UTILITY FLIGHT MANUAL

X-15A-2

ADD-ON ROCKET AIRCRAFT FOR FLIGHT SIMULATOR

Serial number: AF56-6671
(XLR-99 engine)

ENGLISH VERSION 1.0

Desktop commanders are responsible for bringing this publication to the attention of all flight simulator enthusiasts and X-15 fans cleared for operation of subject add-on rocket aircraft.

Contains full product description and specifications, installation instructions, normal procedures and check list.

Xtreme Prototypes

www.xtremeprototypes.com

X-15 FOR FLIGHT SIMULATOR SERIES

UTILITY FLIGHT MANUAL

X-15A-2

ADD-ON ROCKET AIRCRAFT FOR FLIGHT SIMULATOR

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This manual is to be used only in conjunction with the Xtreme Prototypes X-15A-2 add-on rocket aircraft for Flight Simulator. It has been purchased by the end-user as part of a software package and it is subject to the terms of use specified in the enclosed end-user software license agreement. The end-user is authorized to make or print copies of this manual for his/her own use, in conjunction with the X-15A-2 simulation software.

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Portions of this manual have been inspired or adapted from the original real-world X-15 and X-15A-2 utility flight manuals published during the 1950s and 1960s by the U.S. Air Force and North American Aviation. NASA and AFFTC photos have been used in some sections for comparison and illustration purposes only and are the property of their respective owners as credited. Xtreme Prototypes is not affiliated with NASA, North American Aviation (Boeing), the U.S. Air Force, or any other company, entity or government organization related to the X-15 research program. This product is neither sponsored nor endorsed by NASA.

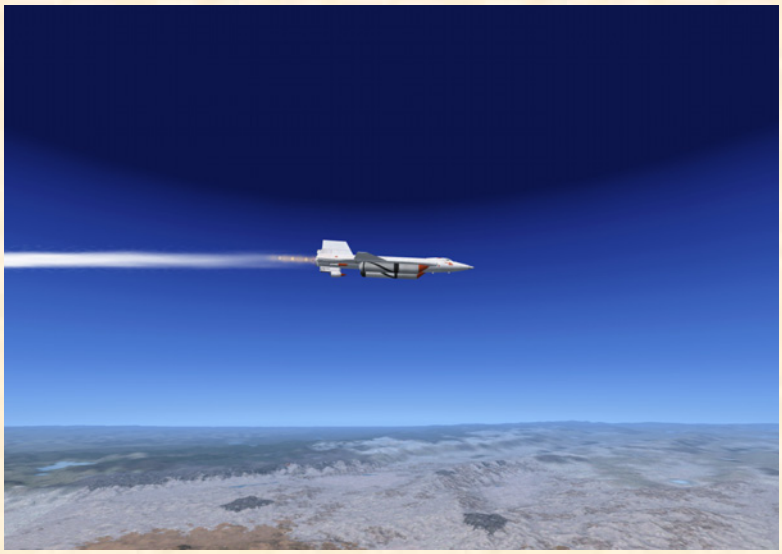
TABLE OF CONTENTS

Foreword

WELCOME TO THE WORLD OF THE X-15 FOR FLIGHT SIMULATOR!

We thank you for purchasing your copy of the Xtreme Prototypes X-15A-2 add-on rocket aircraft for Flight Simulator.

This publication contains the necessary information for the installation and operation of the X-15A-2 virtual aircraft and associated instrument panels. It contains instructions and procedures for XLR-99 rocket engine operation, on the X-15A-2 for Flight Simulator.



High-altitude spot plane view of the Xtreme Prototypes X-15A-2 for Flight Simulator accelerating to Mach 2. (FS2004 screenshot)

For technical and historical accuracy and in an effort to recreate what it was like to prepare and operate the real X-15A-2 rocket plane, portions of this document have been inspired or adapted from the original X-15 and X-15A-2 utility flight manuals. We also wanted to give this manual a look and feel from the 1950s by using presentation templates similar to those found in the original manuals. All images appearing in this document are actual screenshots of the X-15 and X-15A-2 virtual aircraft and panels taken in the Microsoft® Flight Simulator 2004 or Flight Simulator X game environments, except where otherwise noted.

Our goal was to design a series of add-on aircraft and panels that look as realistic as possible and that would allow flight simulation enthusiasts and X-15 fans not only to fly at high altitudes and at several times the speed of sound but also to simulate most aspects of a typical X-15 mission, including nearly every step and procedure required to operate this remarkable and unique aircraft.

This product is a game, and we do not pretend it is one hundred percent historically or technically accurate or that it truly reproduces all the flight characteristics of the real X-15A-2 rocket plane, which would be virtually impossible to achieve in Microsoft® Flight Simulator. But we tried our best to develop a high-quality add-on product that would put the computer pilot virtually in command of one of the most extraordinary flying machines ever designed by man, and have him/her forget for one moment that this is only for fun!

The software and the manual have been designed to evolve with time, according to the feedback we receive from the vast flight simulation community and X-15 fans around the world. Please let us know your comments, ideas and suggestions.

We invite you to visit our web site to get more information about this product and other exciting X-15 add-on products, available fixes and upgrades, and technical support: http://www.xtremeprototypes.com

For those interested in knowing more about the real X-15 research aircraft and program, we have included some interesting Internet links and a selected bibliography at the end of this manual (see appendices 5 and 6).

We hope you will enjoy the X-15 for Flight Simulator experience as much as we enjoyed developing this series of products.

The Development Team at Xtreme Prototypes

Introduction and Product Description

SECTION I

THE REAL-WORLD X-15

The North American X-15 was a single-place rocket-powered experimental aircraft built in the late 1950s and early 1960s for NASA (NACA), the U.S. Air Force and the U.S. Navy to test flight at extremely high speeds and altitudes and to obtain data on the effects of such flight conditions on the aircraft and on the pilot.

The real X-15A-2 in 1965. (NASA photo)

The X-15 was capable of and achieved high speed and altitude records such as Mach 6.7 or 6629 fps (more than twice as fast as a speeding bullet) and 354,200 feet.

Three X-15 rocket planes were built by North American Aviation (NAA) during the X-15 research program, which overall cost more than $300 million. The program succeeded at demonstrating the ability of pilots to fly rocket-propelled aircraft out of the earth's atmosphere and back to precision landing. Today, the X-15 can be considered history's first reusable spacecraft.

After being dropped at a high altitude from a modified B-52 carrier airplane and propelled by its million-horsepower rocket engine at several times the speed of sound, the X-15 would fly to the edge of space, burn all its fuel, perform reentry into the atmosphere and finally glide its way back to land on a dry lake runway in the California desert.

The X-15-1, equipped with the "interim" Reaction Motors XLR-11 rocket engines, was rolled out in October 1958, and was transferred to Edwards Air Force Base for testing. Its first captive flight (while the X-15 is attached to the carrier airplane) occurred in March 1959 followed by its first glide flight in June of the same year. On January 23, 1960, the X-15-1, with NAA test pilot Scott Crossfield, successfully completed its first powered flight attaining Mach 2.53 and 66,844 feet with the XLR-11 rocket engines.

In February 1961, the X-15-1 was returned to North American Aviation for conversion to its design-mission configuration (XLR-99 engine), after completing 21 flights with the XLR-11 engines.

NASA pilot Bill Dana flew the X-15-1 for the last time on October 24, 1968. The No. 1 aircraft completed 81 flights during the entire X-15 program.

X-15-1 for Flight Simulator in her limited-mission configuration. Note the two XLR-11 rocket engines.

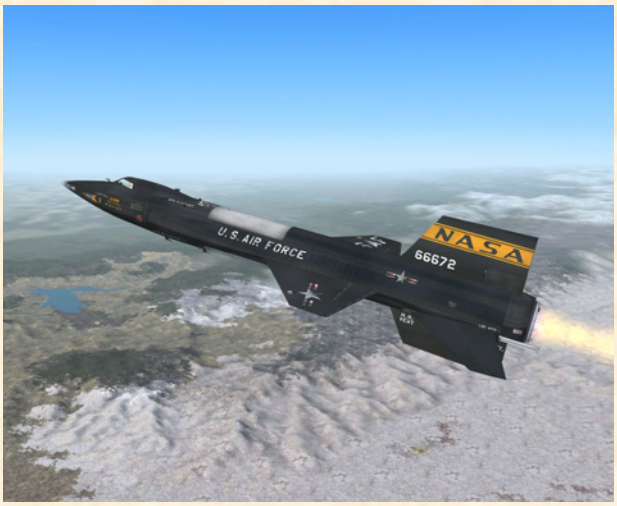
The X-15-2 aircraft arrived at Edwards in April 1959 and made its first powered flight with the XRL-99 engine more than a year later, in November 1960, after completing nine flights with the XLR-11 engines.

In November 1962, the X-15-2 airplane was extensively damaged during an emergency landing, after the flaps refused to operate and the left rear landing skid failed. It was decided to rebuild the airplane as a modified "advanced" version of the X-15, with a longer fuselage and external propellant tanks. The "extended performance" X-15A-2 was rolled out in February 1964.

X-15A-2 for Flight Simulator. Note the external propellant tanks.

In October 1967, Air Force pilot Pete Knight took the X-15A-2 to Mach 6.7 (4520 mph), the fastest manned aircraft flight recorded to this day by a winged vehicle (excluding the Space Shuttle).

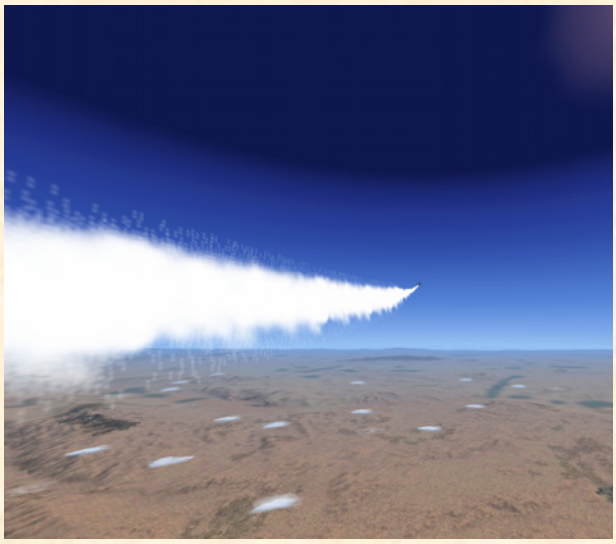
The X-15-3 was delivered to Edwards in June 1959, equipped with the XLR-99 engine. In August 1963, NASA pilot Joe Walker set an altitude record of 354,200 feet in the No. 3 aircraft. Sadly, the X-15-3 was lost in November 1967 after the airplane entered a hypersonic spin, descended in an inverted dive at almost Mach 4 and 65,000 feet and finally broke up, taking the life of Air Force pilot Michael Adams.



X-15-3 for Flight Simulator.

Together, the three aircraft completed 199 flights during a nine-year period, the 200th one being cancelled several times in November and December, 1968. It was the end of the X-15 program.

After almost 40 years, the X-15 still holds impressive speed and altitude records. It was one of the most successful research aircraft tested at Edwards AFB.



X-15-2 for Flight Simulator pulling up for her climb.

Twelve extremely skilled test pilots flew the X-15: Michael Adams (USAF), Neil Armstrong (NASA), Scott Crossfield (NAA), Bill Dana (NASA), Joe Engle (USAF), Pete Knight (USAF), Jack McKay (NASA), Forrest Peterson (USN), Bob Rushworth (USAF), Milt Thompson (NASA), Joe Walker (NASA) and Bob White (USAF).

Today, the X-15-1 hangs from the ceiling in the main gallery of the Smithsonian National Air and Space Museum in Washington, D.C. The X-15A-2 is on display at the National Museum of the United States Air Force (Wright-Patterson Air Force Base, Dayton, Ohio).

You can find many excellent books and publications about the X-15 research program. Pictures and movie clips are also available on a number of web sites. Internet links and a selected bibliography are included in appendices 5 and 6, at the end of this manual.

THE X-15 FOR FLIGHT SIMULATOR SERIES

The X-15 for Flight Simulator series of add-on aircraft brings the excitement of high-speed and high-altitude flight and the challenge of an X-15 research mission to the desktop PC.

X-15A-2 for Flight Simulator. Note the XLR-99 rocket engine and the external fuel tanks. This aircraft also carries a dummy ramjet attached to its lower vertical stabilizer.

It consists of 11 fully detailed versions of the legendary North American X-15 experimental rocket plane, available in three separate add-on packages (see appendix 7):

- **Package A contains:** 4 versions of the X-15-1 airplane (s/n. AF56-6670);
- **Package B contains:** 2 versions of the X-15-2 airplane (s/n. AF56-6671) together with 2 versions of the X-15-3 airplane (s/n. AF56-6672);
- **Package C contains:** 3 versions of the "advanced" X-15A-2 airplane (s/n. AF56-6671).

Each aircraft comes with fully functional instrument panels that allow the desktop pilot not only to fly the airplane, but also to recreate and simulate nearly every step and procedure required in a typical X-15 mission.

Contrary to the real-world X-15 that was launched at a high altitude from a carrier airplane, the X-15 for Flight Simulator can take off from an airport runway like any other Flight Simulator aircraft! The flight model allows the airplane to accelerate up to approximately Mach 4.65 (or the maximum speed supported in Flight Simulator 2004), reach an altitude of 100,000 feet (the actual FS2004 limit), burn most of its fuel, complete its ballistic trajectory, decelerate, jettison its remaining propellants and finally glide its way back to the nearest dry lake runway or airport.

The X-15 for Flight Simulator series of add-on aircraft.

FULLY DETAILED MODELS OF THE REAL-WORLD X-15 ROCKET PLANE

Each add-on aircraft in the series is fully detailed and has been carefully modeled based on available drawings, flight manuals, government photographs, movies and other archive material in order to conform as closely as possible to the real-world X-15.

The images on the left are NASA or AFFTC photographs. The images on the right are actual FS2004 screen captures of the X-15 for Flight Simulator. From top to bottom: X-15-1, X-15-2, X-15-3 and X-15A-2.

The airplanes feature different reflective textures, unique markings, movable control surfaces (horizontal stabilizer, vertical stabilizer/rudder with a "jettisonable" ventral section, flaps and speed brakes), extendable landing skids and front gear, a movable canopy with cockpit details, pilot and animated sticks and levers, an animated eyelid and external propellant tanks on the X-15A-2. Selected airplanes may also carry a tail-cone box with research instruments, wing-tip pods and/or a vane-type boom nose.

Astronaut/pilot in full-pressure suit inside the cockpit of the X-15A-2 for Flight Simulator. Note the ejection seat. The cockpit also features detailed instrument panels and animated sticks and levers.

All aircraft feature more than 20 animated visual effects such as XLR-11 and XLR-99 engine flame and contrail effects, XLR-99 first and second stage igniter effects, APU and engine turbopump exhaust effects, propellant jettison effects, engine precool and prime effects, and a fuselage frost effect/texture (around the liquid oxygen tank when filled).

X-15A-2 for Flight Simulator (rollout version). Note the flames inside the engine nozzle (second stage igniter effect) and the flow of liquid oxygen and ammonia coming out of the rear prime drains.

The No. 1 airplane is available with both the twin Reaction Motors XLR-11 interim four-chambered rocket engines and the mighty 60,000-pound Reaction Motors XLR-99 rocket engine. All other airplanes are equipped with the XLR-99 engine.

X-15A-2 just before launch. Note the flow of ammonia and liquid oxygen coming out from the back of the aircraft during the engine prime phase.

The million-horsepower Reaction Motors XLR-99 engine on the X-15A-2 for Flight Simulator. The XLR-99 was a liquid-fuel turbo-rocket engine of variable-thrust design capable of delivering up to 60,000 pounds of thrust at high altitude.

ADVANCED INSTRUMENT PANELS AND SYSTEMS

Each aircraft in the series comes with different instrument panels, either in their original black version or the later light blue-gray version. Special (X-15-specific) systems have been integrated into each panel to simulate the complex operation of the X-15 rocket plane.

Nearly 300 custom gauges (and systems) have been produced for the X-15 for Flight Simulator series, and each one has been carefully designed and programmed based on the original analog instrument found in the real X-15 aircraft during the 1950s and 1960s.Virtually all gauges, switches, lights and instruments found on each panel are functional and behave like the original ones described in the real-world X-15 flight manuals.

Each add-on aircraft package comes with a comprehensive, illustrated and fully detailed user manual (printable PDF format), inspired and adapted from the original X-15 utility flight manuals. Each manual is available in both English and French.

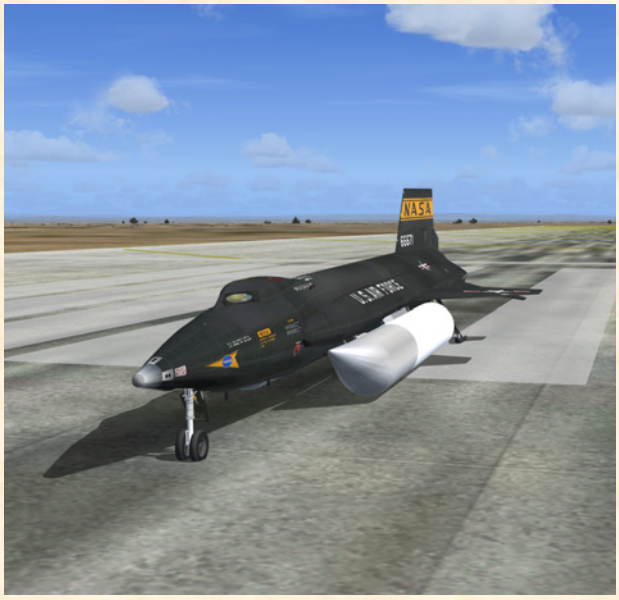
The X-15A-2 instrument panels (XLR-99 engine) feature over 180 animated and fully functional gauges, flight instruments, light indicators and switches.

A closer view of the electrical section on the X-15A-2 main instrument panel. Note the APU and generator switches, the dual-pointer AC bus voltmeter and the emergency battery switch.

Software Installation

SECTION II

The X-15A-2 for Flight Simulator is an **add-on** software package which requires **Microsoft® Flight Simulator 2004 (FS2004)** to be installed on your computer in order to function. Make sure FS2004 has been properly installed according to the instructions provided by the manufacturer before you proceed.



X-15A-2 for Flight Simulator (rollout version).

COMPATIBILITY

The X-15 for Flight Simulator series of add-on rocket aircraft has been designed and optimized for Microsoft® Flight Simulator 2004. The product has not been extensively tested in FS2002 but may work as well.

This software version is compatible with Microsoft® Flight Simulator X but has not been optimized for this platform (refer to the enclosed FSX flight manual supplement for information on the installation and use of the X-15A-2 add-on aircraft in FSX). Check our web site regularly for fixes, patches and upgrades.

As a rule of thumb, if Microsoft® Flight Simulator 2004 runs properly on your computer, you should be able to fly the X-15A-2 for Flight Simulator without problems.

Special visual effects such as rocket engine flames and exhaust contrails might reduce your frame rate on slower processors and video cards. Adjust your Flight Simulator display parameters to correct this problem if necessary.

Consult the documentation included with Microsoft® Flight Simulator 2004 for information about minimum system requirements and how to optimize your display settings.

If you need additional support, please visit our web site: www.xtremeprototypes.com

MINIMUM SYSTEM REQUIREMENTS

Flight Simulator: FS2004, FSX
Windows®: 2000/XP (128 MB RAM)
Processor: 450 MHz
Hard Drive: 1.8 GB
Available Disk Space: 200 MB (space required to install the add-on software)
Video Card: 32 MB (DirectX® 9.0 or later)
Other: Sound card and speakers, joystick, Adobe® Acrobat® Reader 5.0 or later

UTILITY FLIGHT MANUAL AND FSX SUPPLEMENT

Included with the software are the English and French versions of the present **X-15A-2 Utility Flight Manual** (X-15A-2_manual_eng_01.pdf) and **FSX supplement** (X-15A-2_fsx_supplement_eng_01.pdf), both available in a printable PDF format (Adobe® Acrobat® Reader 5.0 or later required).

To download Acrobat® Reader, visit: http://www.acrobat-reader-ib.com

The flight manual contains the necessary information for the installation and operation of the X-15A-2 virtual aircraft and associated instrument panels. It contains instructions and procedures for XLR-99 rocket engine operation, with external propellant tanks, on the X-15A-2 for Flight Simulator.

The end-user is authorized and encouraged to print copies of the manual and of the supplement for his/her own use, in conjunction with the enclosed add-on simulation software. The best way to keep the manual handy for easy reference during flight is to organize it in a durable presentation binder.

PACKAGE DESCRIPTION

The installation disk (or the downloaded package) contains the following:

- A "**read me" file** (readme.txt) that contains the present installation instructions and other important information.
- A copy of the **end-user license agreement** (eula.rtf).
- English and French versions of the present **utility flight manual** and of the **FSX supplement** in a printable PDF format.
- A self-executable **Setup program file** (X-15A-2_setup.exe) that is launched automatically when the disk is inserted into your computer disk drive. This program can also be launched manually by double-clicking the Setup icon in the disk folder.

If you have downloaded the software, the manuals and the documentation are included in the Setup program file.

The Setup program file contains the necessary software components to be installed on your computer:

1. The X-15A-2 **aircraft** and **panels**:
   - **3 versions of the X-15A-2 aircraft (s/n AF-56-6671) with the XLR-99 rocket engine and "jettisonable" external propellant tanks:**
     - "Rollout" version (black) with silver external propellant tanks and the X-15A-2 light blue-gray instrument panel;
     - "Dirty" version (black) with red and white external propellant tanks and the X-15A-2 light blue-gray instrument panel;
     - "White" version with full ablative coating, a modified lower vertical stabilizer, a dummy ramjet, an animated eyelid on the left canopy window and the X-15A-2 light blue-gray instrument panel.
2. A cabinet (.cab) file that contains all the **gauges, switches, lights, instruments and systems** for the X-15A-2 advanced panels.
3. All the **special visual effects** for the X-15A-2 aircraft (e.g.: rocket engine flame effects, propellant jettison effects, APU and engine turbopump exhaust effects, etc.).

Note that there is no custom sound package included with the software at this time. The current version of the X-15A-2 for Flight Simulator uses the default FS2004 aircraft sounds. Check our web site regularly for fixes, patches and upgrades.

AUTOMATIC INSTALLATION

Refer to the following instructions for installation in Flight Simulator 2004. Refer to the separate FSX supplement (X-15A-2_fsx_supplement_eng_01.pdf) for installation in Flight Simulator X.

The X-15A-2 for Flight Simulator is installed like any other add-on aircraft in your default "Flight Simulator 9" folder.

DOWNLOAD

If you have downloaded the software, simply run the Setup program (X-15A-2_setup.exe) and follow the instructions that appear on screen. Enter your product registration key when asked. You must accept the end-user license agreement and enter a valid registration key before you can install and use this product. If FSX is also installed on your computer, select if you want the X-15A-2 add-on aircraft to be installed in FS2004, FSX or both. The installation program will then copy the necessary files into their default locations in the "Flight Simulator 9" and/or "Microsoft Flight Simulator X" folder (s) on your computer.

CD-ROM

If you have purchased the CD-ROM package, insert the enclosed disc into your CD-ROM drive and follow the instructions that appear on screen. Enter your product registration key when asked. You must accept the end-user software license agreement and enter a valid registration key before you can install and use this product. If FSX is also installed on your computer, select if you want the X-15A-2 add-on aircraft to be installed in FS2004, FSX or both. The installation program will then copy the necessary files into their default locations in the

"Flight Simulator 9" and/or "Microsoft Flight Simulator X" folder(s) on your computer.

(If your computer does not support automatic installation, click **Start** on the Windows® taskbar and select **Control Panel**. Double-click the **Add/Remove Programs** icon and click **Add New Programs**. Follow the instructions that appear on screen.)

Once the add-on aircraft are installed, they will be available on the **Select Aircraft page** in Flight Simulator.

Note that the X-15A-2 Utility Flight Manual and FSX supplement are copied by default in the "C:\Program Files\Xtreme Prototypes\X-15A-2 Documentation" folder for your convenience and future reference. There are available in the **"Start\Programs\Xtreme Prototypes"** section of the Windows® taskbar.

FILE STRUCTURE

The X-15A-2 aircraft and panels are installed in your "Flight Simulator 9\Aircraft" folder, under different names. Each aircraft and associated components are contained in a different folder. The X-15A-2 gauge cabinet is installed in your "Flight Simulator 9\Gauges" folder. Similarly, the X-15A-2 special effects are installed in your "Flight Simulator 9\Effects" folder.

Your file structure should look like the one in Figure 2-1, depending on the add-on aircraft purchased.

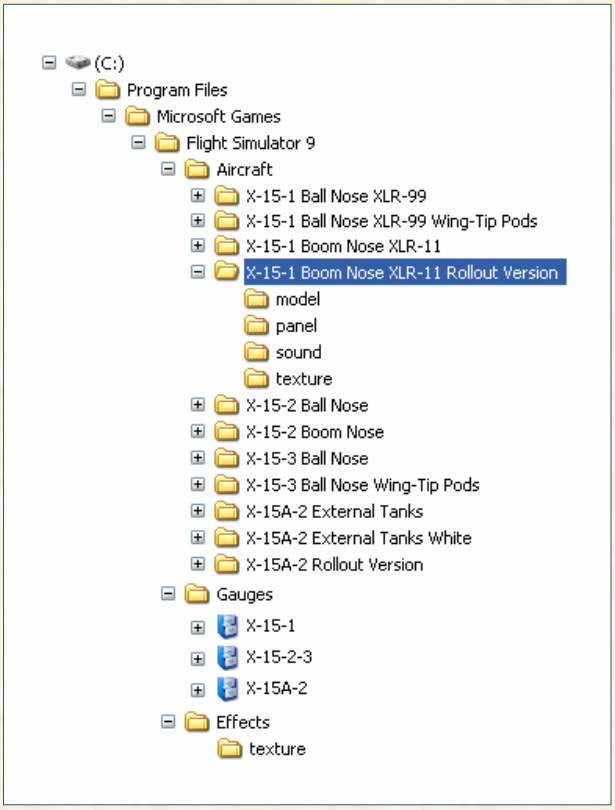


Figure 2-1

COPYRIGHT NOTICE

The X-15A-2 for Flight Simulator is neither freeware nor shareware and is subject to the terms of use specified in the enclosed end-user software license agreement.

The software and the present manual are protected by international copyright laws. The end-user is authorized to print copies of the present manual for his/her own use, in conjunction with the enclosed add-on simulation software. Please do not make unauthorized copies of the software and/or its related components and documentation, including the present user manual.

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Aircraft Description and Specifications

SECTION III

AIRPLANE

The real-world X-15 was a single-place research rocket airplane, specifically designed to obtain data on flight at extremely high altitudes and speeds and on the effects of such flight conditions on the aircraft and on the pilot.

X-15A-2 (rollout version). Note the elliptical canopy windows, the external propellant tanks, a 29-inch fuselage extension (between the internal liquid oxygen and ammonia tanks) and the open speed brakes.

Built by North American Aviation in the late 1950s and early 1960s, under public contract by NACA (NASA), the U.S. Air Force and the U.S. Navy, the airplane was developed and tested in two basic configurations.

The limited-mission configuration included two interim Reaction Motors XLR-11 ("Experimental Liquid Rocket-11"), 5900-pound four-chambered turbo-rocket engines and either a conventional flight reference system or an inertial flight data system.

The design-mission configuration included an inertial

XLR-11 engines installed on the X-15-1 (limited-mission configuration). The X-15-1 for Flight Simulator is available in a separate package (see appendix 7).

XLR-99 engine installed on the X-15A-2. Note the large spherical helium tank behind the upper vertical stabilizer.

flight reference system and one Reaction Motors XLR-99, 60,000-pound liquid-propellant turbo-rocket engine. All other systems and components for each airplane configuration were essentially the same.

The 25½ degree swept back wing had hydraulically operated flaps on the inboard trailing edge of each wing

panel. All aerodynamic control surfaces were actuated by irreversible hydraulic systems.

The horizontal stabilizer had a 15-degree cathedral. The left and right sections moved simultaneously for pitch control, differentially for roll control, and in compound for pitch-roll control.

The upper and lower vertical stabilizers (rudders) were in two sections; a movable outer span for yaw control and a fixed section adjacent to the fuselage. The lower movable section (ventral) was "jettisonable" for landing. Each fixed section incorporated a split-flap speed brake.

For changes in airplane attitude at altitudes where aerodynamic controls are relatively ineffective, the airplane incorporated a ballistic control system, wherein the release of gas (hydrogen peroxide) through small rockets in the nose and wing caused the airplane to move about each axis as required.

X-15A-2 in flight. Note the frost on the fuselage, around the liquid oxygen tank, and the flow of propellants coming out of the rear prime ports.

Propellants for the rocket engine(s) and associated turbopump(s) – water-alcohol (XLR-11 engines) or anhydrous ammonia (XLR-99 engine), liquid oxygen and hydrogen peroxide – were carried internally.

Engine pneumatic control systems and propellant tanks were pressurized either by helium or nitrogen gas. The airplane pressurization and air conditioning systems used liquid nitrogen and helium.

Two auxiliary power units (APUs) drove the airplane hydraulic pumps and AC electrical generators. They used hydrogen peroxide as a monopropellant.

The X-15 landing gear consisted of a dual wheel nose gear and two main (rear) landing skids. The gear was lowered in flight by gravity and air loads.

The real-world X-15 was not designed for normal ground takeoff but was air-launched by a modified B-52 bomber. Unlike the original airplane, the X-15 for Flight Simulator can actually take off from the ground, like any other Flight Simulator aircraft!

The X-15A-2 for Flight Simulator. The right external tank contains 1053 gallons of anhydrous ammonia and the left tank contains 770 gallons of liquid oxygen.

THE X-15A-2

After the X-15-2 was damaged in 1962, it was rebuilt as a modified "advanced" version of the X-15.

The X-15A-2 was rolled out in early 1964. It was specifically designed to attain hypersonic velocities in the range of 8000 feet per second at an altitude of 100,000 feet.

The obvious modifications are the addition of a 29-inch fuselage extension between the internal liquid oxygen and ammonia tanks and two large external propellant tanks which can be jettisoned and reused. The added propellant permits a longer engine run which results in added velocity.

The fuselage extension provides an optical window and additional space for experimental and instrumentation equipment as well as housing for liquid hydrogen. Other changes include a removable right wing tip, a modified lower fixed vertical stabilizer for attachment of experi-

mental equipment such as ramjet test bed engines, an extended landing gear, a revised canopy with new elliptical windows, a sky hatch on top of the instrument compartment, extended side fairings to carry more hydrogen peroxide and a helium spherical tank behind the upper vertical stabilizer.

