximately the correct terminal speed (~3 km/s) but that's it...my warhead is a dummy and will not explode. Users will probably not like what happens next: the warhead will bounce a few times and skid along the ground at hypersonic velocities. (In other words, Sorry: the realism flies 'out the window' at this point.)