X-15A-2 (rollout version) at Edwards AFB.

AIRPLANE DIMENSIONS

The overall dimensions of the X-15A-2 airplane (in-flight configuration, external tanks attached, with gear up and ventral retained) were as follows:

- **Length (with ball nose and XLR-99 engine):** 51 feet, 11 inches.
- **Span:** 22 feet, 4 inches.
- **Height:** 13 feet, 1 inch.

AIRPLANE GROSS WEIGHT

The approximate launch gross weight of the airplane (including full internal load, drop tanks and pilot) was approximately 51,600 pounds. However, this could vary a few hundred pounds, depending on the type of instrumentation carried.

Launched with drop tanks:

- **Launch:** 51,600 lbs.
- **Burnout (drop tanks off):** 16,500 lbs.
- **Landing (drop tanks off):** 15,600 lbs.

Launched without drop tanks:

- **Launch:** 32,250 lbs.
- **Burnout:** 16,200 lbs.
- **Landing:** 15,500 lbs.

AIRPLANE SERIAL NUMBER

The U.S. Air Force serial number for the X-15A airplane covered by this manual is AF56-6671 (X-15A-2).

October 3, 1967: The fastest flight of the X-15 program and the last flight of the X-15A-2.

HISTORICAL DATA (X-15A-2)

- **Arrived** at Edwards AFB in February 1964.
- **First captive flight:** June 15, 1964.
- **First powered flight:** June 25, 1964 (pilot: Robert Rushworth).
- **Last flight:** October 3, 1967 (pilot: Pete Knight).
- **Number of flights:** 22.
- **Highest Mach number:** Mach 6.7 (October 3, 1967; pilot: Pete Knight).
- **Highest speed:** 4520 mph (October 3, 1967; pilot: Pete Knight).
- **Highest altitude:** 249,000 feet (August 3, 1966; pilot: Pete Knight).

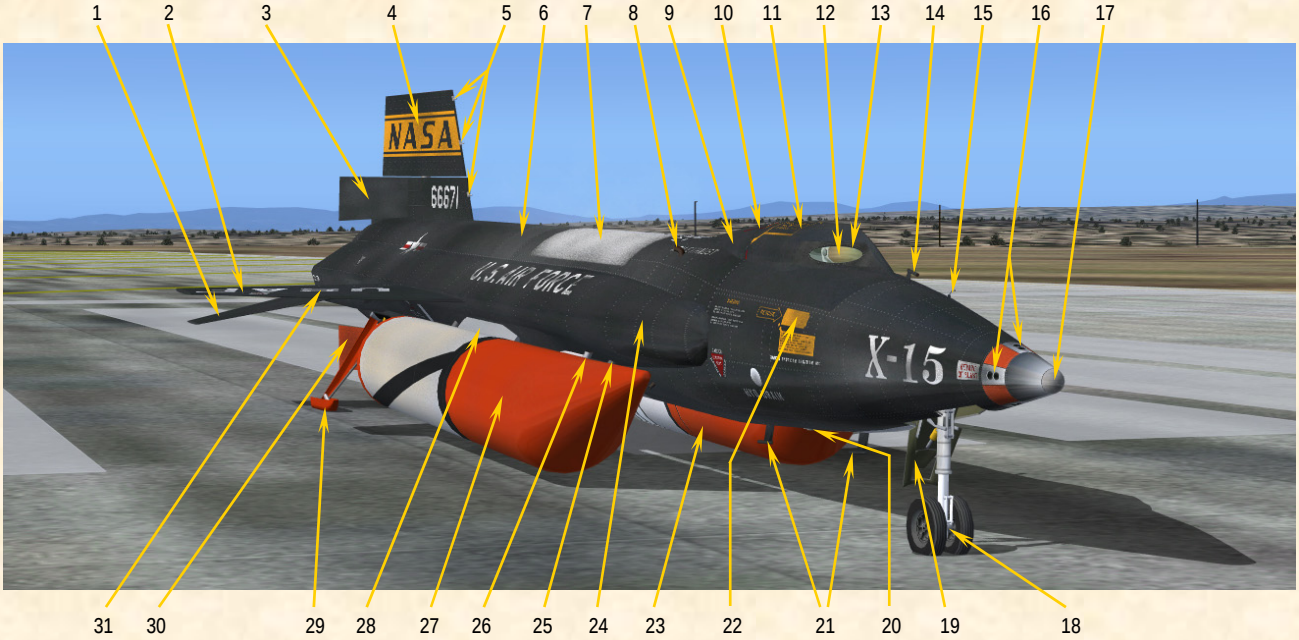
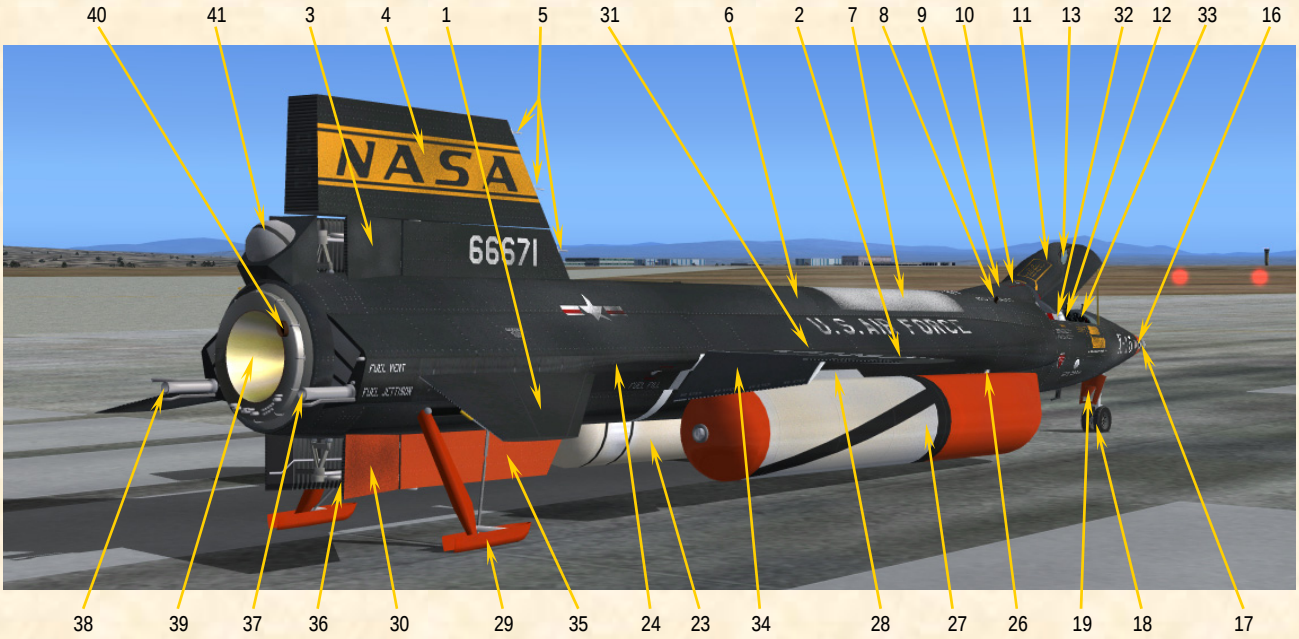


Figure 3-1

1. MOVABLE HORIZONTAL STABILIZER
2. BALLISTIC CONTROL SYSTEM ROCKETS (2, ON BOTH WINGS)
3. UPPER SPEED BRAKE
4. MOVABLE UPPER VERTICAL STABILIZER
5. IMPACT PRESSURE PROBES
6. 29-INCH FUSELAGE EXTENSION
7. LIQUID OXYGEN TANK (FROST)
8. APU EXHAUST (2, LEFT AND RIGHT)
9. EQUIPMENT COMPARTMENT
10. SKYLIGHT HATCH
11. CANOPY
12. PILOT (FULL PRESSURE SUIT)
13. ELLIPTICAL WINDOW (2)
14. PITOT HEAD
15. RETRACTABLE PITOT HEAD
16. BALLISTIC CONTROL SYSTEM ROCKETS (8)
17. NACA/NORTRONICS BALL NOSE
18. NOSE LANDING GEAR
19. NOSE LANDING GEAR DOOR
20. RADAR ANTENNA
21. UHF ANTENNAS
22. EXTERNAL CANOPY EMERGENCY JETTISON HANDLE ACCESS DOOR
23. LEFT EXTERNAL PROPELLANT TANK (LOX)
24. SIDE FAIRING (2, LEFT AND RIGHT)
25. TANK EJECTOR (2, FORWARD & AFT, ON EACH TANK)
26. TANK ROCKET THRUSTERS (ON EACH TANK)
27. RIGHT EXTERNAL PROPELLANT TANK (NH_3)
28. TANK PYLON (ON EACH TANK)
29. REAR LANDING GEAR SKID (2, ON BOTH SIDES)
30. LOWER SPEED BRAKE
31. WING (2, LEFT AND RIGHT)
32. EJECTION SEAT
33. INSTRUMENT PANEL
34. FLAP (2, LEFT AND RIGHT)
35. LOWER FIXED VERTICAL STABILIZER (MOVABLE VENTRAL REMOVED)
36. HYDROGEN PEROXIDE JETTISON PORT
37. AMMONIA JETTISON PORT
38. LIQUID OXYGEN JETTISON PORT
39. XLR-99 ROCKET ENGINE
40. ENGINE TURBOPUMP EXHAUST
41. SPHERICAL HELIUM TANK



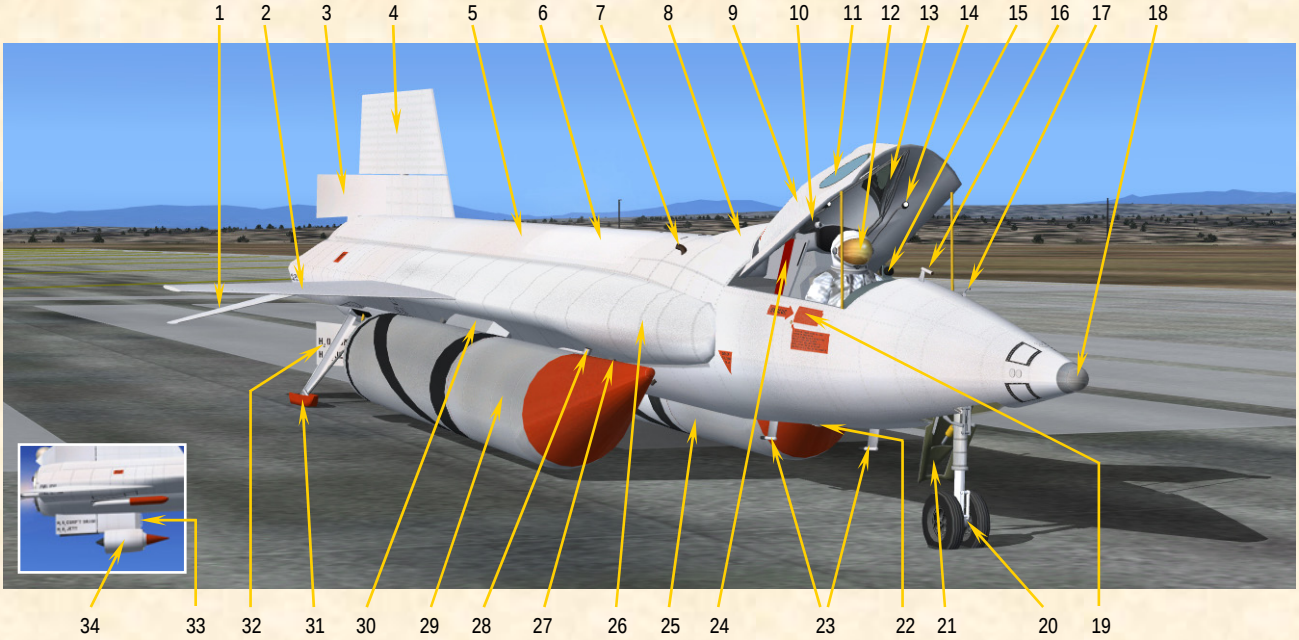
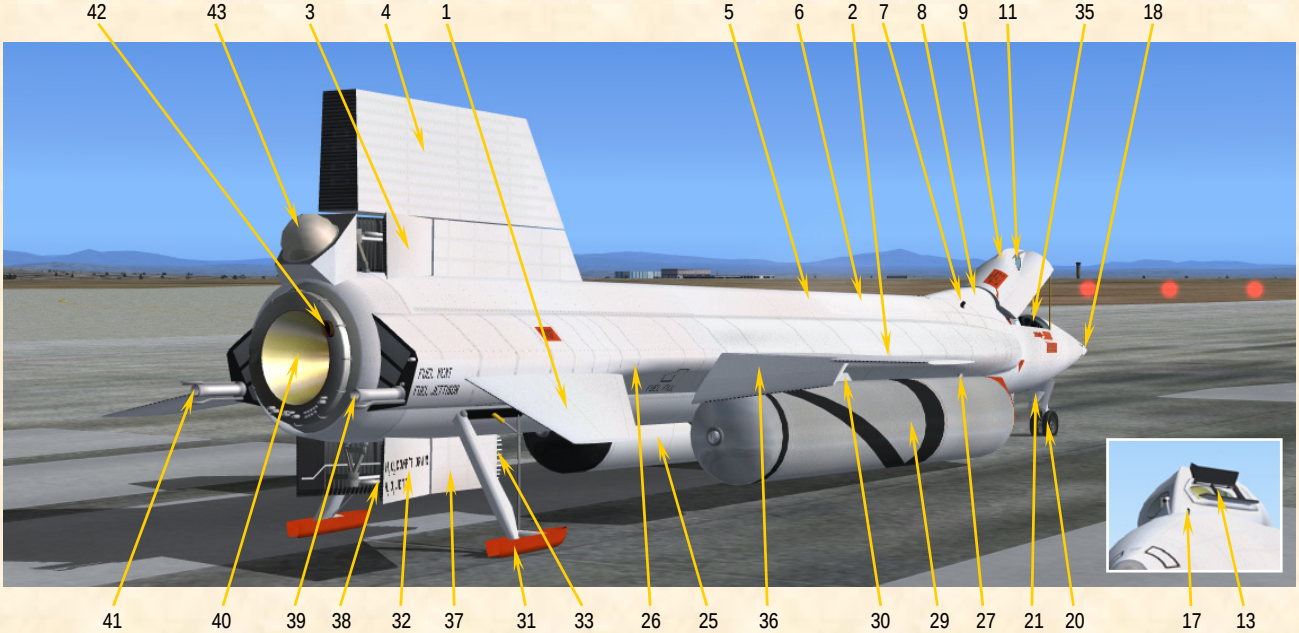


Figure 3-2

1. MOVABLE HORIZONTAL STABILIZER
2. WING (2, LEFT AND RIGHT)
3. UPPER SPEED BRAKE
4. MOVABLE UPPER VERTICAL STABILIZER
5. 29-INCH FUSELAGE EXTENSION
6. LIQUID OXYGEN TANK (FROST)
7. APU EXHAUST (2, LEFT AND RIGHT)
8. EQUIPMENT COMPARTMENT
9. CANOPY
10. COCKPIT CAMERA
11. ELLIPTICAL WINDOW (2)
12. PILOT (FULL PRESSURE SUIT)
13. EYELID (OUTSIDE OF LEFT WINDOW)
14. COCKPIT LIGHT (2)
15. ENGINE TIMER (STOPWATCH)
16. PITOT HEAD
17. RETRACTABLE PITOT HEAD
18. NACA/NORTRONICS BALL NOSE
19. EXTERNAL CANOPY EMERGENCY JETTISON HANDLE ACCESS DOOR
20. NOSE LANDING GEAR
21. NOSE LANDING GEAR DOOR
22. RADAR ANTENNA
23. UHF ANTENNAS
24. EJECTION SEAT
25. LEFT EXTERNAL PROPELLANT TANK (LOX)
26. SIDE FAIRING (2, LEFT AND RIGHT)
27. TANK EJECTOR (2, FORWARD & AFT, ON EACH TANK)
28. TANK ROCKET THRUSTERS (ON EACH TANK)
29. RIGHT EXTERNAL PROPELLANT TANK (NH_3)
30. TANK PYLON (ON EACH TANK)
31. REAR LANDING GEAR SKID (2, ON BOTH SIDES)
32. LOWER SPEED BRAKE
33. IMPACT RAKES
34. DUMMY RAMJET (EXPERIMENTAL)
35. INSTRUMENT PANEL
36. FLAP (2, LEFT AND RIGHT)
37. MODIFIED LOWER FIXED VERTICAL STABILIZER (RAM JET ENGINE REMOVED)
38. HYDROGEN PEROXIDE JETTISON PORT
39. AMMONIA JETTISON PORT
40. XLR-99 ROCKET ENGINE
41. LIQUID OXYGEN JETTISON PORT
42. ENGINE TURBOPUMP EXHAUST
43. SPHERICAL HELIUM TANK



Instrument Panels

SECTION IV

What makes the X-15 for Flight Simulator exciting and unique are the **fully functional** instrument panels that have been designed for the desktop pilot to simulate almost every step and procedure required during a typical X-15 mission. For example:

- Aircraft servicing (all three propellants and gases);
- APUs/generators/hydraulic pump operation;
- Propellant tank pressurization;
- Engine precool and prime;
- Turbopump operation;
- Rocket ignition sequence;
- Monitoring of propellant pressure gauges;
- Propellant jettison.

Almost every X-15 internal system has been integrated into the X-15A-2 for Flight Simulator panels:

- Engine propellant and control system (including the external tanks propellant transfer system on the X-15A-2);
- Engine ignition system;
- APUs and electrical power distribution systems;
- Hydraulic system and temperature control systems.

(Note that the cabin air conditioning and pressurization system is not fully functional in this software version.)

Each X-15 for Flight Simulator add-on aircraft comes with one main instrument panel and at least seven secondary panels. Included with the X-15A-2 add-on aircraft is:

1. A main panel;
2. A service panel;
3. A "vent, pressurize, jettison" lever panel;
4. A throttle and speed brake lever panel;
5. A left side panel;
6. A right side panel;
7. A radio panel;
8. A center pedestal panel;
9. An external drop tank control panel.

In addition, the default FS2004 Garmin GPS and magnetic compass panels are available to the desktop pilot.

Virtually all gauges, switches, light indicators and instruments are functional and behave like the original analog devices described in the real-world X-15 and X-15A-2 flight manuals. Over 180 custom gauges have been developed for the X-15A-2 for Flight Simulator.

X-15 instrument panels are complex. In order for the desktop pilot to familiarize him/herself with the many different panels, special "tooltips" or captions have been integrated within every gauge, switch, light and instrument. Simply move the cursor over a gauge and its name will appear under it. Therefore, each panel can be used as a learning tool for understanding the different panel configurations and the complex operation of the X-15 and X-15A-2 rocket planes.

An interesting aspect of the X-15A-2 for Flight Simulator is that because the aircraft systems and panels have been designed according to their real-world counterparts, the original X-15 flight manuals can also be used by experienced desktop pilots, along with the software, to go through the check lists and procedures, just as the X-15 test pilots were accustomed to doing back in the 1960s.

To fully cover the description and operation of the X-15 and X-15A-2 internal systems and individual gauges and instruments is beyond the scope of this manual. Interested desktop pilots will find this information in reproductions of the original X-15 and X-15A-2 utility flight manuals, available today in book form or on the Internet (see appendices 5 and 6).

MAIN PANEL

* Gauges in gray do not perform any specific simulator function.

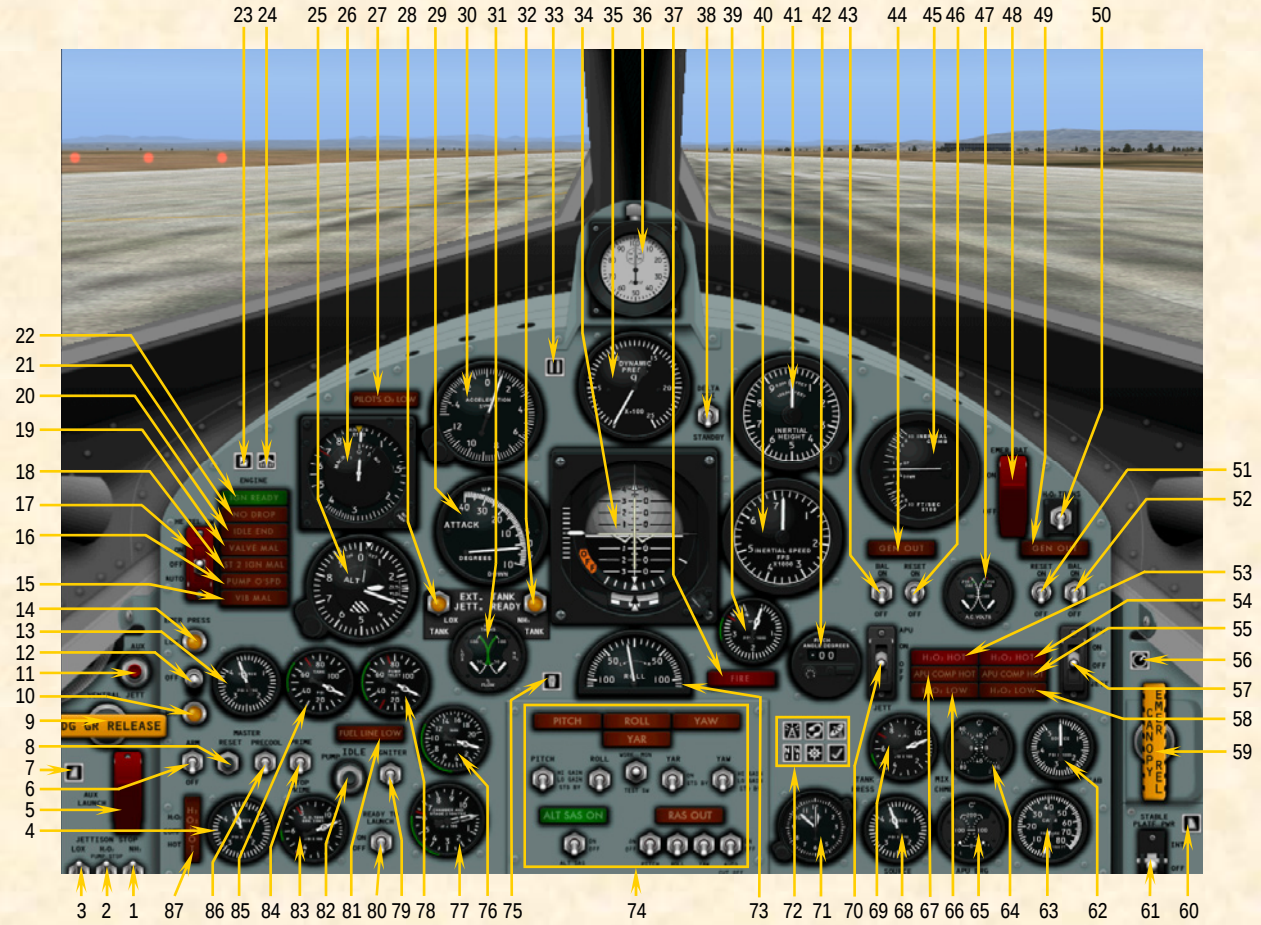


Figure 4-1

1. AMMONIA JETTISON STOP SWITCH
2. H_2O_2 JETTISON STOP SWITCH
3. LIQUID OXYGEN JETTISON STOP SWITCH
4. H_2O_2 SOURCE PRESSURE GAUGE (INT./EXT.)
5. AUXILIARY LAUNCH SWITCH*
6. ENGINE MASTER SWITCH
7. DISPLAY/HIDE LEFT SIDE PANEL ICON
8. ENGINE RESET BUTTON
9. LANDING GEAR HANDLE
10. AMMONIA TANK PRESSURE-LOW CAUTION LIGHT
11. VENTRAL (OR RAMJET) JETTISON BUTTON
12. PROPELLANT EMERGENCY PRESS SWITCH
13. PROPELLANT SOURCE PRESSURE GAUGE (INT./EXT.)
14. LIQUID OXYGEN PRESSURE-LOW CAUTION LIGHT
15. ENGINE VIB MALFUNCTION CAUTION LIGHT
16. TURBOPUMP OVERSPEED CAUTION LIGHT
17. HELIUM RELEASE SELECTOR SWITCH
18. STAGE 2 IGNITION MALFUNCTION CAUTION LIGHT
19. VALVE MALFUNCTION CAUTION LIGHT
20. IDLE-END CAUTION LIGHT
21. NO-DROP OR 23-SECOND CAUTION LIGHT
22. IGNITION-READY LIGHT
23. DISPLAY/HIDE LEFT WHITE CONSOLE ICON
24. DISPLAY/HIDE THROTTLE AND SPEED BRAKE PANEL ICON
25. ALTIMETER
26. AIRSPEED/MACH INDICATOR
27. PILOT'S OXYGEN-LOW CAUTION LIGHT
28. LEFT (LIQUID OXYGEN) EXTERNAL TANK JETTISON-READY INDICATOR LIGHT
29. ANGLE-OF-ATTACK INDICATOR
30. ACCELEROMETER
31. EXTERNAL TANKS FUEL FLOW INDICATOR
32. RIGHT (AMMONIA) EXTERNAL TANK JETTISON-READY INDICATOR LIGHT
33. DISPLAY/HIDE EXTERNAL DROP TANKS CONTROL PANEL ICON
34. ATTITUDE INDICATOR
35. DYNAMIC PRESSURE INDICATOR
36. ENGINE TIMER (STOPWATCH)
37. FIRE-WARNING LIGHT
38. SIDESLIP SELECTOR SWITCH
39. HYDRAULIC PRESSURE GAUGE
40. INERTIAL SPEED (VELOCITY) INDICATOR
41. INERTIAL HEIGH (ALTIMETER) INDICATOR
42. PITCH ANGLE SET CONTROL
43. NO. 1 BALLISTIC CONTROL SWITCH
44. NO.1 GENERATOR-OUT LIGHT
45. VERTICAL VELOCITY INDICATOR
46. NO.1 GENERATOR SWITCH
47. GENERATOR AC VOLTMETER
48. EMERGENCY BATTERY SWITCH
49. NO. 2 GENERATOR-OUT LIGHT
50. HYDROGEN PEROXIDE TRANSFER SWITCH
51. NO. 2 GENERATOR SWITCH
52. NO. 2 BALLISTIC CONTROL SWITCH
53. NO.1 APU H_2O_2 COMPARTMENT OVERHEAT WARNING LIGHT
54. NO. 2 APU H_2O_2 COMPARTMENT OVERHEAT WARNING LIGHT
55. NO. 2 APU COMPARTMENT CAUTION LIGHT
56. DISPLAY/HIDE SERVICE PANEL ICON
57. NO.2 APU SWITCH
58. NO. 2 APU H_2O_2-LOW CAUTION LIGHT
59. CANOPY INT. EMERGENCY JETTISON HANDLE
60. DISPLAY/HIDE RIGHT PANEL ICON
61. STABLE PLATFORM SWITCH
62. CABIN HELIUM SOURCE PRESSURE GAUGE
63. CABIN PRESSURE ALTIMETER
64. MIXING CHAMBER TEMPERATURE GAUGE
65. APU BEARING TEMPERATURE GAUGE
66. NO.1 APU H_2O_2-LOW CAUTION LIGHT
67. NO. 1 APU COMPARTMENT OVERHEAT CAUTION LIGHT
68. APU SOURCE PRESSURE GAUGE
69. APU H_2O_2 TANK PRESSURE GAUGE
70. NO. 1 APU SWITCH
71. CLOCK
72. DISPLAY/HIDE ICONS: RADIO PANEL, ATC WINDOW, GPS, COMPASS, MAP, KNEEBOARD
73. RATE-OF-ROLL INDICATOR
74. SAS/RAS PANEL (SEE FIGURE 4-10)
75. DISPLAY/HIDE CENTRAL PEDESTAL ICON
76. PROPELLANT MANIFOLD PRESSURE GAUGE
77. CHAMBER AND STAGE 2 IGNITER PRESSURE GAUGE
78. PROPELLANT PUMP INLET PRESSURE GAUGE
79. IGNITER IDLE SWITCH
80. READY-TO-LAUNCH SWITCH
81. FUEL LINE-LOW CAUTION LIGHT
82. TURBOPUMP IDLE BUTTON
83. H_2O_2 TANK AND ENGINE CONTROL LINE PRESSURE GAUGE
84. ENGINE PRIME SWITCH
85. PROPELLANT TANK PRESSURE GAUGE
86. ENGINE PRECOOL SWITCH
87. H_2O_2 COMPARTMENT-HOT CAUTION LIGHT

SERVICE PANEL

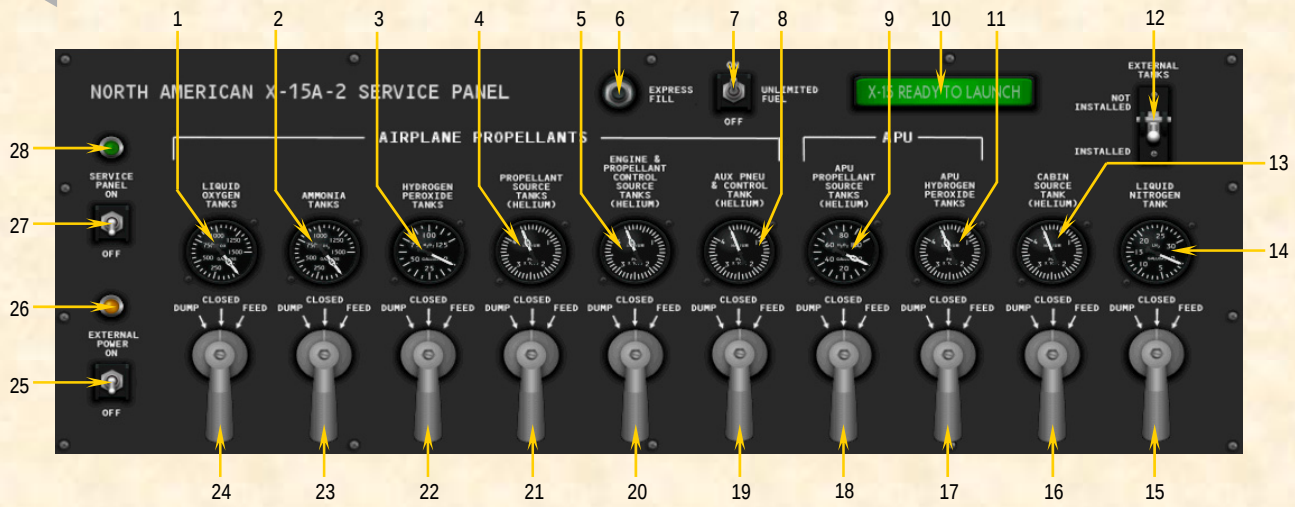


Figure 4-2

1. LIQUID OXYGEN TANKS VOLUME GAUGE
2. AMMONIA TANKS VOLUME GAUGE
3. TURBOPUMP HYDROGEN PEROXIDE TANKS VOLUME GAUGE
4. PROPELLANT SOURCE TANKS (HELIUM) PRESSURE GAUGE
5. ENGINE & PROPELLANT CONTROL SOURCE TANKS (HELIUM) PRESSURE GAUGE
6. EXPRESS FILL BUTTON
7. UNLIMITED FUEL OPTION SWITCH
8. AUXILIARY PNEUMATIC AND CONTROL (HELIUM) TANK PRESSURE GAUGE
9. APU PROPELLANT SOURCE TANKS (HELIUM) PRESSURE GAUGE
10. APU HYDROGEN PEROXIDE TANKS VOLUME GAUGE
11. B-52 CARRIER X-15 READY-TO-LAUNCH INDICATOR
12. EXTERNAL TANKS OPTION SWITCH
13. CABIN SOURCE TANK (HELIUM) PRESSURE GAUGE
14. LIQUID NITROGEN VOLUME GAUGE
15. LIQUID NITROGEN FEED VALVE LEVER
16. CABIN SOURCE TANK (HELIUM) FEED VALVE LEVER
17. APU HYDROGEN PEROXIDE TANKS FEED VALVE LEVER
18. APU PROPELLANT SOURCE TANKS (HELIUM) FEED VALVE LEVER
19. AUXILIARY PNEUMATIC AND CONTROL (HELIUM) FEED VALVE LEVER
20. ENGINE & PROPELLANT CONTROL SOURCE TANKS (HELIUM) FEED VALVE LEVER*
21. PROPELLANT SOURCE TANKS (HELIUM) FEED VALVE LEVER
22. TURBOPUMP HYDROGEN PEROXIDE TANKS FEED VALVE LEVER
23. AMMONIA TANKS FEED VALVE LEVER
24. LIQUID OXYGEN TANKS FEED VALVE LEVER
25. EXTERNAL POWER SWITCH
26. EXTERNAL POWER INDICATOR LIGHT
27. SERVICE PANEL POWER SWITCH
28. SERVICE PANEL POWER INDICATOR LIGHT

LEFT SIDE PANEL

* **NOTE:** Gauges in gray are animated and behave like their real-world counterparts but they do not perform any specific simulator function at this time in the X-15 for Flight Simulator series of add-on aircraft.

Figure 4-3

1. LANDING GEAR HANDLE
2. VENTRAL JETTISON BUTTON
3. AUXILIARY LAUNCH SWITCH*
4. AMMONIA JETTISON STOP SWITCH
5. HYDROGEN PEROXIDE JETTISON STOP SWITCH
6. LIQUID OXYGEN JETTISON STOP SWITCH

RIGHT SIDE PANEL

* **NOTE:** Gauges in gray are animated and behave like their real-world counterparts but they do not perform any specific simulator function at this time in the X-15 for Flight Simulator series of add-on aircraft.

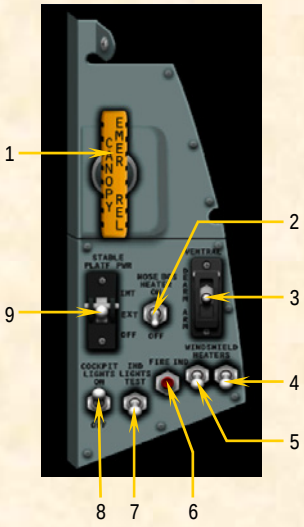


Figure 4-4

1. CANOPY INTERNAL EMERGENCY JETTISON HANDLE*
2. NOSE BALLISTIC ROCKET HEATER SWITCH
3. VENTRAL ARMING SWITCH
4. RIGHT WINDSHIELD HEATER SWITCH
5. LEFT WINDSHIELD HEATER SWITCH
6. FIRE-WARNING LIGHT TEST BUTTON
7. INDICATOR, CAUTION AND WARNING LIGHT TEST SWITCH
8. COCKPIT LIGHTING SWITCH
9. STABLE PLATFORM SWITCH

RADIO PANEL

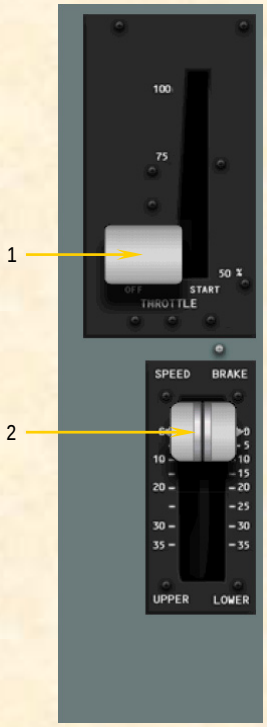
Figure 4-5

1. MAIN CHANNEL SECLECTOR KNOB
2. MAIN CHANNEL INDICATOR
3. FUNCTION SELECTOR SWITCH
4. MAIN CHANNEL "VOLUME" CONTROL
5. AUXILLIARY CHANNEL "VOLUME" CONTROL
6. AUXILLIARY CHANNEL INDICATOR
7. AUXILLIARY CHANNEL SELECTOR KNOB

THROTTLE AND SPEED BRAKE PANEL

Figure 4-6

1. **XLR-99 ENGINE THROTTLE LEVER**
2. **UPPER AND LOWER SPEED BRAKE LEVERS (LINKED TOGETHER)**



LEFT WHITE CONSOLE

* **NOTE:** Gauges in gray are animated and behave like their real-world counterparts but they do not perform any specific simulator function at this time in the X-15 for Flight Simulator series of add-on aircraft.

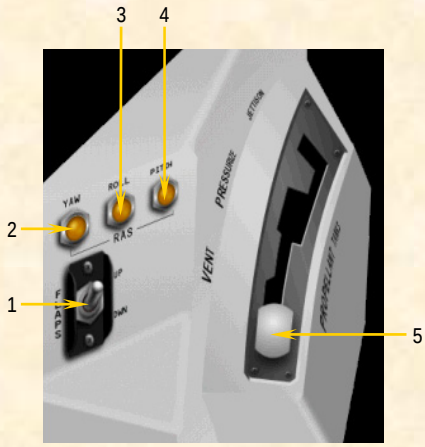


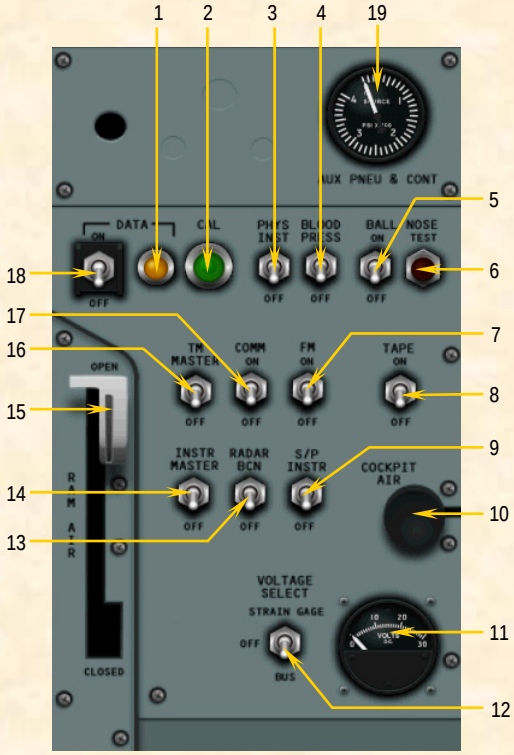
Figure 4-7

1. **FLAP SWITCH**
2. **RAS (YAW) CONTROL INDICATOR LIGHT***
3. **RAS (ROLL) CONTROL INDICATOR LIGHT**
4. **RAS (PITCH) CONTROL INDICATOR LIGHT**
5. **VENT, PRESSURIZE, JETTISON LEVER**

CENTER PEDESTAL

* **NOTE:** Gauges in gray are animated and behave like their real-world counterparts but they do not perform any specific simulator function at this time in the X-15 for Flight Simulator series of add-on aircraft.

Figure 4-8



1. DATA LIGHT*
2. CALIBRATE BUTTON AND LIGHT
3. PHYSIOLOGICAL INSTRUMENTATION SWITCH
4. BLOOD PRESSURE SWITCH
5. **BALL NOSE POWER SWITCH**
6. **BALL NOSE TEST BUTTON**
7. FM TELEMETER POWER SWITCH
8. TAPE RECORDER POWER SWITCH
9. **STABLE PLATFORM INSTRUMENT SWITCH**
10. COCKPIT RAM-AIR KNOB
11. **DC VOLTMETER**
12. **DC VOLTMETER SELECTOR SWITCH**
13. RADAR BEACON POWER SWITCH
14. **INSTRUMENTATION MASTER POWER SWITCH**
15. RAM-AIR LEVER
16. TELEMETER MASTER POWER SWITCH
17. TELEMETER COMMUTATOR MOTOR SWITCH
18. DATA SWITCH
19. AUXILIARY PNEUMATIC AND CONTROL PRESSURE GAUGE

EXTERNAL (DROP) TANKS CONTROL PANEL

* **NOTE:** Gauges in gray are animated and behave like their real-world counterparts but they do not perform any specific simulator function at this time in the X-15 for Flight Simulator series of add-on aircraft.

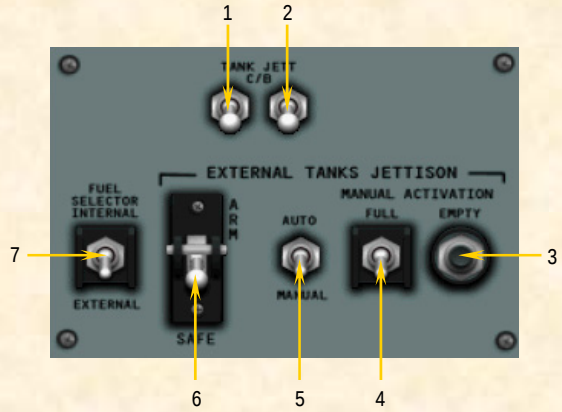


Figure 4-9

1. **TANK JETTISON C/B SWITCH NO. 1***
2. **TANK JETTISON C/B SWITCH NO. 2**
3. **EXTERNAL TANKS JETTISON EMPTY BUTTON**
4. **EXTERNAL TANKS JETTISON FULL SWITCH**
5. **EXTERNAL TANKS JETTISON AUTO-MANUAL SWITCH**
6. **EXTERNAL TANKS JETTISON SAFE-ARM SWITCH**
7. **FUEL SELECTOR SWITCH**

SAS/RAS PANEL

* **NOTE:** Gauges in gray are animated and behave like their real-world counterparts but they do not perform any specific simulator function at this time in the X-15 for Flight Simulator series of add-on aircraft.

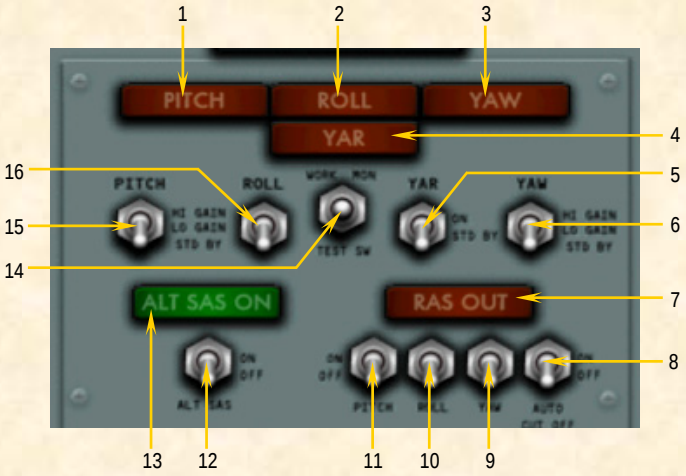


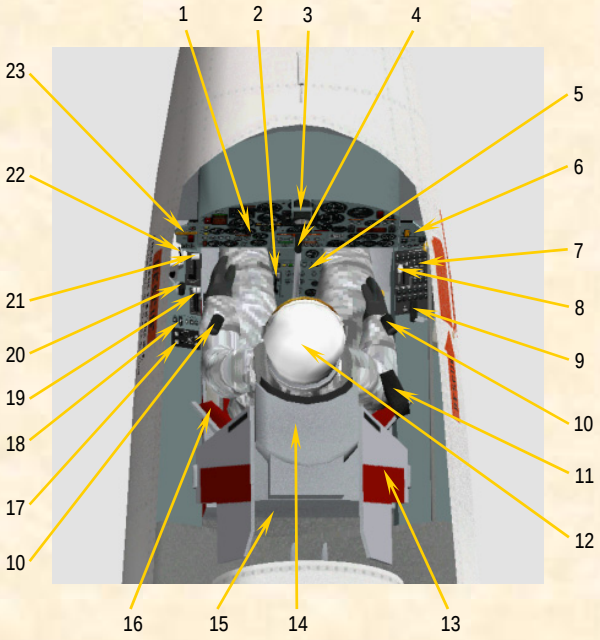
Figure 4-10

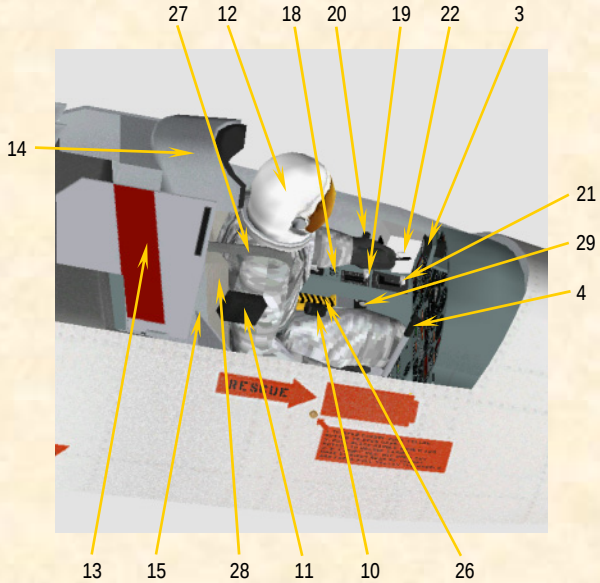
1. SAS PITCH CAUTION LIGHT
2. SAS ROLL CAUTION LIGHT
3. SAS YAW CAUTION LIGHT
4. SAS YAR CAUTION LIGHT
5. SAS YAR FUNCTION SWITCH
6. SAS YAW FUNCTION SWITCH
7. RAS-OUT CAUTION LIGHT
8. RAS AUTOMATIC CUTOFF SWITCH
9. RAS YAW FUNCTION SWITCH
10. RAS ROLL FUNCTION SWITCH
11. RAS PITCH FUNCTION SWITCH
12. ALTERNATE SAS SWITCH
13. ALTERNATE SAS ON INDICATOR LIGHT
14. SAS TEST SWITCH
15. SAS PITCH FUNCTION SWITCH
16. SAS ROLL FUNCTION SWITCH

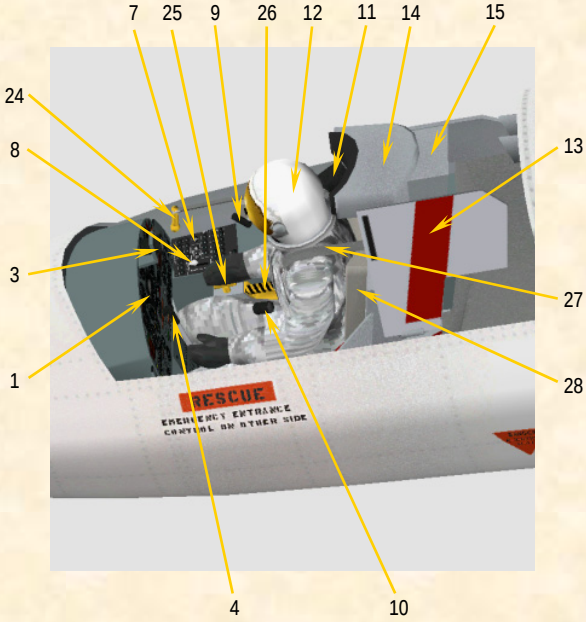
COCKPIT CONFIGURATION (CANOPY REMOVED, TYPICAL)

Figure 4-11

1. MAIN INSTRUMENT PANEL
2. RAM-AIR LEVER
3. ENGINE TIMER (STOPWATCH)
4. CENTER STICK
5. CENTER PEDESTAL
6. RIGHT SIDE PANEL
7. CIRCUIT-BREAKER PANEL
8. PRESSURE COOLING LEVER
9. CONSOLE STICK
10. COCKPIT LIGHT
11. COCKPIT CAMERA
12. PILOT (DAVID CLARK A/P22S-2 FULL-PRESSURE SUIT AND HELMET)
13. EJECTION SEAT STABILIZING FIN
14. EJECTION SEAT EJECTABLE HEADREST
15. EJECTION SEAT
16. EJECTION SEAT ARMREST
17. RADIO PANEL
18. EXTERNAL (DROP) TANKS CONTROL PANEL
19. SPEED BRAKE HANDLES
20. BALLISTIC CONTROL STICK
21. ENGINE THROTTLE (XLR-99 ENGINE)
22. VENT, PRESSURIZE AND JETTISON LEVER
23. LEFT SIDE PANEL
24. CANOPY INTERNAL HANDLE
25. RESTRAINT EMERGENCY RELEASE HANDLE
26. EJECTION HANDLE
27. SHOULDER HARNESS
28. PARACHUTE CONTAINER
29. OXYGEN SELECTOR AND GAUGE, FOOT RESTRAINT RELEASE BUTTON







Normal Procedures and Check List

SECTION V

This section contains the complete normal procedures and check list for the operation of the X-15A-2 add-on rocket aircraft for Flight Simulator (a condensed version of these procedures is provided in section VI). You can also refer to appendix 1 to start the engine and fly the X-15A-2 for Flight Simulator without going through the complete check list and procedures presented here.

Aircraft reference information is provided in appendix 3. The same information is also available in the FS aircraft Reference information tab of the Kneeboard (**F10**).

NOTE: This section contains instructions and procedures for XLR-99 rocket engine operation with external propellant tanks, on the X-15A-2 add-on aircraft.

INTRODUCTION

In an effort to recreate the real-world X-15 experience and for historical and technical accuracy, most of the following procedures are inspired or adapted from the original X-15 and X-15A-2 utility flight manuals. Following each step presented here will allow you to recreate a typical X-15 mission in Flight Simulator and will make your overall experience more realistic and enjoyable.

The operation of the add-on aircraft is very similar to the operation of the real-world aircraft. Reading this section before your first flight is highly recommended and will help you in understanding the complex operation of this unusual and remarkable air and space vehicle.

However, fully covering the description and operation of each of the X-15A-2 systems and individual gauges, light indicators, switches and instruments is beyond the scope of the present manual. Interested flight simulation enthusiasts can find this information in reproductions of the original X-15 utility flight manuals, available today in book form or on the Internet (see appendices 5 and 6).

These manuals, now in the public domain, contain complementary information to the material presented in this section and can also be used by experienced desktop pilots, along with the X-15A-2 add-on software, to recreate X-15 flights and missions in Flight Simulator.

TYPICAL MISSION

In a typical and real-world X-15 mission (see fig. 5-1 on page 5-21), the rocket airplane would be attached under the right wing of a modified B-52 bomber (NB-52) and carried to an altitude of about 45,000 feet. Then, at a scheduled launch time, it would be dropped and the pilot would ignite the airplane's powerful rocket engine(s) to propel the X-15A-2 at several times the speed of sound to high altitude and speed records.

X-15A-2 accelerating to Mach 4.65.

Several experiments would be conducted during the mission to get as much information as possible about high-speed and high-altitude flight and about the effects of such flight conditions on the aircraft and on the pilot.

After the airplane propellants were exhausted or the engine was shut down by the pilot, the X-15 would perform reentry into the atmosphere (if on a high-altitude mission) and begin a shallow descent during its glide back to a dry lakebed in the California desert.

The X-15A-2 for Flight Simulator can be launched either from a high altitude like the real X-15 (saved flight) or simply take off from an airport runway like any other Flight Simulator aircraft. For simplicity and to allow ground servicing of the virtual airplane, the following procedures assume a normal takeoff from the ground.

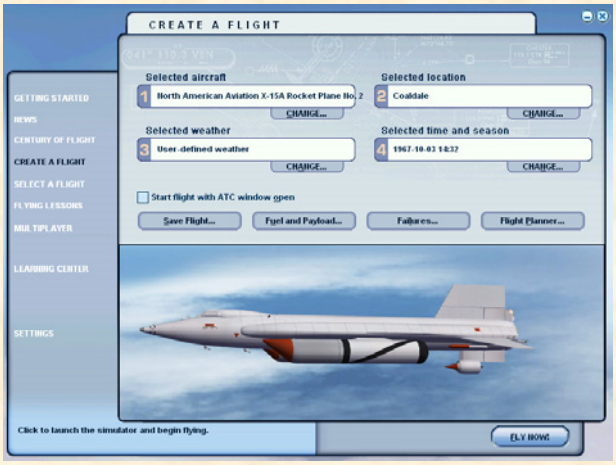
Because of the limitations of the Microsoft® Flight Simulator game environment, the maximum altitude to be reached by any of the X-15 for Flight Simulator aircraft in FS2004 is 100,000 feet. The maximum speed is approximately Mach 4.65.

The procedures presented here are for a typical mission, and do not cover any specific experimentation.

INITIAL FLIGHT SIMULATOR CONFIGURATION

For your first X-15A-2 flight, we suggest a normal takeoff from Coaldale airfield, Nevada (2Q6), runway 12 and a landing near Rogers Dry Lake at Edwards Air Force Base (KEDW), runway 22. Although the real X-15 landed on the lakebed, we will attempt to land our virtual X-15 on the base runway like a conventional FS2004 aircraft.

Even though we are limited to Mach 4.65, we will attempt to recreate Pete Knight's historical flight No. 2-53-97 which took place on October 3, 1967 (the fastest X-15 flight), from Mud Lake to Rogers Dry Lake.



Flight configuration page in Microsoft FS2004.

CREATING A FLIGHT

1. Make sure the X-15A-2 for Flight Simulator has been properly installed in your **"Flight Simulator 9"** folder according to the instructions provided in section II.

2. Make sure your joystick, or yoke and pedals are properly connected to your computer and have been previously tested in Flight Simulator. (A joystick is recommended to fly the X-15A-2 for Flight Simulator aircraft. Pedals are optional.)

3. Start Microsoft® Flight Simulator.

4. Select the **CREATE FLIGHT** option in the menu at left.

5. In the "Create Flight" page, click **CHANGE** under "Selected Aircraft" (1) to open the "Select Aircraft" page.

6. Select the following:

   a. Aircraft Manufacturer – **NORTH AMERICAN AVIATION**.
   b. Aircraft Model – **X-15A ROCKET PLANE NO. 2**.
   c. Variation – **BALL NOSE, XLR-99 ENGINE, EXTERNAL TANKS, WHITE ABLATIVE COATING** (or any other available version of the X-15A-2, if you want to fly a different mission).

7. Click **OK**.

8. On the "Create Flight" page, click **CHANGE** under "Selected Weather" (3) to open the "Weather" page.

9. On the "Weather" page, select **USER-DEFINED WEATHER**, then click the **CUSTOMIZE WEATHER** button.

10. On the "Customized Weather" page, enter the following conditions:

    a. Clouds – **CLEAR**.
    b. Precipitation – **NONE**.
    c. Visibility – **40 MI / 64 KM**.
    d. Wind Speed – **LIGHT (8 KTS)**.
    e. Wind Direction – **120˚.**

11. Click **OK** twice.

12. On the "Create Flight" page, click **CHANGE** under "Selected Time and Season" (4).

13. On the "Time and Season" page, set "Local Time" to: **14:32:11**.

14. On the "Time and Season" page, set date to: **OCTOBER 3, 1967**.

15. Click **OK**.

16. On the "Create Flight" page, click on the **FLIGHT PLANNER** button.

17. On the "Flight Planner" page, select:

    a. Departure location – **COALDALE (2Q6), RUNWAY 12** (Coaldale – 2Q6, Nevada, United States, Runway 12).
    b. Destination – **EDWARDS AIR FORCE BASE (KEDW)** (Edwards AFB - KEDW, California, United States).
    c. Flight plan type – **VFR**.
    d. Routing – Direct-**GPS**.

18. Click the **FIND ROUTE** button.

19. On the "Find Route" page, enter: Cruising Altitude – **60,000 feet**.

20. Click **SAVE** to save your route.

21. Click **OK**. Answer **YES** when asked if you want Flight Simulator to move your aircraft to the selected airport.

22. On the "Create Flight" page, click the **SAVE FLIGHT** button to save your flight. Name this flight: **X-15A-2 Flight No. 2-53-97**.

23. On the "Create Flight" page, click the **FLY NOW** button to start your flight.

FUEL MANAGEMENT SYSTEM

Conventional aircraft found in Microsoft® Flight Simulator use only one type of fuel (either aviation gasoline or jet fuel). Propellant consumption is automatically calculated and managed by the game engine.

Like the real-world rocket airplane, the X-15A-2 for Flight Simulator uses at least three different types of propellants: anhydrous (waterless) ammonia as the main engine fuel, liquid oxygen as the oxidizer and hydrogen peroxide as a monopropellant for the engine turbopump, the APUs and the ballistic control system rockets.

The airplane's pneumatic controls and the main propellant tanks in the X-15 aircraft are pressurized with helium.

Concurrently, the two auxiliary power units (APUs) consume hydrogen peroxide under helium pressure from separate tanks. The APUs provide both electrical power and hydraulic power to the aircraft.

Finally, the airplane air conditioning and pressurization systems use liquid nitrogen pressurized by helium.

X-15A-2 venting her propellant tanks. Frost and condensation from the cold propellants can be seen on the fuselage and around the internal liquid oxygen tank. The boiling point of liquid oxygen is –297° F in standard atmospheric conditions.

In order to recreate these complex systems and simulate as close as possible the true operation of the X-15 and X-15A-2 aircraft, special built-in systems have been designed and integrated into the X-15 for Flight Simulator instrument panels. These systems bypass the Flight Simulator fuel management system and need some special settings in the simulator:

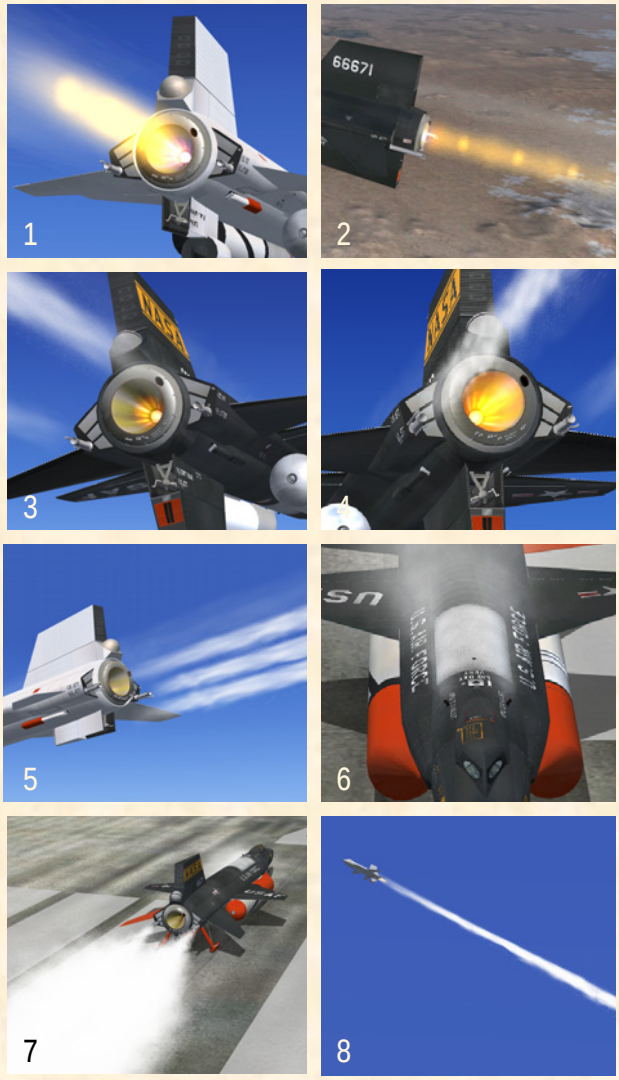
1. Under the "Aircraft" menu in the main Flight Simulator window, select **REALISM SETTINGS**.

2. On the "Settings – Realism" page, under "Engines", select the **UNLIMITED FUEL** option.

IMPORTANT NOTE: The **engine autostart** command in Flight Simulator (**CTRL-E**) is intentionally disabled in order to simulate the true rocket engine start procedures described herein and because of the complexity of the X-15A-2 fuel management system, servicing and engine ignition sequence. **Also note that all systems are reset when a new X-15 aircraft main instrument panel is reloaded in Flight Simulator.**

SPECIAL VISUAL EFFECTS (AIRCRAFT LIGHTS)

The X-15 for Flight Simulator special visual effects such as the rocket engine flames or the APU exhaust effects are internally triggered with aircraft system commands ("event IDs"). For example, the No. 2 APU exhaust effect



Some of the spectacular special visual effects created for the X-15 for Flight Simulator series of add-on aircraft. Each effect is associated with a FS aircraft light or system.

appears when the aircraft navigation lights are on.

There were no external lights or smoke systems on the real-world X-15 airplane, so we can use all the available Flight Simulator aircraft lights and systems to display many X-15-specific visual effects (see images above).

1. On the "Settings – Realism" page, under "Instruments and Lights", select the **PILOT CONTROLS AIRCRAFT LIGHT** option.

The following is a list of Flight Simulator aircraft lights and systems and their corresponding X-15 special visual effects. Note that these effects are internally triggered by the X-15 for Flight Simulator systems and panels and should be off at this time.

For all aircraft equipped with the XLR-99 engine:

- **Aircraft smoke system:** XLR-99 rocket engine flame effect, as shown in fig. 1 and 2 at left.
- **Cabin lights:** XLR-99 first and second stage igniter effects, as shown in fig. 3 and 4 at left.
- **Wing lights:** hydrogen peroxide jettison effect, as shown in fig. 5 at left.
- **Recognition lights:** XLR-99 engine turbopump exhaust effect (see page 5-18).
- **Taxi lights:** frost on the fuselage and condensation vapor effect around the liquid oxygen tank when filled, as shown in fig. 6 at left.
- **Strobe lights:** No. 1 APU exhaust effect, as shown in fig. 6, 5 and 3 at left.
- **Navigation lights:** No. 2 APU exhaust effect, as shown in fig. 6, 5 and 3 at left.
- **Beacon lights:** liquid oxygen jettison effect in addition to engine precool and prime effects, as shown in fig. 3, 5 and 7 at left.
- **Logo lights:** ammonia jettison effect in addition to prime effect, as shown in fig. 3, 5 and 7 at left.
- **Landing lights:** external propellant tanks jettison.
- **Tailhook:** ventral (or dummy ramjet) jettison animation effect (see page 5-28).
- **Aircraft contrail:** X-15 rocket engine contrail effects, as shown in fig. 8 at left.

OTHER FLIGHT SIMULATOR SETTINGS

The other recommended settings will make your first flight in the X-15A-2 more enjoyable:

1. On the "Settings – Realism" page, set the following:
   a. All "Flight Model" settings – **50%** (cursor in the middle).
   b. Gyro drift – **SELECTED**.
   c. Display indicated airspeed – **SELECTED**.
   d. Ignore crashes and damage – **SELECTED**.
   e. G-effects – **UNSELECTED**.
2. Click **OK** to close the "Settings – Realism" page.

EXTERIOR INSPECTION

X-15A-2 for Flight Simulator (with white ablative coating).

An exterior description of the X-15A-2 for Flight Simulator is available in section III (figure 3-1 and figure 3-2). It is recommended to familiarize yourself with the general external arrangement of the aircraft before proceeding.

In the real world: Because of the mission of the X-15 and the equipment used by the pilot, it was not feasible for him to perform an exterior inspection of the aircraft before flight. This task was left to the ground personnel.

1. Select the **SPOT PLANE** view, either with the appropriate button on your joystick, by depressing the **"S"** key on your keyboard several times, or in the "View Options" page (under the "Views" menu in the Flight Simulator main window, click "**View Options**" and select **SPOT PLANE** view).

This will permit you to inspect the exterior of the X-15A-2. You can use the appropriate button on your joystick (or the arrow keys on your numeric keypad) to move around the aircraft. Use the **"+/="** or **"_/-"** keys on your keyboard to zoom in and out.

At this time, the X-15A-2 has not yet been serviced and the engine should be shut down. If the engine has been ignited by the simulator and has not been shut down automatically by the X-15 integrated systems, do the following procedure to shut down the engine:

1. Simultaneously press the **CTRL-SHIFT-F1** keys on your keyboard.

No visual effects (associated with aircraft lights or systems) such as engine flames, APU exhaust steam or frost on the fuselage should be observed around the airplane at this time. If such effects are visible, do the following procedure to turn off the unwanted effects:

1. Press the "**L**" key (All Lights On/Off command) on your keyboard as necessary, until the effects disappear.

The dummy ramjet on the ventral section of the vertical stabilizer does not appear on the X-15A-2 at this time to provide ground clearance and enough space for the rear landing skids. The ramjet (or ventral) will appear later, when the landing gear and skids are raised after takeoff.

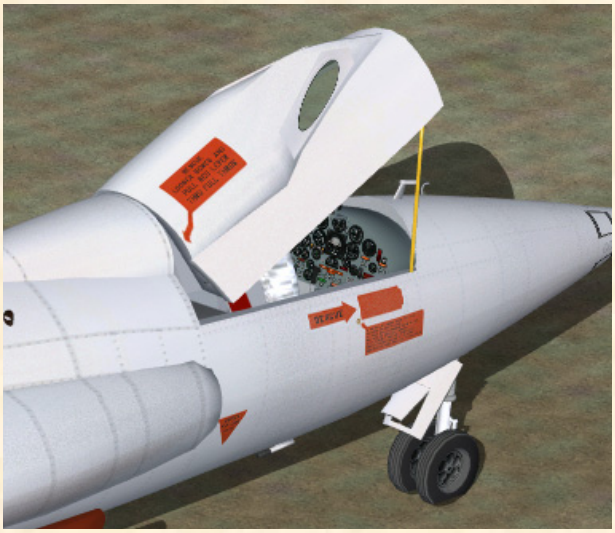
Rear view of the X-15A-2 showing the XLR-99 rocket engine. The dummy ramjet (normally attached to the ventral) does not appear at this time to provide ground clearance and enough space for the rear landing skids.

In the real world: The ventral rudder (or dummy ramjet) was installed by the ground crew after the X-15A-2 was lifted and attached under the wing of the NB-52 carrier. It was later jettisoned by the pilot before landing (see page 5-28).

To open or close the canopy, simultaneously press the **SHIFT-E** keys on your keyboard.

Take a look inside the cockpit and observe how the movement of the center stick and of the right stick controller

corresponds to the movement of your joystick. The throttle and speed brake levers inside the cockpit behave according to the movement of the throttle on your joystick or the movement of the speed brakes.



X-15A-2 showing the main instrument panel inside the cockpit. The caution and warning markings are minimal.

Note that the astronaut/pilot is wearing the David Clark A/P22S-2 full-pressure suit and helmet, released in early 1961, an improvement over the earlier MC-2 suit used at the beginning of the X-15 program.

Don't forget to close the canopy before takeoff!

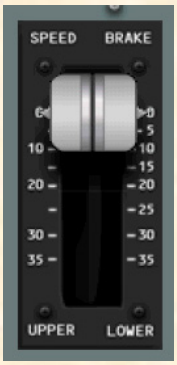
It is possible to observe the movement of the control surfaces, including the speed brakes, at this time. *In the real world, that would not be totally feasible without the APUs operating and providing enough hydraulic power to the motors (a characteristic not supported in this version of the software).*

1. Use your joystick (and/or pedals) to control and observe the movement of the upper vertical stabilizer (rudder) and of the horizontal stabilizer. Note that there are no ailerons on the X-15. The left and right sections of the horizontal stabilizer move simultaneously for pitch control, differentially for roll control, and in compound for pitch-roll control.

2. To open or close the speed brakes, press the **" / "** key on your keyboard. The speed brakes can also be opened, closed and adjusted using the speed brake handle on the throttle and speed brake side panel:

    a. Click the **DISPLAY/HIDE THROTTLE AND SPEED BRAKE PANEL** icon [24, fig. 4-1] on the main panel to display the throttle and speed brake panel (or select **THROTTLE AND SPEED BRAKE PANEL** from the "Instrument Panel" menu, under the "Views" menu of the main Flight Simulator window menu bar).

    b. Undock and reposition the panel if necessary. You can undock the throttle and speed brake panel (like any other Flight Simulator panel) from the main window by right-clicking the panel and selecting the **UNDOCK WINDOW** option.



    c. **Pull** the speed brake lever (downward) to open the speed brakes.

    d. **Push** the speed brake lever forward (upward) to close the speed brakes.

3. Again, if desired, click the **DISPLAY/HIDE THROTTLE AND SPEED BRAKE PANEL** icon 24, fig. 4-1] on the main panel to hide the throttle and speed brake panel (or unselect **THROTTLE AND SPEED BRAKE PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

Make sure the canopy is closed (**SHIFT-E** on your keyboard) and return to the "Cockpit" view.

Rear view of the X-15A-2 showing the large split-flap upper and lower speed brakes.

SERVICING

In the real world: Propellants and gases were loaded onto both the NB-52 carrier and the X-15A-2 by the ground crew before flight. During captive flight (while the rocket plane was attached to the NB-52 and gaining altitude), the X-15A-2 internal liquid oxygen tank was topped off from the carrier airplane supply.

To simulate the complex servicing of the X-15 and X-15A-2 rocket planes both from the ground or from the NB-52 carrier airplane, a fictional "service panel" has been provided with each X-15 for Flight Simulator aircraft. This panel is adapted in part from the launch operator's panel installed inside the NB-52 carrier. Refer to figure 4-2 in section IV for a description of the X-15A-2 for Flight Simulator service panel.

NOTE: Like on the real-world aircraft, all X-15 for Flight Simulator instruments and gauges use imperial measures.

1. Click the **DISPLAY/HIDE X-15A-2 SERVICE PANEL** icon [56, fig. 4-1] on the right side of the main panel, to display the service panel (or select **SERVICE PANEL** from the "Instrument Panel" menu, under the "Views" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the panel if necessary.

The service panel provides electrical power to the X-15 aircraft before the APUs can be turned on. This would simulate electrical power to be supplied to the X-15 either from a ground receptacle or from the carrier airplane.

1. Service panel power switch [27, fig. 4-2] – **ON.** This will turn on the service panel.

2. Service panel (green) power light [28, fig. 4-2] – **Check ON.**

3. External power switch [25, fig. 4-2] – **ON.** We will assume that electrical power will be supplied from the carrier airplane at this time.

4. External power (yellow) light [26, fig. 4-2] – **Check ON.**

The service panel also allows the individual filling of the X-15A-2 internal and external propellant and gas tanks by turning a series of control valve levers.

An "express fill" button has been provided to accelerate the procedure and concurrently fill all the tanks in a single operation. Pressure and volume gauges are provided to monitor each tank at any time during servicing and during flight.

In a typical X-15A-2 mission, a normal "burnout" occurred after approximately 90 seconds (internal tanks off) to 150 seconds (external tanks on) of XLR-99 engine operation, after all the propellants were exhausted.

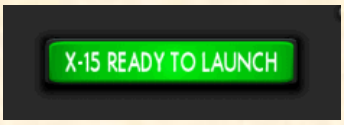
Although by default it is possible to simulate this condition, an "unlimited fuel" switch has been provided on the X-15A-2 for Flight Simulator service panel to allow unlimited-duration burns. Simply turn the switch to **ON** if you wish to use this feature.

As long as the engine master switch [6, fig. 4-1] is set to **OFF**, the fuel consumption can be reset to normal at any time by returning the "unlimited fuel" switch to the **OFF** position.

An external tanks option switch [12, fig. 4-2] has been provided on the service panel for the desktop pilot to choose whether or not the X-15A-2 external drop tanks are installed or not installed on the aircraft. Make sure this switch is set to **INSTALLED** for true X-15A-2 operation (external tanks on).

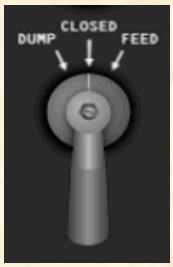
In the real world: The X-15A-2 external tanks provided an additional 1053 gallons of anhydrous ammonia and 770 gallons of liquid oxygen which corresponds approximately to an additional 60 seconds of engine burn time.

NOTE: The external tanks option switch [12, fig. 4-2] cannot be set if the propellant tanks are pressurized (vent, pressurize, and jettison control lever [5, fig. 4-7] not at **VENT**).



Note that a green placard-type indicator light is installed at the top right side of the service panel to give an indication to the NB-52 crew that the X-15 pilot has turned the "Ready-to-Launch" switch [80, fig. 4-1] to **ON**.

To service the X-15A-2, proceed as follows:



Make sure all control valve levers [15-24, fig. 4-2] under each gauge are in the (center) **CLOSED** position.

1. Express fill button [6, fig. 4-2] – **Push (once).** All tanks will be filled simultaneously.

Check each gauge, from left to right, for proper filling:

"Airplane Propellants" section:

1. Liquid oxygen tanks volume gauge [1, fig. 4-2] – **Check (internal tank, 1017 gallons; external tank, 770 gallons).**

2. Ammonia tanks volume gauge [2, fig. 4-2] – **Check (internal tank, 1445 gallons; external tank, 1053 gallons).**

3. Turbopump hydrogen peroxide (H_2O_2) tanks volume gauge [3, fig. 4-2] – **Check (118 gallons).**

4. Propellant source (helium) tanks pressure gauge [4, fig. 4-2] – **Check (both internal and external tanks, 3200-3800 psi).**

5. Engine and propellant control source (helium) tanks pressure gauge [5, fig. 4-2] – **Check (both internal and external tanks, 3200-3800 psi).**

6. Auxiliary pneumatic and control (helium) tank pressure gauge [8, fig. 4-2] – **Check (3200-3800 psi).**

"APU" section:

1. APU propellant source (helium) tanks pressure gauge [9, fig. 4-2] – **Check (3200-3800 psi, both pointers).**

2. APU H_2O_2 tanks volume gauge [11, fig. 4-2] – **Check (60-75 gallons, both pointers).**

"Air Conditioning and Pressurization" section:

1. Cabin helium tank pressure gauge [13, fig. 4-2] – **Check (3200-3800 psi).**

2. Liquid N_2 tank volume gauge [14, fig. 4-2] – **Check (25-30 gallons).**

Note that the air conditioning and pressurization system is not truly functional in this software version.

(As an alternate procedure, each propellant or gas tank can be controlled individually with its associated control valve lever [15-24, fig. 4-2]:

1. Turn the lever to the left in the **DUMP** position to jettison contents of tank.

2. Turn the lever to the right in the **FEED** position to fill the tank.

3. Leave (or turn) lever at center in the **CLOSED** position to stop filling or jettisoning and close the valve.

The tanks will be topped off automatically to prevent overfill. Each tank can be monitored by reading the pressure or volume gauge above each control valve lever.

After the previous procedures have been completed, if desired, click the **DISPLAY/HIDE X-15A-2 SERVICE PANEL** icon [56, fig. 4-1] on the main panel to hide the service panel (or unselect **SERVICE PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

IMPORTANT NOTE: Some switches and levers on the service panel and other X-15A-2 for Flight Simulator instrument panels must be activated **in a logical, predetermined order or sequence** to function. If not, the switch is simply disabled and will not respond to mouse clicks or perform any desired function.

For example, the service panel control valve levers [15-24, fig. 4-2] cannot be turned if the "vent, pressurize and jettison" lever [5, fig. 4-7] is not in the **VENT** position or if the engine precool switch [86, fig. 4-1] is set to **PRECOOL**. Concurrently, the "vent, pressurize and jettison" lever can only be moved to the **PRESSURIZE** or **JETTISON** positions when all the service panel control valve levers are in the **CLOSED** (center) position.

Some switches, especially the ones related to the engine ignition sequence, behave in the same manner. If a switch or lever simply refuses to operate normally, the desktop pilot should revise the previous procedures and make sure that all the required steps have been performed in the correct order. Forgetting to fill the propellant source (helium) tanks, for example, will prevent the propellant tanks from being pressurized and the engine prime switch from being activated because there is simply no pressurized gas to allow the propellants to be pushed and to circulate through the engine feed lines.

PREFLIGHT CHECK

Refer to section IV for a description of the X-15A-2 for Flight Simulator instrument panels.

Left console and side panel:

1. Click the **DISPLAY/HIDE RADIO PANEL** icon [72, fig. 4-1] on the main panel to display the radio panel (or select **RADIO PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the panel if necessary.

3. Radio function selector switch [3, fig. 4-5] – **OFF.**

4. If not already displayed, click the **DISPLAY/HIDE THROTTLE AND SPEED BRAKE PANEL** icon [24, fig. 4-1] on the main panel to display the throttle and speed brake panel (or select **THROTTLE AND SPEED BRAKE PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

5. Undock and reposition the panel if necessary.

6. Speed brake handles [2, fig. 4-6] – **CLOSED (forward).**

7. Click the **DISPLAY/HIDE LEFT WHITE CONSOLE** icon [23, fig. 4-1] on the main panel to display the left white console panel (or select **LEFT WHITE CONSOLE** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

8. Undock and reposition the panel if necessary.

9. Wing flap switch [1, fig. 4-7] – **UP.**

10. Vent, pressurize, and jettison control lever [5, fig. 4-7] – **VENT.**

In the real world: The vent valve on the internal ammonia tank will be manually closed before flight to prevent losing ammonia during captive flight (when the X-15A-2 is

attached to the NB-52 carrier). When the vent, pressurize, or jettison control lever is placed in the PRESSURIZE or JETTISON position and then back to VENT, the ammonia vent valve will then be open.

12. Throttle [1, fig. 4-6] – **OFF**.

13. Click the **DISPLAY/HIDE LEFT SIDE PANEL** icon [7, fig. 4-1] at the far left of the main panel to display the left side panel (or select **LEFT SIDE PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

14. Undock and reposition the panel if necessary.

15. Jettison stop switches [4-6, fig. 4-3] – **STOP.** Check that all three switches (LOX, H_2O_2, and NH_3) are in the **STOP** position.

16. Auxiliary launch switch [3, fig. 4-3] – **OFF (guard down).**

17. Ventral jettison button [2, fig. 4-3] – **Check (normal).**

18. Landing gear handle [1, fig. 4-3] – **IN.**

Main instrument panel (XLR-99 engine):

1. Ignition-ready (green) light [22, fig. 4-1] – **Check OFF.**

2. No-drop or 23-second caution (amber) light [21, fig. 4-1] – **Check OFF.**

3. Idle-end caution (amber) light [20, fig. 4-1] – **Check OFF.**

4. Valve malfunction caution (amber) light [19, fig. 4-1] – **Check OFF.**

5. Stage 2 igniter malfunction caution (amber) light [18, fig. 4-1] – **Check OFF.**

6. Turbopump overspeed caution (amber) light [16, fig. 4-1] – **Check OFF.**

7. Engine vibration malfunction caution (amber) light [15, fig. 4-1] – **Check OFF.**

8. Fire-warning (red) light [37, fig. 4-1] – **Check OFF.**

9. Helium release selector switch [17, fig. 4-1] – **OFF.**

10. Propellant (helium) source pressure gauge [13, fig. 4-1] – **Check (both internal and external tanks, 3300 to 3900 psi).**

11. Engine master switch [6, fig. 4-1] – **OFF.**

12. Engine reset button [8, fig. 4-1] – **Check (normal).**

13. Engine precool switch [86, fig. 4-1] – **OFF.**

14. Engine prime switch [84, fig. 4-1] – **STOP PRIME (DOWN).**

15. Turbopump idle button [82, fig. 4-1] – **Check (normal).**

16. Igniter idle switch [79, fig. 4-1] – **OFF.**

17. Propellant tank pressure gauge [85, fig. 4-1] – **Check (liquid oxygen or "L" pointer, 0 to 5 psi; ammonia or "A" pointer, 0 to 10 psi).**

18. Propellant pump inlet pressure gauge [78, fig. 4-1] – **Check (both pointers, 0 to 10 psi).**

19. Fuel line low caution (amber) light [81, fig. 4-1] – **Check OFF.**

20. H_2O_2 (helium) source pressure gauge [4, fig. 4-1] – **Check (both internal and external tanks, 3000 to 3900 psi).**

21. H_2O_2 tank and engine control line pressure gauge

[83, fig. 4-1] – **Check ("C" pointer, 575 to 615 psi; "T" pointer, 0 psi).**

22. Propellant manifold pressure gauge [76, fig. 4-1] – **Check (both pointers, 0 to 10 psi).**

23. H_2O_2 compartment-hot caution (amber) light [87, fig. 4-1] – **Check OFF.**

24. Chamber and stage 2 igniter pressure gauge [77, fig. 4-1] – **Check (both pointers, 0 psi).**

25. SAS pitch function switch [74, fig. 4-1; 15, fig. 4-10] – **STD BY.**

26. SAS roll function switch [74, fig. 4-1; 16, fig. 4-10] – **STD BY.**

27. SAS test switch [74, fig. 4-1; 14, fig. 4-10] – Check **OFF.**

28. SAS yar function switch [74, fig. 4-1; 5, fig. 4-10] – **STD BY.**

29. SAS yaw function switch [74, fig. 4-1; 6, fig. 4-10] – **STD BY.**

30. SAS caution (amber) lights (four) [74, fig. 4-1; 1-4, fig. 4-10] – Check **ON.**

Main instrument panel (flight instruments):

1. Accelerometer [30, fig 4-1] – **Reset and check.**

2. Altimeter [25, fig 4-1] – **Set.**

3. Attitude indicator [34, fig. 4-1] – **Set.**

Instrument panel (electrical, hydraulic, and cockpit):

1. Emergency battery switch [48, fig. 4-1] – **OFF (guard down).**

2. No. 1 generator-out (amber) light [44, fig. 4-1] – **Check ON (generator not in operation).**

3. No. 2 generator-out (amber) light [49, fig. 4-1] – **Check ON (generator not in operation).**

4. Generator (AC) voltmeter [47, fig. 4-1] – **Check (both pointers, 200 volts, external, from carrier airplane).**

5. No. 1 and No. 2 generator switches [46, 51, fig. 4-1] – **OFF.**

6. APU No. 1 switch [70, fig. 4-1] – **OFF.**

7. APU No. 1 warning and caution lights [53, 66-67, fig. 4-1] – **Check OFF.**

8. No. 1 ballistic control switch [43, fig. 4-1] – **OFF.**

9. No. 2 ballistic control switch [52, fig. 4-1] – **OFF.**

10. APU No. 2 warning and caution lights [54-55, 58, fig. 4-1] – **Check OFF.**

11. APU No. 2 switch [57, fig. 4-1] – **OFF.**

12. APU (helium) source pressure gauge [68, fig. 4-1] – **Check (both pointers, 3300 to 3900 psi).**

13. APU H_2O_2 pressure gauge [69, fig. 4-1] – **Check (both pointers, 0 psi).**

14. Hydraulic pressure gauge [39, fig 4-1] – **Check (both pointers, 0 psi).**

15. Clock [71, fig. 4-1] – **Check and set.**

16. Mixing chamber temperature gauge [64, fig. 4-1] –

Check.

17. APU bearing temperature gauge [65, fig. 4-1] – **Check.**

18. Cabin (helium) source pressure gauge [62, fig. 4-1] – **Check.**

19. Cabin pressure altimeter [63, fig. 4-1] – **Check.**

Center pedestal (research instrumentation panel):

1. Click the **DISPLAY/HIDE CENTER PEDESTAL** icon [75, fig 4-1] at the center of the main panel to display the center pedestal (or select **CENTER PEDESTAL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the panel if necessary.

3. Auxiliary pneumatic and control (helium) pressure gauge [19, fig. 4-8] – **Check (3000 to 3900 psi).**

4. Ball nose test button [6, fig. 4-8] – **Check.**

5. Ram-air lever [15, fig. 4-8] – **OPEN.**

6. Radar beacon switch [13, fig. 4-8] – **OFF.**

7. Instrumentation master power switch [14, fig. 4-8] – **OFF.**

8. Stable platform instrument switch [9, fig. 4-8] – **ON.**

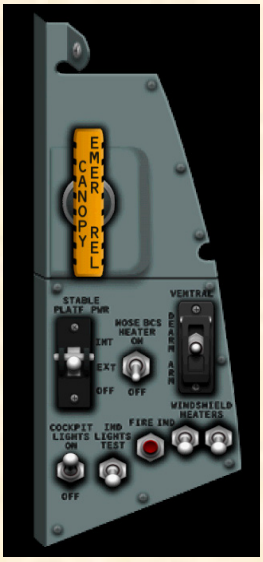
9. Ball nose power switch [5, fig. 4-8] – **ON.**

10. Cockpit ram-air knob [10, fig. 4-8] – **OFF (in).**

11. DC voltmeter selector switch [12, fig. 4-8] – **BUS.**

12. DC voltmeter [11, fig. 4-8] – **Check (28-volt bus or 24-volt strain gage or battery).**

Right console and side panel:



1. Click the **DISPLAY/HIDE RIGHT SIDE PANEL** icon [60, fig. 4-1] at the far right of the main panel to display the right side panel (or select **RIGHT SIDE PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the panel if necessary.

3. Canopy emergency release handle [1, fig. 4-4] – **IN.**

4. Stable platform switch [9, fig. 4-4] – **EXT (carrier airplane, middle position).**

5. Nose ballistic rocket heater switch [2, fig. 4-4] – **OFF.**

6. Ventral arming switch [3, fig. 4-4] – **DE-ARM.**

7. Cockpit lighting switch [8, fig. 4-4] – **ON.**

8. Indicator, caution, and warning light test switch [7, fig. 4-4] – **NORMAL (down position).**

9. Fire-warning light test button [6, fig. 4-4] – **Push once to test.** Fire-warning (red) light [37, fig. 4-1] **ON** indicates continuity of detection circuit.

10. Windshield heater switches (two) [4-5, fig. 4-4] – **OFF.**

11. Center control stick – **Check joystick (stick centered, throttle to MIN).**

Interior inspection operational check:

1. Ready-to-Launch switch [80, fig. 4-1] – **OFF.**

2. Instrumentation master power switch [14, fig. 4-8] – **ON.**

3. Data switch [18, fig. 4-8] – **ON.**

4. Calibrate instrumentation button [2, fig. 4-8] – **Push once** (button green light should come **ON** for 3 seconds, then **OFF**, indicating instrumentation calibration).

5. Ready-to-Launch switch [80, fig. 4-1] – **Test ON.** Ready-to-Launch (green) indicator light on service panel [10, fig. 4-2] should come **ON**. **Turn OFF** Ready-to-Launch switch. Ready-to-Launch (green) indicator light on service panel should come **OFF.**

6. Indicator, caution and warning lights – **Check.** Place the indicator, caution, and warning light test switch [7, fig. 4-4] at **TEST** (up position). All indicator, caution, and warning lights (except the fire warning light) will come **ON**. This is only a test of the bulbs. Return the switch to **NORMAL** (down position).

Make sure the canopy is closed at this time.

X-15A-2 for Flight Simulator after servicing.

CAPTIVE TAXI AND FLIGHT

1. Radio function selector switch [3, fig. 4-5] – Turn right to **MIDDLE position (Main, T/R; Aux., ADF).**

NOTE: The radio function selector switch [3, fig. 4-5] must stay in this (middle) position or be turned further right for the simulator's GPS to be turned on. Turning this switch to OFF (in the left position) turns off the aircraft's avionics and the GPS (see page 5-23).

TAXI (CARRIER AIRPLANE)

In the real world: The following procedures were done during taxi and before takeoff of the carrier airplane.

1. SAS function switches and (amber) lights [74, fig. 4-1; 1-4, 5-6, 15-16, fig. 4-10] – **Check.** Move SAS function switches to **LO GAIN** and check lights (should come **OFF**). Return function switches to **STD BY** after each function trips.

2. Radar beacon switch [13, fig. 4-8] – **ON.**

BEFORE TAKEOFF (CARRIER AIRPLAINE)

In the real world: The following procedures were done before takeoff of the carrier airplane.

1. Ram-air lever [15, fig. 4-8] – **CLOSED.**

2. Helium release switch [17, fig. 4-1] – **AUTO.**

3. Jettison stop switches [1-3, fig. 4-1] – **STOP.**

In the real world: The X-15 pilot would check and report

on the following instruments.

1. Propellant source pressure gauge [13, fig. 4-1] – **Check (both internal and external tanks, 3300 to 3800 psi).**

2. Propellant tank pressure gauge [85, fig. 4-1] – **Check (pointer "L", 0 to 5 psi; "A", 0 to 10 psi).**

3. Propellant pump inlet pressure gauge [78, fig. 4-1] – **Check (pointer "L", 0 to 5 psi; "A", 0 psi).**

4. Chamber and stage 2 igniter pressure gauge [77, fig. 4-1] – **Check (both pointers, 0 psi).**

5. H_2O_2 source pressure gauge [4, fig. 4-1] – **Check (both internal and external tanks, 3000 to 3900 psi).**

6. H_2O_2 tank and engine control line pressure gauge [83, fig. 4-1] – **Check ("C" pointer, 575 to 615 psi; "T" pointer, 0 psi).**

TAKEOFF (CARRIER AIRPLANE)

NOTE: The following procedures can be performed on the ground with the X-15A-2 for Flight Simulator.

In the real world: During takeoff of the carrier airplane, the X-15 pilot would monitor all instruments and relay any information that could affect the planned mission.

1. Ventral arming switch [3, fig. 4-4] – **ARM.**

2. Windshield heater switches (two) [4-5, fig. 4-4] – **ON.**

3. Engine master switch [6, fig. 4-1] – **ARM.**

4. Engine reset button [8, fig. 4-1] – **Push (once).**

5. Engine precool switch [86, fig. 4-1] – **PRECOOL.** Precool the engine, then turn the engine precool switch to **OFF.**

In the real world: The X-15 pilot would precool the engine for 10 minutes on, then 20 minutes off.

A continuous flow overboard of liquid oxygen vapor is emitted during precooling through the engine liquid oxygen prime valve at the rear of the X-15A-2 aircraft.

CLIMB (CARRIER AIRPLANE)

NOTE: The following procedures can be performed on the ground with the X-15A-2 for Flight Simulator.

In the real world: The following procedures were done after takeoff of the carrier airplane, during the climb and cruise part of the flight.

1. Instrumentation master power switch [14, fig. 4-8] – **Check ON.**

2. Telemeter master power switch [16, fig. 4-8] – **ON.**

3. Communications – **Check.** You may want to display the ATC window at this time. Click the **DISPLAY/HIDE ATC WINDOW** icon [72, fig. 4-1] on the main panel to display or hide the ATC window.

In the real world: The X-15 pilot would confirm radio communication with chase planes and ground station and also that communication is available between the X-15 airplane, chase planes, carrier airplane and ground station.

4. Nose ballistic rocket heater switch [2, fig. 4-4] – **ON.**

5. Ram-air lever [15, fig. 4-8] – **OPEN.**

CRUISE-CLIMB TO LAUNCH ALTITUDE

NOTE: The following procedures can be performed on the ground with the X-15A-2 for Flight Simulator.

In the real world: During the cruise-climb to launch altitude, the pilot of the NB-52 carrier would start the time-to-go sequence and confirm with the launch operator that the liquid oxygen top-off is satisfactory. The following procedures would be performed at an altitude of between 35,000 to 45,000 feet.

1. Ram-air lever [15, fig. 4-8] – **CLOSED.**

PRELAUNCH

BEFORE COUNTDOWN

Before countdown, complete final cockpit check as follows:

1. Ram-air lever [15, fig. 4-8] – **Check CLOSED.**

2. Ventral arming switch [3, fig. 4-4] – **Check ARM.**

APUs:

When the APUs are operating, steam should be observed coming out of the APU exhaust pipes.

1. APU switch No. 1 [70, fig. 4-1] – **ON.** As APU No. 1 comes up to speed, hydraulic pressure will increase and then stabilize at 3000 to 3500 psi.

2. No. 1 generator switch [46, fig. 4-1] – Move No. 1 generator switch momentarily to **RESET**, then to **ON.**

3. No. 1 generator out (amber) light [44, fig. 4-1] – Check **OFF.**

4. APU switch No. 2 [57, fig. 4-1] – **ON.** As APU No. 2 comes up to speed, hydraulic pressure will increase and then stabilize at 3000 to 3500 psi.

5. No. 2 generator switch [51, fig. 4-1] – Move No. 2 generator switch momentarily to **RESET**, then to **ON.**

6. No. 2 generator out (amber) light [49, fig. 4-1] – **Check OFF.**

7. Stable platform power switch [61, fig. 4-1; 9, fig. 4-4] – **INT (up position).**

8. Service panel external power switch [25, fig. 4-2] – **OFF.**

9. Service panel external power (yellow) light [26, fig. 4-2] – **Check OFF.**

10. Generator (AC) voltmeter [47, fig. 4-1] – **Check (both pointers, 200 volts, internal).**

11. Hydraulic pressure gauge [39, fig 4-1] – **Check (both pointers, 3000 to 3500 psi).**

12. DC voltmeter selector switch [12, fig. 4-8] – Check **BUS.**

13. DC voltmeter [11, fig. 4-8] – **Check (28 volts).**

SAS IN-FLIGHT CHECK

At a Mach number of about 3.0 and an angle-of-attack greater than 10°, the X-15 was uncontrollable without damping when normal piloting techniques were used.

Before launch, perform the following functional check of the stability augmentation system [74, fig. 4-1]:

1. Yar function switch [5, fig. 4-10] – **STD BY.**

2. Pitch, roll and yaw function switches [4-5, 15-16, fig. 4-10] – **LO GAIN.** Check that the roll, pitch, and yaw caution (amber) lights are out.

3. SAS test switch [14, fig. 4-10] – Move SAS test switch to **WORK** and check that the SAS pitch, roll and yaw caution (amber) lights blink (once); then release switch to **OFF (CENTER).**

4. Pitch, roll and yaw function switches [4-5, 15-16, fig. 4-10] – **STD BY**, then **LO GAIN.** When the switches are moved to **STD BY**, check that the caution lights burn steadily; then move the switches to **LO GAIN**, and check that the caution lights go out.

5. SAS test switch [14, fig. 4-10] – Move SAS test switch to **MON** and check that the SAS pitch, roll and yaw caution (amber) lights blink; then release switch to **OFF (CENTER).**

6. Pitch, roll and yaw function switches [4-5, 15-16, fig. 4-10] – **STD BY**, then **LO GAIN.** When the switches are moved to **STD BY**, check that the caution lights burn steadily; then move the switches to **LO GAIN**, and check that the caution lights go out.

In the real world: If a SAS malfunction is suspected during flight, the pilot can perform the preceding check at his discretion. The SAS check may be performed on any one function or a combination of pitch, roll, and yaw functions.

NOTE: Flight Simulator does not provide true SAS functions at this time. Consequently, the switches on the X-15A-2 SAS panel do not perform any specific simulator function in this software version, other than being animated to simulate SAS-related procedures.

COUNTDOWN

1. All instrumentation switches on center pedestal [Fig. 4-8] (depending on center pedestal configuration) – **ON.**

2. Ball nose power switch [5, fig. 4-8] – **Check ON.**

3. Ball nose test button [6, fig. 4-8] – **Depress, then release.**

Depressing the ball nose test button electrically simulates a predetermined airplane attitude. The ball nose should drive to a position that causes the angle-of-attack indicator to show about a 5-degree nose-down indication. The sideslip indicator will also read about a 15-degree sideslip to the left.

When the button is released, the ball nose should drive to the extreme position and appear as a 40-degree nose-up indication on the attitude indicator and a 30-degree sideslip to the right on the sideslip indicator. This reading should be maintained for 2 to 3 seconds, then the ball nose should resume normal operation, driving rapidly to indicate the actual angle of attack and sideslip of the airplane.

Propellant jettison tests:

Propellant jettison tests will be conducted concurrently on all three systems (liquid oxygen, ammonia and hydrogen peroxide).

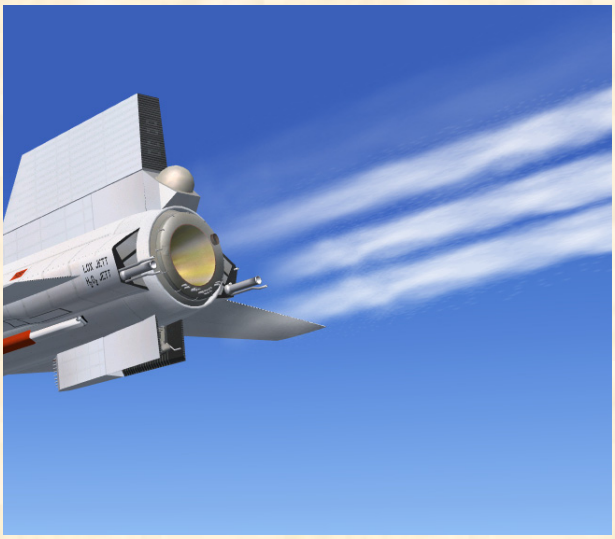
1. Instrument readings – **Check for proper reading before pressurization.**

2. Vent, pressurize, and jettison control lever [5, fig. 4-7] – **JETTISON.**

3. Jettison stop switches [4-6, fig. 4-3] – **JETT** for about 3 seconds then **STOP.** In the spot plane exterior view, check for vapor emitting from the jettison ports, at the back of the X-15 aircraft.

4. External tanks fuel flow indicator [31, fig. 4-1] – **Check (both pointers, about 80% during jettison test).**

NOTE: The liquid oxygen and ammonia jettison ports are the long tubes protruding at the back of the airplane's side fairings (each side of the engine compartment). The hydrogen peroxide jettison port is located inside the lower speed brake compartment (right side). Because of some limitations of the FS2004 platform, there is no special effect associated with the APU H_2O_2 jettison.



The three propellants (liquid oxygen, ammonia and hydrogen peroxide) are being dumped overboard through the jettison ports at the back of the X-15A-2.

Propellant tank pressurization:

1. Vent, pressurize, and jettison control lever [5, fig. 4-7] – **PRESSURIZE.**

When the vent, pressurize, and jettison control lever is moved to **PRESSURIZE**, ammonia and liquid oxygen tanks are pressurized and the propellants will be supplied to the engine turbopump. The hydrogen peroxide tank is also pressurized and H_2O_2 will be supplied to the turbopump cut-off valve.

In the real world: The X-15 pilot would check and report the following instruments. If instruments are not within limits, the pilot would check with ground control for an alternate mission.

1. Propellant tank pressure gauge [85, fig. 4-1] – **Check ("L" pointer, 45 to 65 psi; "A" pointer, 45 to 65 psi).**

2. External tanks fuel flow indicator [31, fig. 4-1] – **Check (both pointers, about 50% after initial pressurization). Fuel flow will gradually increase to about 80% during the jettison check and up to 100% during engine operation.**

3. H_2O_2 tank and engine control line pressure gauge [83, fig. 4-1] – **Check ("C" pointer, 575 to 615 psi; "T" pointer, 425 to 475 psi).**

4. DC voltmeter selector switch [12, fig. 4-8] – **STRAIN GAGE.**

5. Check strain gauge (battery) power supply **(24 volts)** on DC voltmeter [11, fig. 4-8].

6. DC voltmeter selector switch [12, fig. 4-8] – **BUS.**

7. SAS function switches [6, 15-16, fig. 4-10] – **LO GAIN.** Check that the pitch, roll, and yaw caution (amber) lights are **OUT**.

8. Flight controls – **Check.**

In the real world: The X-15 pilot would move all flight

controls through allowable travel and would receive verbal acknowledgment from the launch operator (in the carrier airplane) and the chase pilots that all control surfaces are operating properly.

9. Propellant tank pressure gauge [85, fig. 4-1] – **Check ("L" pointer, 45-65 psi; "A" pointer, 45-65 psi).**

10. Engine precool switch [86, fig. 4-1] – **PRECOOL.**

11. Propellant pump inlet pressure gauge [78, fig. 4-1] – **Check ("L" pointer, 45 to 65 psi; "A" pointer, 0 psi).**

12. Engine prime switch [84, fig. 4-1] – **PRIME.** Move engine prime switch to **PRIME** for one second, then release it and check ignition ready light [22, fig. 4-1] **ON**. The engine will continue to prime (at high flow rates) until the actual start stops the prime.

In the real world: About 30 seconds are required to prime the engine, with the prime valve at high-flow position. A continuous flow overboard of liquid oxygen and ammonia will be observed at the back of the aircraft by the launch operator.

XLR-99 engine prime (X-15A-2).

NOTE: The prime can be stopped at any time by placing the engine prime switch at **STOP PRIME**. This closes the liquid oxygen and NH_3 tank main propellant valves and the H_2O_2 safety valve.

13. Chamber and stage 2 igniter pressure gauge [77, fig. 4-1] – **Check (both pointers, 0 psi).**

14. H_2O_2 source pressure gauge [4, fig. 4-1] – **Check (both internal and external tanks, 3000 to 3900 psi).**

15. H_2O_2 tank and engine control line pressure gauge [83, fig. 4-1] – **Check (both pointers, 575 to 615 psi).**

16. Propellant pump inlet pressure gauge [78, fig. 4-1] – **Check (both pointers, 45 to 65 psi).**

Turbopump operation.

17. Turbopump idle button [82, fig. 4-1] – **Push once.** This will start the engine turbopump and hot exhaust gas will be emitted at the back of the aircraft.

18. Propellant manifold pressure gauge [76, fig. 4-1] – **Check (both pointers, 300 to 450 psi).**

The manifold pressure will increase during engine operation and will vary according to the movement of the throttle. Make sure that the throttle on your joystick is set to its minimum position:

19. Move the throttle on your joystick to its maximum

(forward) position. **Then pull the throttle back to its minimum position.**

20. Telemeter and radar switches [16, 13, fig. 4-8] – **Recheck.**

21. Telemeter commutator motor switch [17, fig. 4-8] – **Check ON.**

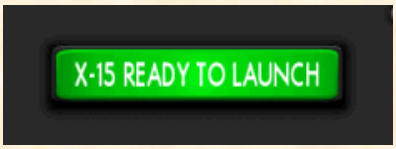
22. Communications – **Check.**

In the real world: Check communication with ground station, carrier pilot, and chase pilots.

23. Ready-to-Launch switch [80, fig. 4-1] – **ON.**

In the real world: Verbally check with carrier pilot and launch operator that the Ready-to-Launch light is on.

24. Ready-to-Launch (green) light on Service Panel [10, fig. 4-2] – **Check ON.**



Operation of igniter idle is limited to 30 seconds. When 7 seconds remain of the normal igniter idle phase, the no-drop or 23-second (amber) caution light [21, fig. 4-1] will come **ON.** With the no-drop or 23-second (amber) caution light on, the pilot must terminate the igniter idle phase – by moving the engine prime switch to **STOP PRIME** – or continue on to the launch phase.

In the real world: The igniter idle phase must be terminated immediately if the idle-end (amber) caution light [20, fig. 4-1] comes on, as damage to the engine chamber will occur because of insufficient cooling.

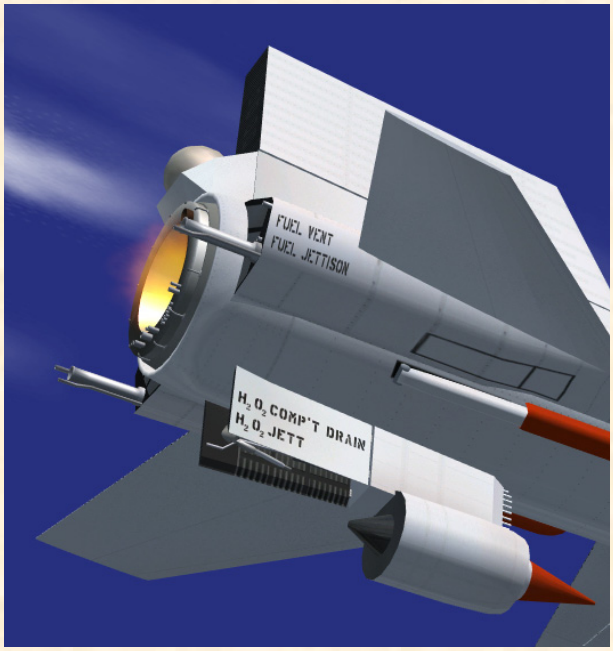
25. Igniter idle switch [79, fig. 4-1] – **IGNITER.**

When the igniter idle switch is placed to **IGNITER**, the ignition-ready light [22, fig. 4-1] goes out for 2 seconds while the engine is purged with helium and the igniter spark plugs are energized. When this phase is completed, the ignition-ready light comes on again.

26. Chamber and stage 2 igniter pressure gauge [77, fig. 4-1] – **Check (small pointer, 150 psi in about 5 seconds, when stage 2 is ignited).** Flames should be observed inside the rocket engine bell (nozzle) as stage 1 and stage 2 are ignited.

The main chamber and stage 2 igniter pressure will increase during engine operation and will vary according to the movement of the throttle.

Ready to launch! *In the real world: Countdown by carrier pilot.*



Igniter idle phase.

BALLISTIC CONTROL AND REACTION AUGMENTATION SYSTEM OPERATION

Since some missions will involve flight at altitudes where control surfaces are ineffective and where ballistic control system operation will be required to maintain airplane attitude, the ballistic control system should be

turned on before launch. The reaction augmentation system (RAS) should be turned on as soon as possible after engine burnout.

In the real world: The ballistic control system rockets were removed from the X-15A-2 with the full white ablative coating because the system was unnecessary for the high-speed flights.

To turn on the ballistic control and reaction augmentation systems, proceed as follows:

1. No. 1 ballistic control switch [43, fig. 4-1] – **ON.**

2. No. 2 ballistic control switch [52, fig. 4-1] – **ON.**

3. RAS function switches [9-11, fig. 4-10] – **ON.**

4. RAS-out (amber) light [7, fig. 4-10] – **OUT (OFF).**

5. RAS control indicator lights [2-4, fig. 4-7] – **ON.**

NOTE: Flight Simulator does not provide ballistic control or reaction augmentation systems for rocket airplanes at this time. Consequently, the BCS and RAS switches on the X-15A-2 main panel do not perform any specific simulator function in this software version, other than being animated to simulate BCS and RAS-related procedures.

LAUNCH

When the X-15 for Flight Simulator is launched from a high altitude (for example, from 45,000 feet in a saved flight), the following X-15 airplane control surface deflections are recommended:

- Horizontal stabilizer:
  - Symmetrical deflection – **0˚**
  - Differential deflection – **0˚**
- Vertical stabilizer – **0˚**
- Speed brakes – **0˚ (in)**
- Flaps – **0˚ (up)**

NOTE: It is possible to simulate a high-altitude launch from a carrier aircraft by using the slew mode commands (**"Y"**) to reposition the aircraft without flying in real time or simply by changing the altitude and speed settings in the map dialog box (click on the **Map icon** [72, fig. 4-1] or **"Map"** on the **World** menu).

When taking off from an airport runway like a conventional Flight Simulator aircraft, control surfaces must be adjusted by the desktop pilot to maintain a nose-up climb/pitch angle of about 30 to 45 degrees.

In the real world: As seen before, the real X-15 was not designed for a normal takeoff from the ground. Instead, it was dropped from a modified B-52 carrier airplane at an altitude of about 45,000 feet.

Takeoff (from the ground) can be accomplished at around 250 to 280 knots IAS (!)* by gently pulling on the joystick. As soon as the aircraft is airborne, raise the landing gear by clicking the **landing gear handle** [9, fig. 4-1; 1, fig. 4-3] on the left side panel (or using the **"G"** key on your keyboard or the appropriate button on your joystick). When the landing gear is up, the ventral section of the vertical stabilizer (or the dummy ramjet) will appear.

X-15A-2 for Flight Simulator after launch.

In the real world: The X-15 pilot could not retract the landing gear once it has been deployed because it was locked in place.

***:** Like the real aircraft, the X-15A-2 for Flight Simulator has a very low lift-drag ratio at low speed (one that produces little aerodynamic lift).

After the rocket engine is ignited, the X-15A-2 for Flight Simulator will accelerate at a very high rate to high Mach numbers and will reach high altitudes in a matter of seconds (see fig. 5-1). Refer to the FS aircraft **Reference information tab** of the Kneeboard (**F10**) for airspeed vs altitude limitations (see also appendix 3). Use the throttle and the speed brakes to increase or decrease speed depending on the mission's objectives and altitude.

If strong movements are applied to the joystick and translated to the control surfaces of the airplane traveling at several times the speed of sound, the pilot might lose control of the aircraft. During the initial acceleration (zooming) phase, it is recommended to apply only enough movement to the joystick to maintain the correct nose-up pitch angle and a smooth climb.

The X-15A-2 is equipped with two large external aluminum propellant tanks to provide a longer engine run which results in added velocity. In flight, the liquid oxygen and ammonia from the external tanks are transferred, under helium pressure, to their respective internal tanks. Indication of propellant flow from the external tanks is displayed to the pilot on the external tanks fuel flow indicator on the main instrument panel [31, fig. 4-1].

X-15A-2 accelerating. The external tanks are still attached to the airplane.

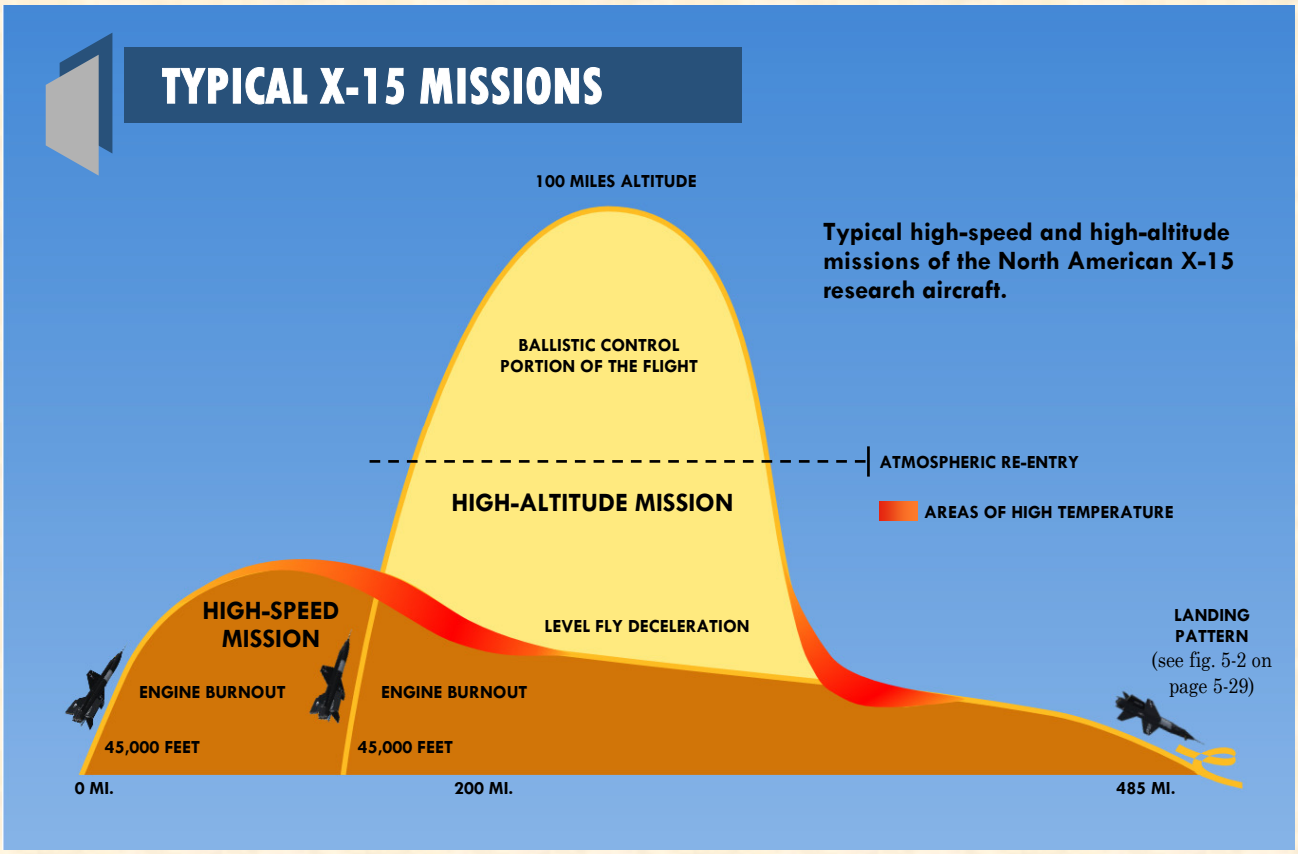
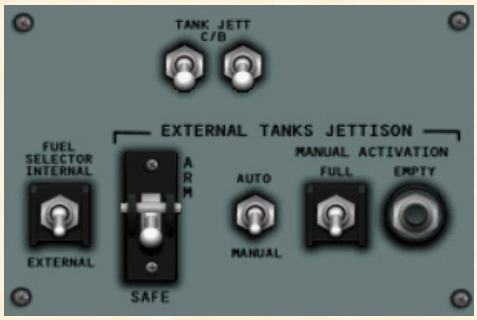


Figure 5-1

When the fuel selector switch [7, fig. 4-9] on the external tanks control panel [fig. 4-9] is set to **EXTERNAL** (propellant system pressurized), a transfer system is activated and the propellant is transferred from the external



tanks to the internal tanks. At the end of a preset time period, an *intervalometer* times out, deactivating the transfer system, and the two external tanks jettison-ready indicator lights in the cockpit [28, 32, fig. 4-1] come **ON**, indicating that the tanks are ready to be released. The propellant feed system automatically shifts to the internal tank feed.

When the fuel selector switch [7, fig. 4-9] on the external tanks control panel [Fig. 4-9] is set to **INTERNAL** (propellant system pressurized), the transfer system is deactivated and propellant feed is from internal tanks only, regardless of propellant remaining in the external tanks.

The external tanks jettison safe-arm switch [6, fig. 4-9] controls arming of the external tank release circuit.

When the external tanks jettison auto-manual switch [5, fig. 4-9] is set to **AUTO** (fuel selector switch at **EXTERNAL** and external tanks jettison safe-arm switch to **ARM**), the automatic mode of external tank release system is activated. When the *intervalometer* (see above) times out, **the external tanks are automatically released.**

Placing the switch to **MANUAL** activates the manual mode of the external tank release system. To release the tanks, the pilot must press the external tanks jettison empty button [3, fig. 4-9]. If the tanks are full, the pilot must actuate the external tanks jettison full switch [4, fig. 4-9]. Either full or empty jettison switches will release the tanks if the system is armed.

IMPORTANT NOTE: Use the external tanks jettison full switch to release full tanks for successful tank separation. **Do not use the external tanks jettison empty button to release a full tank, as serious damage to the tanks and airplane will result.**

To arm the external tank release system and select the manual mode, proceed as follows:

1. Make sure the external tanks option switch on the service panel [12, fig. 4-2] is set to **INSTALLED**.

2. Fuel selector switch [7, fig. 4-9] – **EXTERNAL.**

3. External tanks jettison safe-arm switch [6, fig. 4-9] – **ARM.**

4. External tanks jettison auto-manual switch [5, fig. 4-9] – **MANUAL.**

IMPORTANT NOTE: The maximum Mach number to be reached by the X-15A-2 aircraft with the external tanks attached is 2.6. **The tanks must be released before reaching that speed (see appendix 3).**

X-15A-2 quickly accelerating to high Mach numbers after her external propellant tanks have been released.

Once the external tanks are released, the X-15A-2 will quickly accelerate to higher Mach numbers until the pilot

shuts down the engine or until "burnout" occurs after all the propellants are exhausted (unfortunately, the maximum speed to be attained in FS2004 is Mach 4.65).

In a typical X-15 mission (see fig. 5-1 on page 5-21), a normal burnout will occur after more or less 90 to 150 seconds of XLR-99 engine operation (depending if the external tanks are installed or not).

An engine timer (stopwatch) was installed in the real-world X-15 equipped with the XLR-99 engine. The timer was automatically started during the ignition sequence and would later tell the pilot when to shut down the engine, depending on the mission's objectives (altitude and speed to be attained).

Make sure the X-15 for Flight Simulator engine timer [36, fig. 4-1] has been **RESET**, if not indicating **0**, before the ignition sequence starts.

Once burnout occurs during a high-altitude mission or simply when the engine is shut down by the pilot during a high-speed mission, the X-15 will continue on its trajectory, sometimes to reach even higher altitudes.

The X-15 will complete its course and commence its descent. The pilot will set up the correct angle-of-attack for reentry into the earth's atmosphere (high-altitude mission) and perform a 5G to 7G pullout to level flight at about 70,000 feet, after reentry. The speed brake will be applied to further reduce the speed of the aircraft during its descent (caution: see note on page 5-27).

X-15A-2 during her descent.

Edwards Air Force Base (and nearby Rogers Dry Lake) is at a relatively short distance from Mud Lake (Coaldale airfield). You can use the Garmin GPS unit, provided in Microsoft® Flight Simulator, to track your flight and manually shut down the engine before reaching your final destination.

To display the GPS panel:

1. Click the **DISPLAY/HIDE GPS** icon [72, fig. 4-1] on the main panel to display the GPS panel (or select **GPS** from the "Instrument Panel" menu, under the "Views" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the GPS panel if necessary.

In the real world: Of course, there were no GPS units installed in the real X-15 rocket plane. The pilot would receive guidance from ground station and from the chase plane pilots to help him navigate.

The default Flight Simulator magnetic compass is also available to the X-15 desktop pilot. To display the compass:

1. Click the **DISPLAY/HIDE COMPASS** icon [72, fig. 4-1] on the main panel to display the compass panel (or select **Magnetic Compass** from the "Instrument Panel" menu, under the "Views" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the compass panel if necessary.

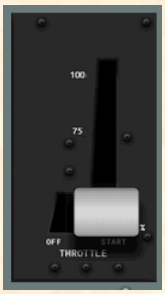
Hypersonic flight generates tremendous amount of heat and a special **ablative coating** needed to be used to protect the exterior of the X-15A-2 aircraft. It consisted of the basic Martin MA-25S pink ablator (still being used today on the space shuttle external tank) sealed with the Dow Corning DC90-090 white protective wear layer.

An external "eyelid" was designed to protect the left canopy window from being smeared by ablator residue during high-speed flight. To open the eyelid before landing, use the Concorde nose simulator command: **SHIFT-Y.** To close the eyelid, use **CTRL-Y.**

ENGINE START

After release from the "carrier airplane" or when ready to take off from the runway, proceed as follows:

On the throttle and speed brake panel:



1. Throttle [1, fig. 4-6] – **START (click and then move inboard to 50%).** Throttle must be moved to 50% by the time the idle-end (amber) caution light [20, fig. 4-1] comes on.

Note that combustion in the main thrust chamber of the XLR-99 engine on the X-15 for Flight Simulator will occur almost instantaneously when the throttle lever is moved from OFF to START 50%.

2. Chamber and stage 2 igniter pressure gauge [77, fig. 4-1] – **Check (large pointer, 335 to 600 psi within 2 seconds, depending on throttle position; small pointer 350 to 630 psi, depending on throttle position).**

3. Propellant manifold pressure gauge [76, fig. 4-1] – **Check ("L" pointer, 455 to 980 psi; "A" pointer, 510 to 1155 psi).**

4. Propellant (helium) source pressure gauge [13, fig. 4-1] – **Check (both internal and external tanks, 3300 to 3900 psi).**

5. H_2O_2 source (helium) pressure gauge [4, fig. 4-1] – **Check (both internal and external tanks, 3300 to 3900 psi).**

6. Propellant tank pressure gauge [85, fig. 4-1] – **Check ("L" pointer, 45 to 65 psi; "A" pointer, 45 to 65 psi).**

7. H_2O_2 tank and engine control line pressure gauge [83, fig. 4-1] – **Check (both pointers, 575 to 615 psi).**

8. External tanks fuel flow indicator on the main instrument panel [31, fig. 4-1] – **50% to 100%.**

XLR-99 engine start on the X-15A-2 for Flight Simulator. The XLR-99 engine produced nearly 60,000 pounds of thrust at high altitude.

NORMAL INDICATIONS DURING START

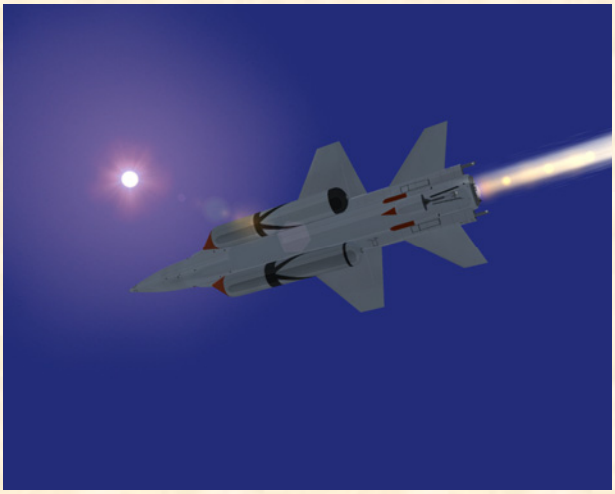
When the thrust chamber or chambers are fired, the following indications will be evident:

- ❑ Turbine whine;
- ❑ Turbine exhaust steam will be seen at the back of the aircraft;
- ❑ Liquid oxygen and ammonia will automatically stop bleeding overboard (as observed during prime);
- ❑ Liquid oxygen and ammonia manifold pressure will rise to rated values;
- ❑ Igniters will be operating;
- ❑ Chamber pressure will rise to a point where the igniters cease firing and chamber pressure will be shown on the indicator gauge;
- ❑ Airplane propellants will be consumed at a very high rate, as can be observed on the volume gauges [1-3, fig. 4-2] on the X-15A-2 for Flight Simulator service panel;
- ❑ Chamber pressure will reach rated values;
- ❑ Thrust chamber will emit a great deal of noise;
- ❑ Flames and exhaust gases (smoke, steam) will be seen at the back of the airplane.

ENGINE THRUST CONTROL

Engine thrust is controlled by movement of the throttle between 50% and 100% thrust. Engine response to throttle movement is very rapid, 50% to 100% in approximately 1.5 seconds.

Remember that combustion in the main thrust chamber of the XLR-99 engine on the X-15A-2 for Flight Simulator will occur almost instantaneously when the throttle lever [1, fig. 4-6] is moved from OFF to START 50%.



X-15A-2 in flight.

NORMAL OPERATING CONDITIONS

The following conditions accompany normal rocket engine operation (see appendix 2 for more details):

XLR-99 engine:

1. Propellant source pressure gauge [13, fig. 4-1] – **(both internal and external tanks) 3200-3800 psi, gradually decreasing.**

2. H_2O_2 source pressure gauge [4, fig. 4-1] – **(both internal and external tanks) 3000 psi, gradually decreasing.**

3. Propellant tank pressure gauge [85, fig. 4-1] – **45 to 53 psi (both pointers).**

4. Propellant pump inlet pressure gauge [78, fig. 4-1] – **"L" pointer, 40 to 70 psi; "A" pointer, 40 to 55 psi.**

5. APU H_2O_2 tank pressure gauge [69, fig. 4-1] – **550 to 610 psi (both pointers).**

6. Cabin helium source pressure gauge [62, fig. 4-1] – **1000 to 3400 psi.**

7. Hydraulic pressure gauge [39, fig. 4-1] – **2900 to 3400 psi (both pointers).**

8. APU bearing temperature gauge [65, fig. 4-1] – **80˚ C to 130˚ C (both pointers).**

9. Mixing chamber temperature gauge [64, fig. 4-1] – **-45˚ C to -35˚ C (both pointers).**

10. Generator (AC) voltmeter [47, fig. 4-1] – **195 to 205 volts.**

11. H_2O_2 tank and engine control line pressure gauge [83, fig. 4-1] – **"C" pointer, 575 to 600 psi; "T" pointer, 565 to 600 psi.**

12. Propellant manifold pressure gauge [76, fig. 4-1] – **"L" pointer, 440 to 1050 psi; "A" pointer, 495 to 1150 psi.**

13. Chamber and stage 2 igniter pressure gauge [77, fig. 4-1] – **large pointer, 345 to 600 psi; small pointer, 350 to 630 psi.**

EXTERNAL TANKS RELEASE

The external tanks must be released before the X-15A-2 reaches Mach 2.6 (see page 5-22 and appendix 3).

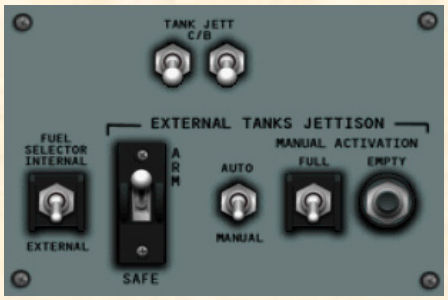
1. Fuel selector switch [7, fig. 4-9] – **Check EXTERNAL.**

2. External tanks jettison safe-arm switch [6, fig. 4-9] – **Check ARM.**

3. External tanks jettison auto-manual switch [5, fig. 4-9] – **Check MANUAL.**

IMPORTANT NOTE: Use the external tanks jettison full switch to release full tanks for successful tank sepa-

ration. **Do not use the external tanks jettison empty button to release a full tank, as serious damage to the tanks and airplane will result.**



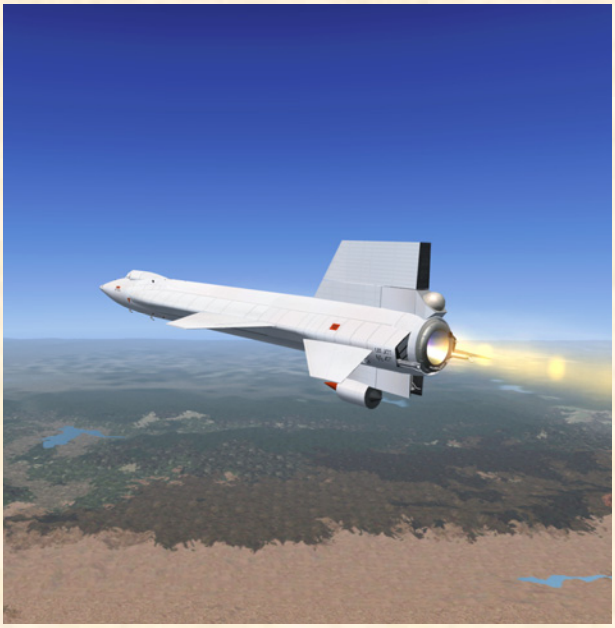
To manually release the external tanks, proceed as follows:

1. If the two external tanks jettison-ready indicator lights [28, 32, fig. 4-1] are **ON** and the tanks are empty, press the external tanks jettison empty button [3, fig. 4-9] to release the tanks.

Or

1. If the two external tanks jettison-ready indicator lights [28, 32, fig. 4-1] are **OFF** and the tanks are not empty, actuate the external tanks jettison full switch [4, fig. 4-9] to release the tanks.

NOTE: See page 5-22 for more details.



X-15A-2 accelerating beyond Mach 3, after the external tanks have been released.

ENGINE BURNOUT

Propellant exhaustion (burnout) will result in the following:

- Ammonia or oxygen manifold pressure drops, with consequent shutdown (of the engine) by low manifold safety circuit;
- Pump cavitates, with consequent overspeed (pump and engine) cut-off.

SHUTDOWN PROCEDURE

To shut down the engine, proceed as follows:

1. **Retard throttle** [1, fig. 4-6] to **50%**: then move throttle outboard to **OFF (click in the black area left of the throttle handle after it is moved to 50%)**.

Or

1. Engine prime switch [84, fig. 4-1] – **STOP PRIME**.
2. Igniter idle switch [79, fig. 4-1] – **Check OFF.**
3. Engine master switch [6, fig. 4-1] – **OFF.**
4. Vent, pressurize, and jettison control lever [5, fig. 4-7] – **VENT** (left white console panel).

ABORTED LAUNCH

If for any reason the decision is made to abort the launch after the countdown has started, proceed as follows:

1. Engine prime switch [84, fig. 4-1] – **STOP PRIME.**
2. Igniter idle switch [79, fig. 4-1] – **Check OFF.**
3. Engine master switch [6, fig. 4-1] – **OFF.**
4. External power switch [25, fig. 4-2] on the service panel – **ON.** Electrical power will be supplied from the carrier airplane at this time.
5. No.1 and No. 2 generator switches [46, 51, fig. 4-1] – **OFF.** Check that both No. 1 and No. 2 generator-off (amber) lights come on.
6. APU switches [57, 70, fig. 4-1] – **OFF.**
7. Ventral arming switch [3, fig. 4-4] – **DE-ARM.**

DESCENT

1. **IF NECESSARY**, use the speed brakes to reduce the speed of the aircraft during its descent*. To open or close the speed brakes, press **" / "** on your keyboard as desired (the speed brakes can also be opened, closed and adjusted using the **speed brake handle** on the throttle and speed brake side panel).

X-15A-2 during her descent and about to perform a 5G pullout to level flight at about 65,000 feet.

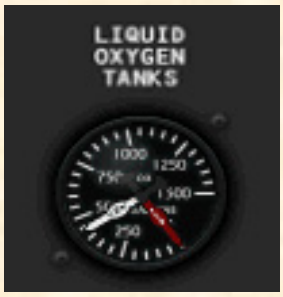
2. **Pull the joystick SMOOTHLY** to perform a 5-G to 7-G pullout to level flight at about 70,000 to 60,000 feet, after reentry (see fig. 5-1 on page 5-29).

NOTE: The speed brakes on the X-15 aircraft were not designed for use as a low-speed drag device. Their design function was to provide the necessary drag conditions for control of the airplane at supersonic speeds and relatively high altitudes.

***CAUTION:** Remember that the X-15 possesses a very low lift-drag ratio. After the engine burned out, the aircraft would come down fast and steep. Because of the high rate of descent and the reduced stability at low Mach numbers, **the speed brakes are not to be used at full deflection below Mach 1.5.**

FUEL JETTISON

While approaching the landing site, the remaining propellants must be jettisoned from the X-15 to minimize fire or explosion hazard upon landing and to lower the weight of the aircraft. To jettison the remaining propellants from the X-15A-2 airplane before landing or after an aborted launch, proceed as follows:



1. Source pressure [13, fig. 4-1] – **Check.**

2. Vent, pressurize, and jettison control lever [5, fig. 4-7] – **JETTISON.** Fuel jettison will be conducted concurrently on all three systems (liquid oxygen, ammonia and hydrogen peroxide).

3. Jettison stop switches [1-3, fig. 4-1; 4-6, fig. 4-3] – **JETT.**

In the spot plane exterior view, check for vapor emitting from the jettison ports, at the back of the X-15 aircraft. Propellant tank volume gauges [1-3, fig. 4-2], on the X-15A-2 for Flight Simulator service panel, can also give a clear indication of the fuel being jettisoned.

<u>In the real world</u>: Have chase pilots verify that fuel is jettisoning.

4. Vent, pressurize, and jettison control lever [5, fig. 4-7] – **VENT.** After propellants have been jettisoned,

Before landing, the remaining propellants are dumped overboard through the jettison ports on the X-15A-2 for Flight Simulator.

move control lever to **VENT.**

NOTE: The liquid oxygen and ammonia jettison ports are the long tubes protruding at the back of the airplane's side fairings (each side of the engine compartment). The hydrogen peroxide jettison port is located inside the lower speed brake compartment (right side). Because of some limitations of the FS2004 platform, there is no special effect associated with the APU H_2O_2 jettison.

BEFORE LANDING

1. Check all controls and instruments for landing.

See figure 5-2 on page 5-29 for the recommended landing pattern and procedures.

In the real world: Before landing and in no case above 17,000 feet, move the vent, pressurize, and jettison control lever [5, fig. 4-7] to PRESSURIZE, to prevent sand and dust from entering the airplane propellant system.

When the altitude is under 17,000 feet, proceed as follows:

1. Vent, pressurize, and jettison control lever [5, fig. 4-7] – **PRESSURIZE.**

To open the eyelid that protected the left canopy window during the high-speed flight, use the Concorde nose simulator command: **SHIFT-Y.**

LANDING

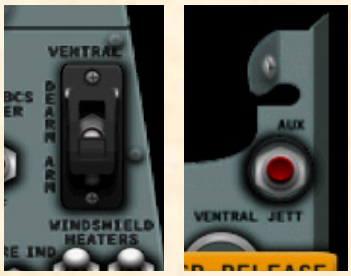
To provide ground clearance for the landing gear, the dummy ramjet (or the lower ventral rudder on the normal configuration) must be jettisoned before landing.

NOTE: Under normal flight conditions, the dummy ramjet (or ventral rudder) should not be jettisoned except during landing approach.

When the altimeter [25, fig. 4-1] indicates 5000 feet, proceed as follows:

1. Ventral arming switch [3, fig. 4-6, 4-4] – **Check ARM.**

2. Ventral jettison button [2, fig. 4-3] – **Push (once).**



In the real world: The dummy ramjet (or ventral) should be jettisoned at an altitude of about 5000 feet and at a minimum of 1500 feet above the ground.

Pushing the ventral jettison button actually fires explosive bolts to release the dummy ramjet (or ventral). Note that the dummy ramjet (or ventral) is also jettisoned automatically when the landing gear and skids are deployed.

The dummy ramjet is jettisoned from the X-15A-2 before landing to make room for the rear landing skids. In the real world, a parachute will prevent the ramjet from being damaged upon landing on the ground. The ramjet will be recovered and reused.

To extend the flaps, turn the wing flap switch [1, fig. 4-7] on the left white console to **DWN** or use the **"F8"** key on your keyboard (or the appropriate button on your joystick).

To lower the landing gear, click the landing gear handle [9, fig. 4-1; 1, fig. 4-3] on the left side panel or use the **"G"** key on your keyboard.

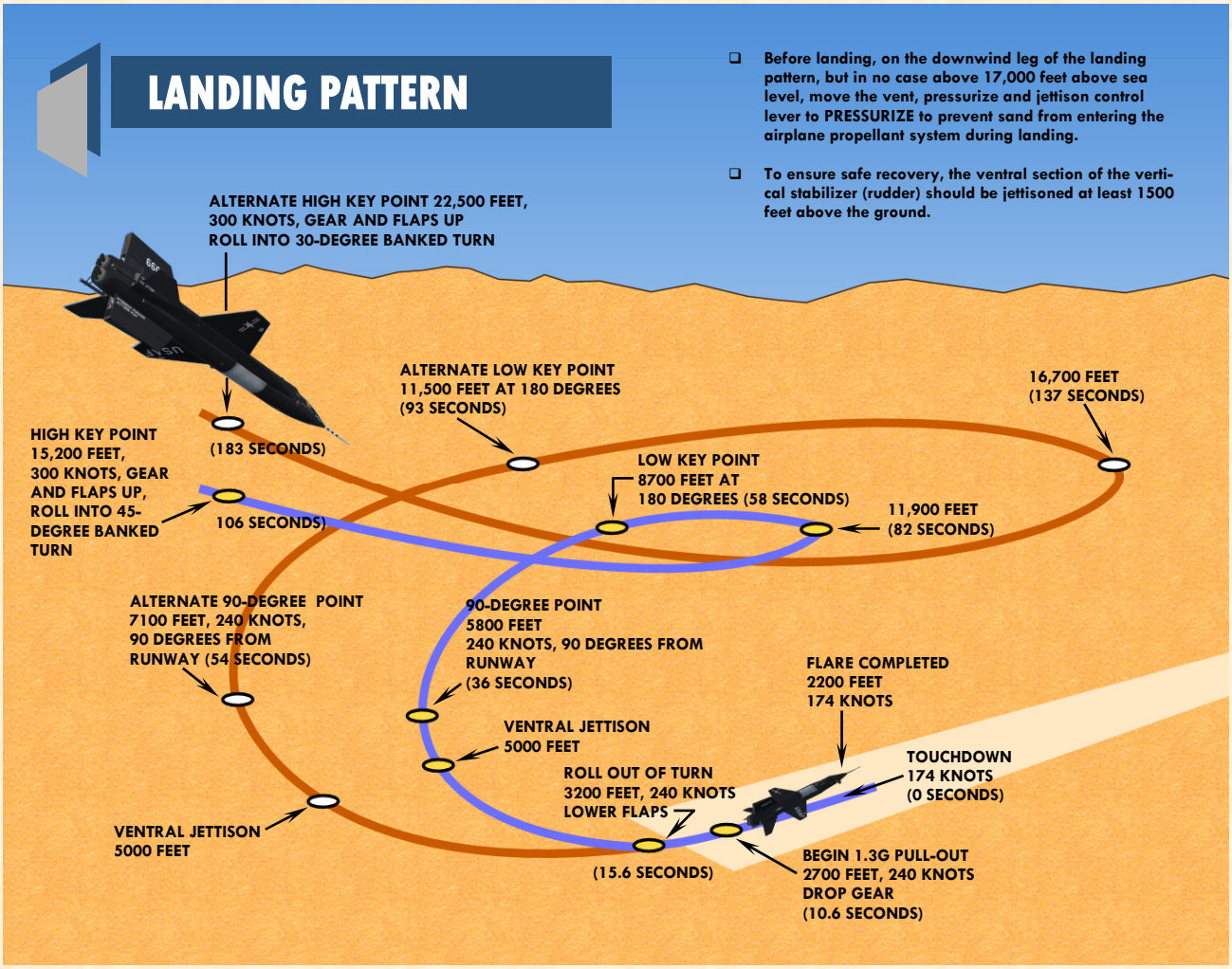

LANDING PATTERN
Before landing, on the downwind leg of the landing pattern, but in no case above 17,000 feet above sea level, move the vent, pressurize and jettison control lever to PRESSURIZE to prevent sand from entering the airplane propellant system during landing.
To ensure safe recovery, the ventral section of the vertical stabilizer (rudder) should be jettisoned at least 1500 feet above the ground.
ALTERNATE HIGH KEY POINT 22,500 FEET, 300 KNOTS, GEAR AND FLAPS UP ROLL INTO 30-DEGREE BANKED TURN
ALTERNATE LOW KEY POINT 11,500 FEET AT 180 DEGREES (93 SECONDS)
16,700 FEET (137 SECONDS)
HIGH KEY POINT 15,200 FEET, 300 KNOTS, GEAR AND FLAPS UP, ROLL INTO 45-DEGREE BANKED TURN
(183 SECONDS)
106 SECONDS)
LOW KEY POINT 8700 FEET AT 180 DEGREES (58 SECONDS)
11,900 FEET (82 SECONDS)
ALTERNATE 90-DEGREE POINT 7100 FEET, 240 KNOTS, 90 DEGREES FROM RUNWAY (54 SECONDS)
90-DEGREE POINT 5800 FEET 240 KNOTS, 90 DEGREES FROM RUNWAY (36 SECONDS)
FLARE COMPLETED 2200 FEET 174 KNOTS
VENTRAL JETTISON 5000 FEET
ROLL OUT OF TURN 3200 FEET, 240 KNOTS LOWER FLAPS
TOUCHDOWN 174 KNOTS (0 SECONDS)
VENTRAL JETTISON 5000 FEET
(15.6 SECONDS)
BEGIN 1.3G PULL-OUT 2700 FEET, 240 KNOTS DROP GEAR (10.6 SECONDS)

Figure 5-2

X-15A-2 approaching the landing site.

AFTER LANDING

After landing, as soon as the airplane stops, proceed as follows:

1. Canopy – Open (**SHIFT-E** on your keyboard).

2. Ram-air lever [15, fig. 4-8] – **CLOSED.**

3. Wing flap switch [1, fig. 4-7] – **UP.**

4. SAS/RAS function switches [5-6, 15-16, 8-11, fig. 4-10] – **STD BY or OFF.**

5. Ventral arming switch [3, fig. 4-4] – **DE-ARM.**

6. APU switches [57, 70, fig. 4-1] – **OFF.**

7. Speed brake levers [2, fig. 4-6] – **Full aft position.**

*In the real world: **WARNING** – Before operating the speed brakes, be sure the fuselage rear section around the speed brakes is clear, because the brakes operate rapidly and forcefully and could injure any personnel near the brakes.*

8. Center control stick (joystick) – **Full forward.**

9. Rudder pedals – **Actuate.** *Deplete hydraulic pressure by actuating rudder pedals.*

BEFORE LEAVING AIRPLANE

In the real world: Before leaving the airplane, complete the required airplane form.

Verify the following cockpit control positions:

Left console and side panel:

1. Radio control function switch [3, fig. 4-5] – **OFF.**

2. Wing flap switch [1, fig. 4-7] – **UP.**

X-15A-2 after landing at Edwards Air Force Base. The frost on the fuselage indicates that the liquid oxygen has not been entirely jettisoned before landing and that some quantity is still present in the internal tank. There is no frost on the fuselage when the liquid oxygen tank is empty, on the X-15 for Flight Simulator.

3. Speed brake handles [2, fig. 4-6] – **Full forward.**

4. Vent, pressurize, and jettison control lever [5, fig. 4-7] – **VENT.**

5. Throttle [1, fig. 4-6] – **OFF.**

6. Jettison stop switches [4-6, fig. 4-3] – **STOP.**

7. Auxiliary launch switch [3, fig. 4-3] – **OFF.**

8. Landing gear handle [1, fig. 4-3] – **IN.**

Main instrument panel:

1. Engine master switch [6, fig. 4-1] – **OFF.**

2. Emergency battery switch [48, fig. 4-1] – **OFF.**

3. Generator switches [46, 51, fig. 4-1] – **OFF.**

4. APU switches [57, 70, fig. 4-1] – **OFF.**

5. SAS/RAS function switches [5-6, 15-16, 8-11, fig. 4-10] – **STD BY.**

6. Ballistic control switches [43, 52, fig. 4-1] – **OFF.**

Center pedestal:

1. Instrumentation master power switch [14, fig. 4-8] – **OFF.**

2. Ram-air lever [15, fig. 4-8] – **CLOSED.**

3. Cockpit ram-air knob [10, fig. 4-8] – **CLOSED (in).**

4. Radar beacon switch [13, fig. 4-8] – **OFF.**

5. Stable platform instrument switch [9, fig. 4-8] – **ON.**

Right console and side panel:

1. Canopy emergency release handle [1, fig. 4-4] – **IN.**

2. Stable platform switch [9, fig. 4-4] – **OFF.**

3. Nose ballistic rocket heater switch [2, fig. 4-4] – **OFF.**

4. Cockpit lighting switch [8, fig. 4-4] – **OFF.**

5. Indicator, caution, and warning light test switch [7, fig. 4-4] – **NORMAL.**

6. Windshield heater switches (two) [4-5, fig. 4-4] – **OFF.**

*In the real world: All circuit breakers [7, fig. 4-11] – **OFF.***

Condensed Procedures and Check List

SECTION VI

The following is a **condensed** version of the normal procedures and check list for the operation of the X-15A-2 add-on aircraft for Flight Simulator. Refer to the previous section for a detailed mission description and complete check list and procedures.

We recommend that you use the following procedures only if you are familiar with both Microsoft® Flight Simulator and the X-15A-2 for Flight Simulator add-on aircraft. Otherwise, use the procedures presented in section V. You can also refer to appendix 1 to start the engine and fly the X-15A-2 for Flight Simulator without going through the complete check list and procedures.

Aircraft reference information is provided in appendix 3. The same information is also available in the FS aircraft **Reference information tab** of the Kneeboard (**F10**).

NOTE: This section contains instructions and procedures for XLR-99 rocket engine operation with external propellant tanks on the X-15A-2 add-on aircraft.

INTRODUCTION

Most of the following procedures are inspired or adapted from the original X-15 and X-15A-2 utility flight manuals. For simplicity and to allow ground servicing of the virtual airplane, the following procedures assume a normal take-off from the ground.

INITIAL FLIGHT SIMULATOR CONFIGURATION

For your first X-15 flight, we will take off from Coaldale airfield, Nevada (2Q6), runway 12 and land at Edwards Air Force Base (KEDW), runway 22.

CREATING A FLIGHT

Refer to the complete procedures in section V if you are not familiar with how to create a flight, set weather and set parameters in Microsoft® Flight Simulator.

1. Make sure the X-15 for Flight Simulator has been properly installed according to the instructions in section II.
2. Make sure your joystick is properly connected to your computer and has been previously tested in Flight Simulator.
3. Start Microsoft® Flight Simulator.
4. Select the **CREATE FLIGHT** option in the menu at left to open the "Create Flight" page.
   Select the following aircraft:
   a. Aircraft Manufacturer – **NORTH AMERICAN AVIATION.**
   b. Aircraft Model – **X-15A ROCKET PLANE NO. 2.**
   c. Variation – **BALL NOSE, XLR-99 ENGINE, EXTERNAL TANKS, WHITE ABLATIVE COATING** (or any other available version of the X-15A-2, if you want to fly a different mission).
5. Set the following "Customized Weather":
   a. Clouds – **CLEAR.**
   b. Precipitation – **NONE.**
   c. Visibility – **40 MI / 64 KM.**
   d. Wind Speed – **LIGHT (8 KTS).**
   e. Wind Direction – **120˚.**
6. Set "Local Time" to: **14:32:11.**
7. Set date to: **OCTOBER 3, 1967.**
8. Click **OK.**
9. Click the **FLIGHT PLANNER** button and create the following flight:
   a. Departure location – **COALDALE (2Q6), RUNWAY 12** (Coaldale – 2Q6, Nevada, United States, Runway 12).
   b. Destination – **EDWARDS AIR FORCE BASE (KEDW)** (Edwards AFB - KEDW, California, United States).

c. Flight plan type – **VFR.**
d. Routing – **Direct-GPS.**

10. Click the FIND ROUTE button, then enter: Cruising Altitude – **60,000 feet.**

11. Click **SAVE** to save your route.

12. Click **OK.** Answer **YES** when asked if you want Flight Simulator to move your aircraft to the selected airport.

13. On the "Create Flight" page, click the **SAVE FLIGHT** button to save your flight. Name that flight: **X-15A-2 Flight No. 2-53-97.**

14. On the "Create Flight" page, click the **FLY NOW** button to start your flight.

FUEL MANAGEMENT SYSTEM

The X-15A-2 for Flight Simulator's special built-in systems bypass the simulator fuel management system and need some special settings:

1. Under the "Aircraft" menu in the main Flight Simulator window, select **REALISM SETTINGS.**

2. On the "Settings – Realism" page, under "Engines", select the **UNLIMITED FUEL** option.

SPECIAL VISUAL EFFECTS (AIRCRAFT LIGHTS)

The X-15A-2 for Flight Simulator special visual effects replace the default simulator aircraft lights and need some special settings:

1. On the "Settings – Realism" page, under "Instruments and Lights", select the **PILOT CONTROLS AIRCRAFT LIGHT** option.

OTHER FLIGHT SIMULATOR SETTINGS

These recommended settings are to make your first flight in the X-15A-2 more enjoyable:

1. On the "Settings – Realism" page, set the following:
   a. All "Flight Model" settings – **50% (cursor in the middle).**
   b. Gyro drift – **SELECTED.**
   c. Display indicated airspeed – **SELECTED.**
   d. Ignore crashes and damage – **SELECTED.**
   e. G-effects – **UNSELECTED.**

2. Click **OK.**

EXTERIOR INSPECTION

Switch to the **SPOT PLANE VIEW**. This will allow you to inspect the exterior of the X-15A-2. An exterior description of the X-15A-2 for Flight Simulator aircraft is available in section III.

At this time, the X-15A-2 has not yet been serviced and the engine should be shut down. If the engine has been ignited by the simulator and has not been shut down automatically by the X-15A-2 integrated systems, do the following procedure to shut down the engine:

1. Simultaneously press the **CTRL-SHIFT-F1** keys on your keyboard.

No special visual effects such as the engine flame, APU exhaust steam or frost on the fuselage should be observed around the airplane at this time. If such effects are visible, do the following procedure to turn off the effects:

1. Press the **"L"** key (All Lights On/Off command) on your keyboard as necessary, until the effects disappear.

Then, proceed as follows:

1. Use your joystick (and/or pedals) to control and observe the movement of the horizontal stabilizer and the upper vertical stabilizer (rudder).

2. To open or close the speed brakes, press the **" / "** key on your keyboard (the speed brakes can also be opened, closed and adjusted using the speed brake handle on the throttle and speed brake side panel).

3. To open or close the canopy, simultaneously press the **SHIFT-E** keys on your keyboard.

Make sure the speed brakes and canopy are closed before takeoff!

SERVICING

To simulate the complex servicing of the X-15 and X-15A-2 rocket planes both from the ground or from the NB-52 carrier airplane, a fictional "service panel" has been pro-

vided with each X-15 for Flight Simulator aircraft. Refer to section IV for a description of the X-15A-2 for Flight Simulator service panel.

1. Click the **DISPLAY/HIDE X-15A-2 SERVICE PANEL** icon on the main panel to display the service panel (or select **SERVICE PANEL** from the "Instrument Panel" menu, under the "Views" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the panel if necessary.

3. Service panel power switch – **ON.**

4. Service panel power light – **Check ON.**

5. External power switch – **ON.** We will assume that electrical power will be supplied from the carrier airplane at this time.

6. External power light – **Check ON.**

7. Make sure all control valve levers on the service panel are in the (center) **CLOSED** position.

8. Express fill button – **Push (once).** All tanks will be filled simultaneously.

9. Unlimited fuel switch – **ON.**

10. External tanks option switch – **INSTALLED.**

Check each service panel gauge, from left to right, for proper filling:

1. Liquid oxygen tanks volume gauge – **Check (internal tank, 1017 gallons; external tank, 770 gallons).**

2. Ammonia tanks volume gauge – **Check (internal tank, 1445 gallons; external tank, 1053 gallons).**

3. Turbopump hydrogen peroxide (H_2O_2) tanks volume gauge – **Check (118 gallons).**

4. Propellant source (helium) tanks pressure gauge – **Check (both internal and external tanks, 3200-3800 psi).**

5. Engine and propellant control source (helium) tanks pressure gauge – **Check (both internal and external tanks, 3200-3800 psi).**

6. Auxiliary pneumatic and control (helium) tank pressure gauge – **Check (3200-3800 psi).**

7. APU propellant source (helium) tanks pressure gauge – **Check (3200-3800 psi, both pointers).**

8. APU H_2O_2 tanks volume gauge – **Check (60-75 gallons, both pointers).**

9. Cabin helium tank pressure gauge – **Check (3200-3800 psi).**

10. Liquid N_2 tank volume gauge – **Check (25-30 gallons).**

(As an alternate procedure, each tank can be controlled individually with its associated control valve lever:

1. Turn the lever to the left in the **DUMP** position to jettison content of tank.

2. Turn the lever to the right in the **FEED** position to fill the tank.

3. Leave (or turn) lever at center in the **CLOSED** position to stop filling or jettisoning and close the valve.

The tanks will be topped off automatically. Monitoring of each tank can be achieved at all times by reading the gauge above each control valve lever.)

PREFLIGHT CHECK

Refer to section IV for a description of the X-15 for Flight Simulator instrument panels.

Left console and side panel:

1. Click the **DISPLAY/HIDE RADIO PANEL** icon on the main panel to display the radio panel (or select **RADIO PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the panel if necessary.

3. If not already displayed, click the **DISPLAY/HIDE THROTTLE AND SPEED BRAKE PANEL** icon on the main panel to display the throttle and speed brake panel (or select **THROTTLE AND SPEED BRAKE PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

4. Undock and reposition the panel if necessary.

5. Click the **DISPLAY/HIDE LEFT WHITE CONSOLE** icon on the main panel to display the left white console panel (or select **LEFT WHITE CONSOLE** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

6. Undock and reposition the panel if necessary.

7. Click the **DISPLAY/HIDE LEFT SIDE PANEL** icon at the far left of the main panel to display the left side panel (or select **LEFT SIDE PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

8. Undock and reposition the panel if necessary.

Main instrument panel (flight instruments):

1. Accelerometer – **Reset and check.**

2. Altimeter – **Set.**

Instrument panel (electrical, hydraulic, and cockpit):

1. No. 1 generator-out light – **Check ON (generator not in operation).**

2. No. 2 generator-out light – **Check ON (generator not in operation).**

3. Generator (AC) voltmeter – **Check (both pointers, 200 volts, external, from carrier airplane).**

4. Clock – **Check and set.**

Center pedestal:

1. Click the **DISPLAY/HIDE CENTER PEDESTAL** icon at the center of the main panel to display the center pedestal (or select **CENTER PEDESTAL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the panel if necessary.

3. Ram-air lever – **OPEN.**

4. Stable platform instrument switch – **ON.**

5. Ball nose power switch – **ON.**

6. Cockpit ram-air knob – **OFF (in).**

7. DC voltmeter selector switch – **BUS.**

8. DC voltmeter – **Check (28-volt bus or 24-volt strain gauge or battery).**

Right console and side panel:

1. Click the **DISPLAY/HIDE RIGHT SIDE PANEL** icon at the far right of the main panel to display the right side panel (or select **RIGHT SIDE PANEL** from the "Instrument Panel" menu, under the "View" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the panel if necessary.

3. Stable platform switch – **EXT (carrier airplane, middle position).**

4. Cockpit lighting switch – **ON.**

5. Fire-warning light test button – **Push once to test.** Fire-warning light **ON** indicates continuity of detection circuit.

6. Center control stick – **Check joystick (stick centered, throttle to MIN).**

Interior inspection operational check:

1. Instrumentation master power switch – **ON.**

2. Data switch – **ON.**

3. Calibrate instrumentation button – **Push once** (button green light should come **ON** for 3 seconds, then **OFF**, indicating instrumentation calibration).

4. Ready-to-Launch switch – **Test ON.** Ready-to-Launch indicator light on service panel should come **ON**. **Turn OFF** Ready-to-Launch switch. Ready-to-Launch indicator light on service panel should come **OFF.**

5. Indicator, caution and warning lights – **Check.** Place the indicator, caution, and warning light test switch at **TEST** (up position). All indicator, caution, and warning lights (except the fire warning light) will come **ON**. This is only a test of the bulbs. Return the switch to **NORMAL** (down position).

CAPTIVE TAXI AND FLIGHT

1. Radio function selector switch – Turn right to **MIDDLE position (Main, T/R; Aux., ADF).**

TAXI (CARRIER AIRPLANE)

Proceed as follows:

1. SAS function switches and lights – **Check.** Move SAS function switches to **LO GAIN** and check lights (should come **OFF**). Return function switches to **STD BY** after each function trips.

2. Radar beacon switch – **ON.**

BEFORE TAKEOFF (CARRIER AIRPLANE)

1. Ram-air lever – **CLOSED.**

2. Helium release switch – **AUTO.**

3. Propellant source pressure gauge – **Check (internal and external tanks, 3300 to 3800 psi).**

4. H_2O_2 source pressure gauge – **Check (internal and external tanks, 3000 to 3900 psi).**

5. H_2O_2 tank and engine control line pressure gauge – **Check ("C" pointer, 575 to 615 psi; "T" pointer, 0 psi).**

TAKEOFF (CARRIER AIRPLANE)

1. Ventral arming switch – **ARM.**

2. Windshield heater switches (two) – **ON.**

3. Engine master switch – **ARM.**

4. Engine reset button – **Push (once).**

5. Engine precool switch – **PRECOOL.**

6. After precooling is completed *(in the real world: approx. 10 minutes)*, return precool switch to **OFF.**

CLIMB (CARRIER AIRPLANE)

1. Instrumentation master power switch – **Check ON.**

2. Telemeter master power switch – **ON.**

3. Communications – **Check.** You may want to display the ATC window at this time. Click the **DISPLAY/HIDE ATC WINDOW** icon on the main panel to display or hide the ATC window.

4. Nose ballistic rocket heater switch – **ON.**

5. Ram-air lever – **OPEN.**

CRUISE-CLIMB TO LAUNCH ALTITUDE

1. Ram-air lever – **CLOSED.**

PRELAUNCH

BEFORE COUNTDOWN

1. Ram-air lever – **Check CLOSED.**

2. Ventral arming switch – **Check ARM.**

APUs:

1. APU switch No. 1 – **ON.** As APU No. 1 comes up to speed, hydraulic pressure will increase and then stabilize at 3000 to 3500 psi.

2. No. 1 generator switch – Move No. 1 generator switch momentarily to **RESET**, then to **ON.**

3. No. 1 generator out light – Check **OFF.**

4. APU switch No. 2 – **ON.** As APU No. 2 comes up to speed, hydraulic pressure will increase and then stabilize at 3000 to 3500 psi.

5. No. 2 generator switch – Move No. 2 generator switch momentarily to **RESET**, then to **ON.**

6. No. 2 generator out light – **Check OFF.**

7. Stable platform power switch – **INT (up position).**

8. Service panel external power switch – **OFF.**

9. Service panel external power light – **Check OFF.**

10. Generator (AC) voltmeter – **Check (both pointers,**

200 volts, internal).

11. DC voltmeter selector switch – **BUS.**

12. DC voltmeter – **Check (28 volts).**

COUNTDOWN

1. All instrumentation switches on center pedestal – **ON.**

2. Ball nose power switch – **ON.**

3. Ball nose test button – **Depress, then release.**

Propellant jettison tests:

1. Vent, pressurize, and jettison control lever – **JETTISON.** Jettison tests will be conducted concurrently on all three systems (liquid oxygen, ammonia and hydrogen peroxide).

2. Jettison stop switches – **JETT** for 3 seconds then **STOP.** In the spot plane exterior view, visually check for vapor emitting from the jettison ports, at the rear of the X-15 aircraft.

Propellant tank pressurization:

1. Vent, pressurize, and jettison control lever – **PRESSURIZE.**

When the vent, pressurize, and jettison control lever is moved to **PRESSURIZE**, propellant tanks are pressurized and the propellants will be supplied to the engine turbopump.

1. Propellant tank pressure gauge – **Check ("L" pointer, 45 to 65 psi; "A" pointer, 45 to 65 psi).**

2. External tanks fuel flow indicator – **Check (both pointers, 50%).**

3. H_2O_2 tank and engine control line pressure gauge – **Check ("C" pointer, 575 to 615 psi; "T" pointer, 425 to 475 psi).**

4. DC voltmeter selector switch – **STRAIN GAUGE.**

5. Check strain gauge (battery) power supply **(24 volts)** on DC voltmeter.

6. DC voltmeter selector switch – **BUS.**

7. SAS function switches – **LO GAIN.** Check that the pitch, roll and yaw caution lights are out.

8. Flight controls – **Check.**

9. Propellant tank pressure gauge – **Check ("L" pointer, 45-65 psi; "A" pointer, 45-65 psi).**

10. Engine precool switch – **PRECOOL.**

11. Propellant pump inlet pressure gauge – **Check ("L" pointer, 45 to 65 psi; "A" pointer, 0 to 10 psi).**

12. Engine prime switch – **PRIME.** Move engine prime switch to **PRIME** for one second, then release it and check ignition ready light **ON**. The engine will continue to prime (at high flow rates) until the actual start stops the prime. A continuous flow overboard of liquid oxygen and ammonia will be observed at the back of the aircraft by the launch operator, during prime.

NOTE: The prime can be stopped at any time by placing the engine prime switch at **STOP PRIME**. This closes the liquid oxygen and NH_3 tank main propellant valves and the H_2O_2 safety valve.

13. Chamber and stage 2 igniter pressure gauge – **Check (both pointers, 0 psi).**

14. H_2O_2 source pressure gauge – **Check (both internal and external tanks, 3000 to 3900 psi).**

15. H_2O_2 tank and engine control line pressure gauge – **Check (both pointers, 575 to 615 psi).**

16. Propellant pump inlet pressure gauge – **Check (both pointers, 45 to 65 psi).**

17. Turbopump idle button – **Push once.** This will start the engine turbopump and hot exhaust gas will be emitted at the back of the aircraft.

18. Propellant manifold pressure gauge – **Check (both pointers, 300 to 450 psi).**

19. Move the throttle on your joystick to its maximum (forward) position. **Then pull the throttle back to its minimum position.**

20. Telemeter and radar switches – **Recheck.**

21. Telemeter commutator motor switch – **Check ON.**

22. Communications – **Check.**

23. Ready-to-Launch switch – **ON.**

24. Ready-to-Launch light on service panel – **Check ON.**

Operation of igniter idle is limited to 30 seconds. When 7 seconds remain of the normal igniter idle phase, the no-drop or 23-second caution light will come **ON.** With the no-drop or 23-second caution light on, the pilot must terminate the igniter idle phase – by moving the engine prime switch to **STOP PRIME** – or continue on to the launch phase.

25. Igniter idle switch – **IGNITER.**

26. Chamber and stage 2 igniter pressure gauge – **Check (small pointer, 150 to 300 psi in less than 5 seconds).** Flames should be observed inside the rocket engine nozzle (bell) as stage 1 and stage 2 are ignited.

Ready to launch! *Countdown by carrier pilot.*

BALLISTIC CONTROL AND REACTION AUGMENTATION SYSTEM OPERATION

Since some missions will involve flight at altitudes where control surfaces are ineffective and where ballistic control system operation will be required to maintain airplane attitude, the ballistic control system should be turned on before launch. The reaction augmentation system (RAS) should be turned on as soon as possible after engine burnout.

In the real world: The ballistic control system rockets were removed from the X-15A-2 with the full white ablative coating because the system was unnecessary for the high-speed flights.

To turn on the ballistic control and reaction augmentation systems, proceed as follows:

1. No. 1 ballistic control switch – **ON.**

2. No. 2 ballistic control switch – **ON.**

3. RAS function switches – **ON.**

4. RAS-out (amber) light – **OUT (OFF).**

5. RAS control indicator lights – **ON.**

NOTE: Flight Simulator does not provide ballistic control or reaction augmentation systems for rocket airplanes at this time. Consequently, the BCS and RAS switches on the X-15A-2 main panel do not perform any specific simulator function in this software version, other than being animated to simulate BCS and RAS-related procedures.

LAUNCH

It is possible to simulate a high-altitude launch from a carrier aircraft by using the slew mode commands (**"Y"**) to reposition the aircraft without flying in real time or simply by changing the altitude and speed settings in the map dialog box.

When taking off from an airport runway like a conventional Flight Simulator aircraft, control surfaces must be adjusted by the desktop pilot to maintain a nose-up climb/pitch angle of about 30 to 45 degrees.

Takeoff (from the ground) can be accomplished at around 250 to 280 knots IAS (!)* by gently pulling on the joystick. As soon as the aircraft is airborne, raise the landing gear by clicking the **landing gear handle** on the left side panel (or using the **"G"** key on your keyboard or the appropriate button on your joystick). When the landing gear is up, the ventral section of the vertical stabilizer (or the dummy ramjet) will appear.

***:** Like the real aircraft, the X-15A-2 for Flight Simulator has a very low lift-drag ratio at low speed (one that produces little aerodynamic lift).

After the rocket engine is ignited, the X-15A-2 for Flight Simulator will accelerate at a very high rate to high Mach numbers and will reach high altitudes in a matter of seconds (see fig. 5-1 on page 5-21). Refer to the FS aircraft **Reference information tab** of the Kneeboard (**F10**) for airspeed vs altitude limitations (see also appendix 3). Use the throttle and the speed brakes to increase or decrease speed depending on the mission's objectives and altitude.

If strong movements are applied to the joystick and translated to the control surfaces of the airplane traveling at several times the speed of sound, the pilot might lose control of the aircraft. During the initial acceleration (zooming) phase, it is recommended to apply only enough movement to the joystick to maintain the correct nose-up pitch angle and a smooth climb.

The X-15A-2 is equipped with two large external aluminum propellant tanks to provide a longer engine run

which results in added velocity. In flight, the liquid oxygen and ammonia from the external tanks are transferred, under helium pressure, to their respective internal tanks. Indication of propellant flow from the external tanks is displayed to the pilot on the external tanks fuel flow indicator on the main instrument panel.

When the fuel selector switch on the external tanks control panel is set to **EXTERNAL** (propellant system pressurized), a transfer system is activated and the propellant is transferred from the external tanks to the internal tanks. At the end of a preset time period, an *intervalometer* times out, deactivating the transfer system, and the two external tanks jettison-ready indicator lights in the cockpit come **ON**, indicating that the tanks are ready to be released. The propellant feed system automatically shifts to the internal tank feed.

When the fuel selector switch on the external tanks control panel is set to **INTERNAL** (propellant system pressurized), the transfer system is deactivated and propellant feed is from internal tanks only, regardless of propellant remaining in the external tanks.

The external tanks jettison safe-arm switch controls arming of the external tank release circuit.

When the external tanks jettison auto-manual switch is set to **AUTO** (fuel selector switch at **EXTERNAL** and external tanks jettison safe-arm switch to **ARM**), the automatic mode of external tank release system is activated. When the *intervalometer* (see above) times out, **the external tanks are automatically released.**

Placing the switch to **MANUAL** activates the manual mode of the external tank release system. To release the tanks, the pilot must press the external tanks jettison empty button. If the tanks are full, the pilot must actuate the external tanks jettison full switch. Either full or empty jettison switches will release the tanks if the system is armed.

IMPORTANT NOTE: Use the external tanks jettison full switch to release full tanks for successful tank separation. **Do not use the external tanks jettison empty button to release a full tank, as serious damage to the tanks and airplane will result.**

To arm the external tank release system and select the manual mode, proceed as follows:

1. Make sure the external tanks option switch on the service panel is set to **INSTALLED**.
2. Fuel selector switch – **EXTERNAL.**
3. External tanks jettison safe-arm switch – **ARM.**
4. External tanks jettison auto-manual switch – **MANUAL.**

IMPORTANT NOTE: The maximum Mach number to be reached by the X-15A-2 aircraft with the external tanks attached is 2.6. **The tanks must be released before reaching that speed.**

Once the external tanks are released, the X-15A-2 will quickly accelerate to higher Mach numbers until the pilot shuts down the engine or until "burnout" occurs after all the propellants are exhausted (unfortunately, the maximum speed to be attained in FS2004 is Mach 4.65).

In a typical X-15 mission (see fig. 5-1 on page 5-21), a normal burnout will occur after more or less 90 to 150 seconds of XLR-99 engine operation (depending if the external tanks are installed or not).

An engine timer (stopwatch) was installed in the real-world X-15 equipped with the XLR-99 engine. The timer was automatically started during the ignition sequence and would later tell the pilot when to shut down the engine, depending on the mission's objectives (altitude and speed to be attained).

Make sure the X-15 for Flight Simulator engine timer has been **RESET**, if not indicating **0**, before the ignition sequence starts.

Once burnout occurs during a high-altitude mission or simply when the engine is shut down by the pilot during a high-speed mission, the X-15 will continue on its trajectory, sometimes to reach even higher altitudes.

The X-15 will complete its course and commence its descent. The pilot will set up the correct angle-of-attack for reentry into the earth's atmosphere (high-altitude mission) and perform a 5G to 7G pullout to level flight at about 70,000 feet, after reentry. The speed brake will be applied to further reduce the speed of the aircraft during its descent (caution: see note on page 5-27).

Edwards Air Force Base (and nearby Rogers Dry Lake) is at a relatively short distance from Mud Lake (Coaldale airfield). You can use the Garmin GPS unit*, provided in Microsoft® Flight Simulator, to track your flight and manually shut down the engine before reaching your final destination.

To display the GPS panel:

1. Click the **DISPLAY/HIDE GPS** icon on the main panel to display the GPS panel (or select **GPS** from the "Instrument Panel" menu, under the "Views" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the GPS panel if necessary.

The default Flight Simulator magnetic compass is also available to the X-15 desktop pilot. To display the compass:

1. Click the **DISPLAY/HIDE COMPASS** icon on the main panel to display the compass panel (or select **Magnetic Compass** from the "Instrument Panel" menu, under the "Views" menu of the main Flight Simulator window menu bar).

2. Undock and reposition the compass panel if necessary.

Hypersonic flight generates tremendous amount of heat and a special **ablative coating** needed to be used to protect the exterior of the X-15A-2 aircraft. An external "eyelid" was designed to protect the left canopy window from being smeared by ablator residue during high-speed flight. To open the eyelid before landing, use the Concorde nose simulator command: **SHIFT-Y.** To close the eyelid, use **CTRL-Y.**

*: *Of course, there were no GPS units installed in the real X-15 rocket plane.*

ENGINE START

After release from the "carrier airplane" or when ready to take off from the runway, proceed as follows:

1. Throttle – **START (click and then move inboard to 50%).** Throttle must be moved to 50% by the time the idle-end caution light comes on.

2. Chamber and stage 2 igniter pressure gauge – **Check (large pointer, 335 to 600 psi within 2 seconds; small pointer 350 to 630 psi).**

3. Propellant manifold pressure gauge – **Check ("L" pointer, 455 to 980 psi; "A" pointer, 510 to 1155 psi).**

4. Propellant (helium) source pressure gauge – **Check (both internal and external tanks, 3300 to 3900 psi).**

5. H_2O_2 source (helium) pressure gauge – **Check (both internal and external tanks, 3000 to 3900 psi).**

6. Propellant tank pressure gauge – **Check ("L" pointer, 45 to 65 psi; "A" pointer, 39 to 59 psi).**

7. H_2O_2 tank and engine control line pressure gauge – **Check (both pointers, 575 to 615 psi).**

NORMAL INDICATIONS DURING START

When the thrust chamber or chambers are fired, the following indications will be evident:

- Liquid oxygen and ammonia will automatically stop bleeding overboard (as observed during prime);
- Turbine exhaust steam will be seen at the back of the aircraft;
- Airplane propellants will be consumed at a very high rate;
- Chamber pressure will reach rated values;
- Flames and exhaust gases will be seen at the back of the airplane.

ENGINE THRUST CONTROL

Engine thrust is controlled by movement of the throttle between 50% and 100% thrust.

NORMAL OPERATING CONDITIONS

Refer to appendix 2 for instrument readings during normal operating conditions.

EXTERNAL TANKS RELEASE

The external tanks must be released before the X-15A-2 reaches Mach 2.6 (see page 5-22).

1. Fuel selector switch – **Check EXTERNAL.**

2. External tanks jettison safe-arm switch – **Check ARM.**

3. External tanks jettison auto-manual switch – **Check MANUAL.**

IMPORTANT NOTE: Use the external tanks jettison full switch to release full tanks for successful tank separation. **Do not use the external tanks jettison empty button to release a full tank, as serious damage to the tanks and airplane will result.**

To manually release the external tanks, proceed as follows:

1. If the two external tanks jettison-ready indicator lights are **ON** and the tanks are empty, **PRESS** the external tanks jettison empty button to release the tanks.

Or

1. If the two external tanks jettison-ready indicator lights are **OFF** and the tanks are not empty, actuate the external tanks jettison full switch to release the tanks.

ENGINE BURNOUT

Propellant exhaustion (burnout) will result in the following:

- Ammonia or oxygen manifold pressure drops, with consequent shutdown (of the engine) by low manifold safety circuit;
- Pump cavitates, with consequent overspeed (pump and engine) cut-off.

SHUTDOWN PROCEDURE

To shut down the engine, proceed as follows:

1. **Retard throttle** to **50%**: then move throttle outboard to **OFF (click in the black area left of the throttle handle after it is moved to 50%)**.

Or

1. Engine prime switch – **STOP PRIME**.

2. Igniter idle switch – **Check OFF.**

3. Engine master switch – **OFF.**

4. Vent, pressurize, and jettison control lever – **VENT** (left white console panel).

ABORTED LAUNCH

Proceed as follows:

1. Engine prime switch – **STOP PRIME.**

2. Engine master switch – **OFF.**

3. External power switch on the service panel – **ON.** **El**ectrical power will be supplied from the carrier airplane at this time.

4. No.1 and No. 2 generator switches – **OFF.** Check that both No. 1 and No. 2 generator-off lights come on.

5. APU switches – **OFF.**

6. Ventral arming switch – **DE-ARM.**

DESCENT

CAUTION: Because of the high rate of descent and the reduced stability at low Mach numbers, the speed brakes are not to be used at full deflection below Mach 1.5.

FUEL JETTISON

While approaching the landing site, the remaining propellants must be jettisoned from the X-15 to minimize fire or explosion hazard upon landing and to lower the weight of the aircraft.

To jettison the remaining propellants from the X-15A-2 airplane, proceed as follows:

1. Source pressure – **Check.**

2. Vent, pressurize, and jettison control lever – **JETTISON.** Fuel jettison will be conducted concurrently on all three systems (liquid oxygen, ammonia, and hydrogen peroxide).

3. Jettison stop switches – **JETT.**

In the spot plane exterior view, check for vapor emitting from the jettison ports, at the back of the X-15 aircraft.

4. Vent, pressurize, and jettison control lever – **VENT.** After propellants have been jettisoned, move control lever to **VENT.**

BEFORE LANDING

See figure 5-2 in section V, page 5-29, for the recommended landing pattern and procedures.
When the altitude is under 17,000 feet, proceed as follows:

1. Vent, pressurize, and jettison control lever – **PRESSURIZE.**

To open the eyelid that protected the left canopy window during the high-speed flight, press: **SHIFT-Y.**

LANDING

To provide ground clearance for the landing gear, the dummy ramjet (or the lower ventral rudder) must be jettisoned before landing. When the altimeter indicates 5000 feet, proceed as follows:

1. Ventral arming switch – **Check ARM.**

2. Ventral jettison button – **Push (once).**

Note that the ramjet (or ventral) will also be jettisoned automatically when the landing gear and skids are deployed.

To extend the flaps, turn the wing flap switch on the left white console to **DWN** or use the **"F8"** key on your keyboard (or the appropriate button on your joystick).

To lower the landing gear, click the landing gear handle on the left side panel or use the **"G"** key on your keyboard (or the appropriate button on your joystick).

AFTER LANDING

After landing, as soon as the airplane stops, proceed as follows:

1. Canopy – Open (**SHIFT-E** on your keyboard).

2. Ram-air lever – **CLOSED.**

3. Wing flap switch – **UP.**

4. SAS/RAS function switches – **STD BY or OFF.**

5. Ventral arming switch – **DE-ARM.**

6. APU switches – **OFF.**

7. Speed brake levers – **Full aft position.**

BEFORE LEAVING AIRPLANE

Left console and side panel:

1. Radio control function switch – **OFF.**

2. Wing flap switch – **UP.**

3. Vent, pressurize, and jettison control lever – **VENT.**

Main instrument panel:

1. Engine master switch – **OFF.**

2. Generator switches – **OFF.**

3. APU switches – **OFF.**

4. SAS/RAS function switches – **STD BY.**

5. Ballistic control switches – **OFF.**

Center pedestal:

1. Instrumentation master power switch – **OFF.**

2. Ram-air lever – **CLOSED.**

3. Cockpit ram-air knob – **CLOSED (in).**

4. Radar beacon switch – **OFF.**

5. Stable platform instrument switch – **OFF.**

Right console and side panel:

1. Stable platform switch – **OFF.**

2. Nose ballistic rocket heater switch – **OFF.**

3. Cockpit lighting switch – **OFF.**

4. Windshield heater switches (two) – **OFF.**

Appendices

Appendix 1: QUICK-START PROCEDURES

INTRODUCTION

Use the following "quick-start" procedures to start the engine and fly the X-15A-2 for Flight Simulator without going through the complete check list and procedures presented in sections V and VI. We recommend that you use these procedures only if you are familiar with both Microsoft® Flight Simulator and the X-15A-2 for Flight Simulator add-on aircraft.

NOTE: This section contains procedures for XLR-99 rocket engine operation with external propellant tanks, on the X-15A-2 add-on aircraft.

INITIAL FLIGHT SIMULATOR CONFIGURATION

We assume that you have already started Microsoft® Flight Simulator, created a flight and configured the simulator with the correct parameters, as described in section V. We also assume that the engine is shut down and that there are no unwanted special visual effects visible around the X-15A-2 aircraft.

QUICK-START PROCEDURES

XLR-99 ENGINE (LIGHT BLUE-GRAY PANEL)

Refer to the figures on pages A1-2 to A1-7 and follow these steps to quickly start the engine:

1. Click this icon to **display the service panel.**
2. Click this icon to **display the center pedestal.**
3. Click this icon to **display the radio panel.**
4. Click this icon to **display the left white console.**
5. Click this icon to display the **throttle and speed brake panel.**
6. Service panel power switch – **ON.**
7. External power switch – **ON.**
8. Express fill button – **Push once.**
9. Unlimited fuel option switch – **ON.**
10. Instrumentation master power switch – **ON.**
11. Stable platform instrument power switch – **ON.**
12. Ball nose power switch – **ON.**
13. Radio function selector switch – Turn right to **MIDDLE position (Main, T/R; Aux., ADF).**
14. No. 1 APU switch – **ON.**
15. No. 2 APU switch – **ON.**
16. No. 1 generator switch – **ON.**
17. No. 2 generator switch – **ON.**
18. Stable platform switch – **INTERNAL (up position).**
19. Vent, pressurize, and jettison control lever – **PRESSURIZE. Wait 5 seconds.**
20. Engine master switch – **ARM.**
21. Engine turbopump reset switch – **PUSH once.**
22. Engine precool switch – **PRECOOL.**
23. Engine prime switch – **PRIME.** Move engine prime switch to **PRIME** for one second, then release it. **Wait 5 seconds.**
24. Engine turbopump idle switch – **PUSH once. Wait 5 seconds.**
25. Engine igniter idle switch – **ON. Wait 10 seconds.**
26. Throttle – **START (click and then move inboard to 50%).** Throttle must be moved to 50% by the time the Idle-end caution light comes on. Engine thrust is controlled by movement of the throttle between 50% and 100% thrust.

A


1
2
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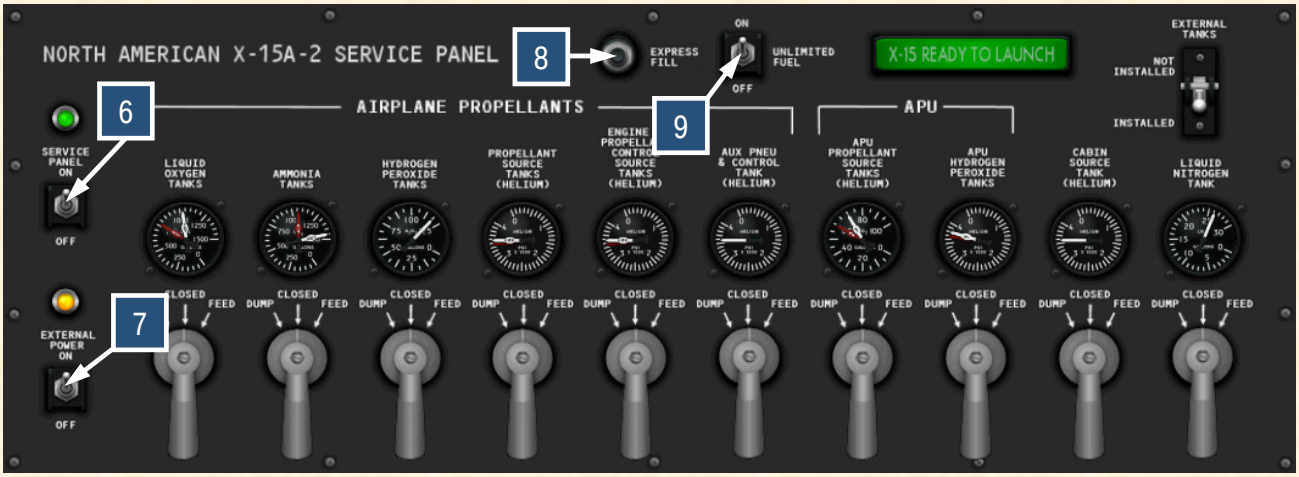
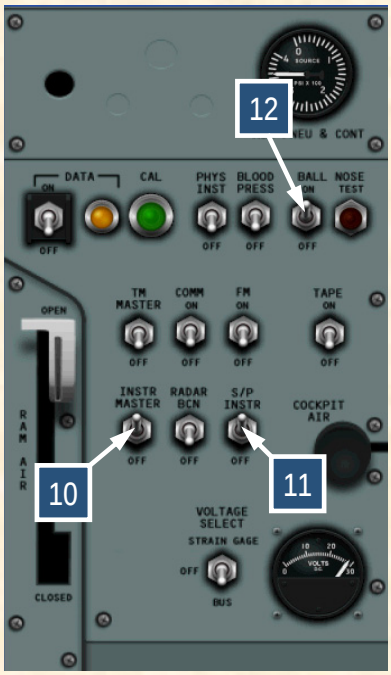
5
EMER CANOPY REL
EXT. TANK JETT. READY
PITCH
ROLL
YAW
ALT SAS ON
RAS OUT

B


NORTH AMERICAN X-15A-2 SERVICE PANEL
6
7
8
9
EXPRESS FILL
UNLIMITED FUEL
X-15 READY TO LAUNCH
EXTERNAL TANKS
NOT INSTALLED
INSTALLED
AIRPLANE PROPELLANTS
APU
SERVICE PANEL ON
EXTERNAL POWER ON
OFF
LIQUID OXYGEN TANKS
AMMONIA TANKS
HYDROGEN PEROXIDE TANKS
PROPELLANT SOURCE TANKS (HELIUM)
ENGINE PROPELLANT CONTROL SOURCE TANKS (HELIUM)
AUX PNEU & CONTROL TANK (HELIUM)
APU PROPELLANT SOURCE TANKS (HELIUM)
APU HYDROGEN PEROXIDE TANKS
CABIN SOURCE TANK (HELIUM)
LIQUID NITROGEN TANK
CLOSED
FEED
DUMP

C


12
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RAM AIR
10
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VOLTAGE SELECT
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AUX
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ADF
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VOL

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15
18
PITCH
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YAW
EXT. TANK JETT. READY
ALT SAS ON
RAS OUT
EMER CANOPY REL

F


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ROLL
PITCH
RAS
FLAPS
UP
DOWN
PRESSURE
VENT
JETTISON

H


26
100
75
OFF
START
THROTTLE
SPEED BRAKE
UPPER
LOWER

G


23
20
21
22
24
25
PITCH
ROLL
YAW
ALT SAS ON
RAS OUT
EXT. TANK JETT. READY
ATTACK
IDLE
IGNITER
FUEL LINE LOW
GEN OUT
APU COMP HOT
EMER CANOPY REL

Appendix 2: INSTRUMENT READINGS

INSTRUMENT READINGS AFTER SERVICING

The following conditions should be observed after servicing the X-15A-2 (external tanks attached):

Service panel:

1. Liquid oxygen tanks volume gauge [1, fig. 4-2] – **Internal tanks, 1017 gallons; external tanks, 770 gallons.**

2. Ammonia tanks volume gauge [2, fig. 4-2] – **Internal tanks, 1445 gallons; external tanks 1053 gallons.**

3. Turbopump hydrogen peroxide (H_2O_2) tanks volume gauge [3, fig. 4-2] – **118 gallons.**

4. Propellant source (helium) tanks pressure gauge [4, fig. 4-2] – **Both internal and external tanks, 3200-3800 psi.**

5. Engine and propellant control source (helium) tanks pressure gauge [5, fig. 4-2] – **Both internal and external tanks, 3200-3800 psi.**

6. Auxiliary pneumatic and control (helium) tank pressure gauge [8, fig. 4-2] – **3200-3800 psi.**

7. APU source (helium) tanks pressure gauge [9, fig. 4-2] – **3200-3800 psi, both pointers.**

8. APU H_2O_2 tanks volume gauge [11, fig. 4-2] – **60-75 gallons, both pointers.**

9. Cabin helium tank pressure gauge [13, fig. 4-2] – **3200-3800 psi.**

10. Liquid N_2 tank volume gauge [14, fig. 4-2] – **25-30 gallons.**

Main panel (XLR-99 engine):

1. Propellant source pressure gauge [13, fig. 4-1] – **Both internal and external tanks, 3200-3800 psi.**

2. H_2O_2 source pressure gauge [4, fig. 4-1] – **Both internal and external tanks, 3200-3800 psi.**

3. External tanks fuel flow indicator [31, fig. 4-1] – **0%.**

4. APU source pressure gauge [68, fig. 4-1] – **3200-3800 psi, both pointers.**

5. Cabin helium source pressure gauge [63, fig. 4-1] – **1000 to 3400 psi.**

6. Generator (AC) voltmeter [47, fig. 4-1] – **200 volts, both pointers (external power).**

7. H_2O_2 tank and engine control pressure gauge [83, fig. 4-1] – **"T" pointer, 0 psi; "C" pointer, 575-600 psi.**

INSTRUMENT READINGS AFTER PROPELLANT SYSTEM PRESSURIZATION

(APUs operating)

The following conditions should be observed after propellant tanks have been pressurized and the APUs operating, but before the engine is ignited:

Service panel:

1. Liquid oxygen tanks volume gauge [1, fig. 4-2] – **Internal tanks, 1017 gallons; external tanks,**

770 gallons (approx.).

2. Ammonia tanks volume gauge [2, fig. 4-2] – **Internal tanks, 1445 gallons; external tanks 1053 gallons (approx.).**

3. Turbopump hydrogen peroxide (H_2O_2) tanks volume gauge [3, fig. 4-2] – **118 gallons.**

4. Propellant source (helium) tanks pressure gauge [4, fig. 4-2] – **Both internal and external tanks, 3200-3800 psi.**

5. Engine and propellant control source (helium) tanks pressure gauge [5, fig. 4-2] – **Both internal and external tanks, 3200-3800 psi.**

6. Auxiliary pneumatic and control (helium) tank pressure gauge [8, fig. 4-2] – **3200-3800 psi.**

7. APU source (helium) tanks pressure gauge [9, fig. 4-2] – **3200-3800 psi, both pointers, gradually decreasing.**

8. APU H_2O_2 tanks volume gauge [11, fig. 4-2] – **60-75 gallons, both pointers, gradually decreasing.**

9. Cabin helium tank pressure gauge [13, fig. 4-2] – **3200-3800 psi.**

10. Liquid N_2 tank volume gauge [14, fig. 4-2] – **25-30 gallons.**

Main panel (XLR-99 engine):

1. Propellant source pressure gauge [13, fig. 4-1] – **Both internal and external tanks, 3200-3800 psi.**

2. H_2O_2 source pressure gauge [4, fig. 4-1] – **Both internal and external tanks, 3200-3800 psi.**

3. Propellant tank pressure gauge [85, fig. 4-1] – **45 to 53 psi (both pointers).**

4. External tanks fuel flow indicator [31, fig. 4-1] – **50%.**

5. Propellant pump inlet pressure gauge [78, fig. 4-1] – **"L" pointer, 40 to 70 psi; "A" pointer, 40 to 55 psi.**

6. APU source pressure gauge [68, fig. 4-1] – **3200-3800 psi, both pointers, gradually decreasing.**

7. APU H_2O_2 tank pressure gauge [69, fig. 4-1] – **550 to 610 psi (both pointers), gradually decreasing.**

8. Cabin helium source pressure gauge [62, fig. 4-1] – **1000 to 3400 psi.**

9. Hydraulic pressure gauge [39, fig. 4-1] – **2900 to 3400 psi (both pointers).**

10. Mixing chamber temperature gauge [64, fig. 4-1] – **-45˚ C to -35˚ C (both pointers).**

11. Generator (AC) voltmeter [47, fig. 4-1] – **195 to 205 volts, both pointers (internal power if generators are ON).**

12. APU bearing temperature gauge [65, fig. 4-1] – **80˚ C to 130˚ C (both pointers), gradually increasing.**

13. H_2O_2 tank and engine control pressure gauge [83, fig. 4-1] – **"T" pointer, 0 psi; "C" pointer, 575-600 psi.**

INSTRUMENT READINGS IN FLIGHT

(APUs and engine operating)

The following conditions accompany normal rocket engine operation:

Service panel:

1. Liquid oxygen tanks volume gauge [1, fig. 4-2] – **Internal tank, 1017 gallons; external tank, 770 gallons (approx.) and gradually decreasing** (if

the unlimited fuel option switch [7, fig. 4-2] is at **OFF**).

2. Ammonia tanks volume gauge [2, fig. 4-2] – **Internal tank, 1445 gallons; external tank 1053 gallons and gradually decreasing** (if the unlimited fuel option switch is at **OFF**).

3. Turbopump hydrogen peroxide (H_2O_2) tank volume gauge [3, fig. 4-2] – **approx. 118 gallons and gradually decreasing** (if the unlimited fuel option switch is at **OFF**).

4. Propellant source (helium) tanks pressure gauge [4, fig. 4-2] – **Both internal and external tanks, 3200-3800 psi and gradually decreasing** (if the unlimited fuel option switch is at **OFF**).

5. Engine and propellant control source (helium) tanks pressure gauge [5, fig. 4-2] – **Both internal and external tanks, 3200-3800 psi and gradually decreasing** (if the unlimited fuel option switch is at **OFF**).

6. Auxiliary pneumatic and control (helium) tank pressure gauge [8, fig. 4-2] – **3200-3800 psi.**

7. APU source (helium) tanks pressure gauge [9, fig. 4-2] – **3200-3800 psi, both pointers, gradually decreasing.**

8. APU H_2O_2 tanks volume gauge [11, fig. 4-2] – **60-75 gallons, both pointers, gradually decreasing.**

9. Cabin helium tank pressure gauge [13, fig. 4-2] – **3200-3800 psi.**

10. Liquid N_2 tank volume gauge [14, fig. 4-2] – **25-30 gallons.**

Main panel (XLR-99 engine):

1. Propellant source pressure gauge [13, fig. 4-1] – **Both internal and external tanks, 3200-3800 psi and gradually decreasing** (if the unlimited fuel option switch is at **OFF**).

2. H_2O_2 source pressure gauge [4, fig. 4-1] – **Both internal and external tanks, 3200-3800 psi and gradually decreasing** (if the unlimited fuel option switch is at **OFF**).

3. Propellant tank pressure gauge [85, fig. 4-1] – **45 to 53 psi (both pointers).**

4. External tanks fuel flow indicator [31, fig. 4-1] – **50% to 100%.**

5. Propellant pump inlet pressure gauge [78, fig. 4-1] – **"L" pointer, 40 to 70 psi; "A" pointer, 40 to 55 psi.**

6. APU source pressure gauge [68, fig. 4-1] – **3200-3800 psi, both pointers, gradually decreasing.**

7. APU H_2O_2 tank pressure gauge [69, fig. 4-1] – **550 to 610 psi (both pointers), gradually decreasing.**

8. Cabin helium source pressure gauge [62, fig. 4-1] – **1000 to 3400 psi.**

9. Hydraulic pressure gauge [39, fig. 4-1] – **2900 to 3400 psi (both pointers).**

10. Mixing chamber temperature gauge [64, fig. 4-1] – **-45˚ C to -35˚ C (both pointers).**

11. Generator (AC) voltmeter [47, fig. 4-1] – **195 to 205 volts, both pointers (internal power if generators are ON).**

12. APU bearing temperature gauge [65, fig. 4-1] – **80˚ C to 130˚ C (both pointers), gradually increasing.**

13. H_2O_2 tank and engine control pressure gauge [83, fig. 4-1] – **"T" pointer, 0 psi; "C" pointer, 575-600 psi.**

14. Propellant manifold pressure gauge [76, fig. 4-1] – **"L" pointer, 440 to 1050 psi; "A" pointer, 495 to 1150 psi.**

15. Chamber and stage 2 igniter pressure gauge [77, fig. 4-1] – **long pointer, 345 to 600 psi; short pointer, 350 to 630 psi.**

Appendix 3: FS AIRCRAFT REFERENCE INFORMATION

NOTE: The following information is also available in the FS aircraft **Reference information tab** of the Kneeboard (**F10**).

X-15A-2 FOR FLIGHT SIMULATOR – XLR-99 ROCKET ENGINE
REFERENCE INFORMATION

For detailed instructions on how to fly this aircraft, refer to the **X-15A-2 Utility Flight Manual**. For condensed procedures, see the **Checklists** tab of the Kneeboard or **section VI** in the manual.

Aircraft Weight with External Tanks

Launch	**51,600 lbs**
Burnout (drop tanks off)	**16,500 lbs**
Landing (drop tanks off)	**15,600 lbs**

Aircraft Weight without External Tanks

Launch	**32,250 lbs**
Burnout	**16,200 lbs**
Landing	**15,500 lbs**

NOTE: Because the X-15A-2 for Flight Simulator's internal systems bypass the game engine fuel management system, it is not recommended to add or dump fuel using the "Fuel and Load" option of the Aircraft menu. Use the X-15A-2 for Flight Simulator **Service Panel** instead (**SHIFT+2**).

Speed Limitations (FS aircraft)

NOTE: The highest Mach number attained by the real-world X-15A-2 aircraft was Mach 6.7 (October 3, 1967), the fastest flight of the X-15 research program.

M_{MO} – Maximum FS Aircraft Operating Speed (Mach)	**4.65 Mach (FS2004 limit)**
Maximum Speed with External Tanks Attached (Mach)	**2.6 Mach**
V_{LO} – Maximum Gear Operating Speed	**300 KIAS**
V_{LE} – Maximum Landing Gear Extension Speed	**300 KIAS**
V_{FE} – Maximum Flap Extended Speed (40 degrees)	**300 KIAS**
q – Maximum Dynamic Pressure without External Tanks	**2200 psf**
q – Maximum Dynamic Pressure with External Tanks	**1000 psf**
Maximum Acceleration (above 50,000 feet)	**8 G**

Mach Limitations vs Altitude

10,000 feet	**0.8 Mach**
20,000 feet	**1.6 mach**
30,000 feet	**1.8 Mach**
40,000 feet	**2.8 Mach**
50,000 feet	**3.5 Mach**
60,000 feet	**4.0 Mach**
70,000 to 100,000 feet	**4.65 Mach**

Ground Takeoff (FS aircraft, standard temperature, sea level pressure altitude)

NOTE: The real-world X-15A-2 was not designed for a normal takeoff from the ground but was launched at a high altitude from a modified B-52 carrier aircraft. The X-15A-2 for Flight Simulator can take off from the ground, like any other FS aircraft.

V_1 – FS Aircraft Takeoff Decision Speed (51,600 lbs)	**250 KIAS**
V_R – FS Aircraft Rotation Speed	**275 KIAS**
V_2 – FS Aircraft Takeoff Safety Speed	**290 KIAS**

Launch from Carrier Aircraft

NOTE: It is possible to simulate a high-altitude launch from a carrier aircraft by using the slew mode commands* (**Y**) to reposition the aircraft without flying in real time or simply by changing the altitude and speed settings in the map dialog box (click **"Map"** on the **World** Menu). A high-altitude launch can also be saved on disk.

Recommended Launch Altitude	**38,000 to 45,000 feet**
Recommended Launch Speed	**0.75 to 0.82 Mach**

External Propellant Tanks Release

NOTE: Under normal flight conditions, external tanks should be released as soon as practical after they are empty, at about 70,000 feet and Mach 2.1, in a zero-G normal load factor condition and an angle of attack of about 10 degrees. The external tanks must be released before an attempt is made to jettison internal system propellants.

The maximum Mach number to be reached by the X-15A-2 with the external tanks attached is 2.6. The tanks must be released before reaching that speed. This limit is imposed because flight characteristics for this configuration have not been determined for higher Mach numbers. Also, there is no data available concerning the effect of releasing partially full external tanks. For this reason, the external tanks should be released when the tanks are either full or empty and the propellant system pressurized.

Refer to the **X-15A-2 Utility Flight Manual** for complete procedures or see the **Checklists** tab or **section VI** in the manual for condensed procedures.

(Aircraft) Maximum Mach Number with External Tanks Attached	**2.6 Mach**
Recommended Mach Number for External Tanks Release	**2.0 to 2.3 Mach**
Recommended Altitude for External Tanks Release	**65,000 to 75,000 feet**
(Aircraft) Maximum Angle of Attack with External Tanks Attached	**16 degrees**
Recommended Angle of Attack for External Tanks Release	**5 to 10 degrees**
Normal Load Factor Condition Recommended	**0-G**

Altitude Limitations (FS aircraft, typical)

NOTE: The highest altitude attained by the real-world X-15A-2 aircraft was 249,000 feet (August 3, 1966).

FS Aircraft Operating Altitude	**45,000 to 100,000 feet**
FS Aircraft Ceiling (maximum) Altitude	**100,000 feet (FS2004 limit)**

Other Limitations (Typical)

Maximum Allowable Rate of Roll	**100 degrees per second**

Speed Brakes

The speed brakes are not to be used at full deflexion below Mach 1.5.

NOTE: The speed brakes on this airplane were not designed for use as a low-speed drag device. Their design function is to provide necessary drag conditions for control of the airplane at supersonic speeds and relatively high altitudes.

Prohibited Maneuvres

The real-world airplane was restricted from performing the following maneuvres:

1. Spin
2. Snap Rolls
3. Snap Maneuvers

Propellant Jettison

NOTE: While approaching the landing site, the remaining propellants must be jettisoned to minimize fire or explosion hazards and to lower the weight of the aircraft. Refer to the **X-15A-2 Utility Flight Manual** for complete procedures or see the **Checklists** tab or **section VI** in the manual for condensed procedures.

Maximum Speed at 30,000 feet	**0.60 Mach**
Maximum Speed at 15,000 feet	**0.45 Mach**

Ventral (or dummy ramjet) Jettison

NOTE: Under normal flight conditions, the ventral rudder (or the dummy ramjet) should not be jettisoned except during landing approach. The ventral (or ramjet) must be jettisoned to provide ground clearance for the landing gear. Refer to the **X-15A-2 Utility Flight Manual** for complete procedures or see the **Checklists** tab or **section VI** in the manual for condensed procedures.

Maximum Mach Number	**300 KIAS or 3.5 Mach, whichever comes first**
Recommended Altitude	**5000 feet**
Minimum Altitude	**1500 feet**
Maximum Angle of Attack	**16 degrees**
Maximum Rate of Roll	**30 degrees per second**

Landing (FS aircraft)

NOTE: Flight characteristics of the X-15A-2 aircraft in the "clean" configuration (external propellant tanks released or not installed) is similar to those of the other X-15 aircraft. Refer to **Figure 5-2** on page 5-29 of the **X-15A-2 Utility Flight Manual** for complete landing procedures.

High Key Point (106 seconds from landing)	**15,200 feet, 300 KIAS, gear and flaps up (45-degree bank turn)**
180-Turn (82 seconds)	**11900 feet, 270 KIAS, gear and flaps up**
Low Key Point (58 seconds)	**8700 feet, 240 KIAS, gear and flaps up (180 degrees opposite to the runway)**
90-Degree Point (36 seconds)	**5800 feet, 240 KIAS, gear and flaps up (90 degrees perpendicular to the runway)**
Ventral (or ramjet) Jettison	**5000 feet, 240 KIAS (lined up with the runway)**
Flaps Extended (15 seconds)	**3200 feet, 240 KIAS, roll out of turn**
Gear Down (10 seconds)	**2700 feet, 240 KIAS, 1.29 G pullout**
Flare Completed	**2200 feet, 174 KIAS**
Touchdown (0 seconds)	**174 KIAS**
V_{REF} - Landing Approach Speed (flaps extended, gear down)	**174 KIAS**
FS Aircraft Stalling Speed (flaps up)	**140 KIAS**
FS Aircraft Stalling Speed (flaps down)	**100 KIAS**

NOTE: This aircraft's real-world reference information **has been modified** for use with Flight Simulator. For explanations of speeds used on this tab, see **"V-speeds"** in the **Learning Center Glossary**.
*: For instructions on how to use the slew commands to reposition the aircraft without flying in real time, see **"Slewing"** in the **Learning Center Glossary**.

X-15A-2 for Flight Simulator Reference Tab – English Version 1.0
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Appendix 4: PRODUCT SPECIFICATIONS (X-15A-2 for Flight Simulator)

GENERAL FEATURES

- **3 versions of the X-15A-2 aircraft (s/n AF-56-6671) with the XLR-99 rocket engine and "jettisonable" external propellant tanks:**
  - "Rollout" version (black) with silver external propellant tanks and the X-15A-2 light blue-gray instrument panel;
  - "Dirty" version (black) with red and white external propellant tanks and the X-15A-2 light blue-gray instrument panel;
  - "White" version with full ablative coating, a modified lower vertical stabilizer, a dummy ram jet, an animated eyelid on the left canopy window and the X-15A-2 light blue-gray instrument panel.

FLIGHT MODEL FEATURES

- Custom X-15 flight model to simulate rocket-powered high-speed and high-altitude flight in FS2004 and FSX
- One Reaction Motors XLR-99, "throttable" 60,000-pound liquid-fuel turbo-rocket engine
- Supersonic flight up to Mach 4.65 in FS2004 and FSX
- High-altitude flight up to 354,200 feet in FSX (100,000 feet in FS2004)
- Ground takeoff or high-altitude launch
- Good maneuvrability at supersonic speeds
- Excellent gliding capabilities

AIRCRAFT 3D MODEL FEATURES

- Highly detailed models based on archive material, with more than 300 parts and 60 animations
- Reflective textures
- Unique markings and liveries (on each aircraft)
- Dynamic frost texture on fuselage (around the liquid oxygen tank when filled)
- Movable aerodynamic control surfaces:
  - Differential horizontal stabilizer
  - Vertical stabilizers with movable and fixed sections and a jettisonable ventral rudder (or dummy ramjet on the white aircraft)
  - Flaps
- Extendable upper and lower speed brakes
- Landing skids and front gear ("steerable")
- Movable canopy
- Cockpit details with astronaut/pilot and animated sticks and levers
- "Jettisonable" external propellant tanks (optional)
- Jettisonable dummy ramjet (on the white aircraft)
- Animated eyelid on the left canopy window of the white aircraft

SPECIAL VISUAL EFFECTS

- Over 10 X-15-specific animated visual effects
- Engine flame and contrail effects
- Engine first and/or second stage igniter effects
- Propellant jettison effects
- APU and turbopump exhaust effects
- Engine precool and prime effects
- Condensation effect near the cold propellant tanks

CUSTOM AIRCRAFT SYSTEMS FEATURES

- Fictional service panel system for external power and aircraft refueling (ammonia, liquid oxygen, hydrogen peroxide, helium, liquid nitrogen)
- Custom X-15 fuel management system for the three different types of propellants and gases, like in the real-world X-15 rocket plane
- Engine propellant pressurization and control system
- External tanks propellant transfer system
- Engine turbopump system
- Engine ignition control system
- Electrical distribution and control system with APUs, generators, emergency battery and an external power source
- Hydraulic systems
- Temperature control systems

ADVANCED 2D PANEL FEATURES

- Advanced X-15A-2 light blue-gray (2D) main instrument panel (for the XLR-99 engine)
- Service panel
- Left white console panel with "vent, pressurize, jettison" lever and flaps switch
- Throttle and speed brake panel
- Left side panel
- Right side panel
- Radio panel
- Center pedestal
- External drop tanks control panel
- 180 fully functional custom integrated systems and

gauges with “tooltips”

- X-15A-2 aircraft kneeboard reference tab and check list
- 100-page English and French language utility flight manuals with step-by-step procedures (PDF format, requires Adobe® Acrobat® Reader)

NOTE: *Specifications are subject to change without notice. Check our web site for fixes and upgrades.*

Appendix 5: SELECTED INTERNET LINKS

NASA AND OTHER GOVERNMENT INFORMATION ABOUT THE X-15

X-15
(NASA web site):
http://history.nasa.gov/x15/cover.html

The X-15 Hypersonic Research Program
(NASA Langley Research Center):
http://nasa.gov/centers/langley/news/factsheets/x-15_2006_1.html

X-15 Photo Collection
(NASA Dryden Flight Research Center):
http://www.dfrc.nasa.gov/gallery/photo/X-15/

X-15 Movie Collection
(NASA Dryden Flight Research Center):
http://www1.dfrc.nasa.gov/gallery/Movie/X-15/index.html

North American X-15
(Edwards Air Force Base History):
http://www.edwards.af.mil/history/docs_html/aircraft/x-15.html

Milestones of Flight – The North American X-15
(Smithsonian National Air and Space Museum, Washington D.C.):
http://www.nasm.si.edu/exhibitions/gal100/X-15.html

X-15A-2 on display
(National Museum of the United States Air Force, Dayton, Ohio):
http://nationalmuseum.af.mil/factsheets/factsheet.asp?id=556

FREE X-15 PUBLICATIONS

Hypersonic before the Shuttle: A Concise History of the X-15 Research Airplane
(PDF document, NASA):
http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20000068530_2000075022.pdf

X-15 Research Results
(NASA):
http://www.hq.nasa.gov/office/pao/History/SP-60/cover.html

Transiting from Air to Space: The North American X-15
(NASA):
http://www.hq.nasa.gov/office/pao/History/hyperrev-x15/cover.html

Proceedings of the X-15 First Flight 30th Anniversary Celebration
(NASA):
http://www.hq.nasa.gov/office/pao/History/x15conf/cover.html

X-15 MANUALS

X-15 Utility Flight Manual
PDF document – XLR-99 engine, black panel, 1961-62 edition
(amateur site):
http://www.sierrafoot.org/x-15/documents/X-15_Flight_Manual.pdf

OTHER X-15 SITES

North American Aviation X-15
(Boeing, official web site):
http://www.boeing.com/history/bna/x15.htm

Wikipedia article about the X-15
(Wikipedia):
http://en.wikipedia.org/wiki/North_American_X-15

To the Edge of Space
Information about the X-15
(amateur site):
http://www.sierrafoot.org/x-15/x-15.html

North American X-15
Information about the X-15, contains many pictures – in French, with English translation
(amateur site):
http://jpcolliat.free.fr/x15/

Encyclopedia Astronautica article about the X-15
(Encyclopedia Astronautica, independent site):
http://www.astronautix.com/craft/x15a.htm

Major Michael Adams Monument
(independent site):
http://www.xb-70.com/wmaa/x15/monument/

News article about X-15 test pilot Scott Crossfield killed in plane crash
(USA Today):
http://www.usatoday.com/tech/science/space/2006-04-20-crossfield-obituary_x.htm

Visit our web site for an updated list of interesting X-15 links:
www.xtremeprototypes.com

Xtreme Prototypes is not responsible for contents or opinions found in external web sites. Internet links are subject to change without notice.

Appendix 6: SELECTED BIBLIOGRAPHY

BOOKS ABOUT THE X-15 RESEARCH PROGRAM AND AIRCRAFT

Hypersonic: The Story of the North American X-15
Dennis R. Jenkins, Tony Landis
Publisher: Specialty Press (2003)
Hardcover: 276 pages
ISBN: 158007068X

X-15 Photo Scrapbook
Tony R. Landis
Publisher: Specialty Press (2003)
Paperback: 108 pages
ISBN: 1580070744

At the Edge of Space: The X-15 Flight Program
Milton O. Thompson
Publisher: Smithsonian Books (2003)
Paperback: 375 pages
ISBN: 1588340783

X-15 Diary: The Story of America's First Space Ship
Richard Tregaskis
Publisher: Bison Books (2004)
Paperback: 317 pages
ISBN: 0803294565

X-15: The NASA Mission Reports with CD-ROM (Apogee Books Space Series)
(see CD-ROMs section on next page)

X-15 Rocket Plane Pilot's Flight Operating Manual
Periscope Films
Publisher: Lulu Press (2006)
Paperback: 188 pages
ISBN: 141169824X

Hypersonics Before the Shuttle: A Concise History of the X-15 Research Airplane
Dennis R. Jenkins, NASA
Publisher: University Press of the Pacific (2005)
Paperback: 132 pages
ISBN: 1410224422

The X-Planes: X-1 to X-45 (3rd Edition)
(not only about the X-15)
Jay Miller
Publisher: Midland (2001)
Hardcover: 440 pages
ISBN: 1857801091

X-Planes Photo Scrapbook (Paperback)
(not only about the X-15)
Dennis R. Jenkins
Publisher: Specialty Press (2004)
Paperback: 144 pages
ISBN: 1580070760

Chuck Yeager and the Bell X-1
(not about the X-15 but contains rare information on the development of the Reaction Motors XLR-11 engine)
Dominick A. Pisano, F. Robert van Linden and Frank H. Winter
Publisher: Smithsonian Institution (2006)
Hardcover: 144 pages
ISBN: 0810955350

Expanding the Envelope – Flight Research at NACA and NASA
(not only about the X-15)
Michael H. Gorn
Publisher: University Press of Kentucky (2001)
Paperback: 476 pages
ISBN: 0813122058

The Supersonic X-15 and High-Tech NASA Aircraft
(for children, not only about the X-15)
Henry M. Holden
Publisher: Enslow Publishers (2002)
Library binding: 48 pages
ISBN: 0766017176

X-15 —Buck Danny, tome 31
(Comics, in French)
Victor Hubinon, Jean-Michel Charlier
Publisher: Dupuis (reprint, 1986)
Board book: 46 pages
ISBN: 2800112271

Atlas des avions de l'extrême
(in French, not only about the X-15)
Publisher: Éditions Atlas/Glénat (2003)
Hardcover: 239 pages
ISBN: 2723443167

MOVIES AND DOCUMENTARIES ABOUT THE X-15 (OR SUPER/HYPERSONIC FLIGHT)

X-15: The Edge of Space
(over 10 hours of rare film footage, NASA documentaries and contractor films on the X-15)
Studio: Spacecraft Films
DVD Release Year: 2006
Run Time: Over 10 hours (3 DVDs)

X-15
Feature Film (1961)
Actors: David McLean, Charles Bronson, Ralph Taeger, Brad Dexter, Kenneth Tobey
Director: Richard Donner
Studio: MGM
DVD Release Year: 2004
Run Time: 110 minutes

NOVA – Faster Than Sound
(not about the X-15, but a must for anyone interested in supersonic flight, the Bell X-1 rocket plane and the XLR-11 engine)
Documentary (1996)
Studio: Image Entertainment
DVD Release Year: 2001
Run Time: 60 minutes

Rocket Science
(not only about the X-15, recommended viewing)
Documentary series (2003)
Studio: Casablanca Media TV
DVD Release Year: 2004
Run Time: 540 minutes (3 DVDs)

Without Limits: NASA Test Projects
(not only about the X-15)
Documentary series (1997)
Studio: Image Entertainment
DVD Release Year: 2002
Run Time: 150 minutes

CD-ROMs

X-15: The NASA Mission Reports with CD-ROM (Apogee Books Space Series)
(CD-ROM contains many pictures, drawings and film clips. Book contains two X-15 utility flight manuals.)
Robert Godwin (Editor)
Publisher: Apogee Books (2001)
Paperback with CD-ROM: 408 pages
ISBN: 1896522653

PLASTIC MODEL KITS

X-15A-2 Experimental Aircraft (plastic model kit, 1:72 scale)
Revell No. 85-5247

North American X-15 (plastic model kit, 1:64 scale)
Revell No. H-164

Visit our web site for an updated list of interesting X-15 books, movies and items:
www.xtremeprototypes.com

Appendix 7: OTHER X-15 FOR FLIGHT SIMULATOR PRODUCTS by Xtreme Prototypes

X-15-1 (AF56-6670)
FOR FLIGHT SIMULATOR

The X-15-1 was the first of three experimental X-15 aircraft built in the late 1950s to demonstrate the ability of pilots to fly rocket-powered airplanes out of the earth's atmosphere* and back to precision landing.

Relive high-speed research missions at the edge of space with the original X-15 aircraft, now available for Flight Simulator in two different mission configurations (XLR-11 and XLR-99 engines).

The X-15-1 was rolled out in October 1958, and successfully completed its first powered flight in January 1960, after a series of captive and glide flights. The No. 1 aircraft completed 81 missions during the entire (9-year) X-15 research program.

Legendary Scott Crossfield was the first test pilot to fly the X-15-1 while NASA pilot Bill Dana flew the aircraft for the last time in October 1968.

Package contains: 2 versions of the X-15-1 with the XLR-11 rocket engines and 2 versions of the X-15-1 with the XLR-99 rocket engine, 3 instrument panels (original black and light blue-gray versions) and a 100-page utility flight manual in English and French.

Version: 1.0
Compatibility: FS2004, FSX**

*: Speed is limited to approximately Mach 4.65 in FS2004 and FSX. The maximum altitude in FS2004 is 100,000 feet.
**: Designed and optimized for FS2004, FSX compatible.

X-15-2 (AF56-6671)
FOR FLIGHT SIMULATOR

The X-15-2 was the first X-15 to test the mighty 60,000-pound XLR-99 rocket engine in flight. This is the second airplane in the X-15 series. The X-15-2 was later converted to the advanced X-15A-2 after it was damaged during an emergency landing.

Package contains: 2 versions of the X-15-2 with the XLR-99 rocket engine, 2 instrument panels (black version). Comes with the X-15-3 for Flight Simulator and a 100-page utility flight manual in English and French.

Version: 1.0
Compatibility: FS2004, FSX**

X-15-3 (AF56-6672)
FOR FLIGHT SIMULATOR

NASA pilot Joe Walker in the No. 3 X-15 set an altitude record of 354,200 feet* in August 1963, the highest flight in the X-15 program. Sadly, the X-15-3 was lost in 1967 during a tragic accident that took the life of Air Force pilot Michael Adams.

Package contains: 2 versions of the X-15-3 with the XLR-99 rocket engine, 2 instrument panels (original black and light blue-gray versions). Comes with the X-15-2 for Flight Simulator and a 100-page utility flight manual in English and French.

Version: 1.0
Compatibility: FS2004, FSX**

*: Speed is limited to approximately Mach 4.65 in FS2004 and FSX. The maximum altitude in FS2004 is 100,000 feet.
**: Designed and optimized for FS2004, FSX compatible.

Xtreme Prototypes X-15A-2 add-on rocket aircraft for Flight Simulator (rollout version) in flight.

Spectacular FS2004 screen capture of the X-15A-2 add-on rocket aircraft for Flight Simulator (with full white ablative coating and external propellant tanks).

X-15A-2 for Flight Simulator jettisoning her remaining propellants while approaching Edwards Air Force Base, California.

FS2004 screenshot of the X-15A-2 for Flight Simulator (rollout version) over the Mojave Desert, California.

Xtreme Prototypes X-15A-2 for Flight Simulator, Version 1.0 – Utility Flight Manual (English). Copyright © 2007 by Xtreme Prototypes, Inc. The software and the present manual are protected by international copyright laws. Please do not make unauthorized copies of the software and/or its related components and documentation, including the present user manual. No part of this document may be reproduced or redistributed in any form or by any means without the written permission of the publisher. All images in this document are actual screenshots of the Xtreme Prototypes X-15-1, X-15-2/3 and X-15A-2 add-on rocket aircraft for Flight Simulator, taken in the Microsoft® Flight Simulator 2004 and Flight Simulator X game environments, except where otherwise noted. Microsoft, Microsoft Flight Simulator, Windows and DirectX are either registered trademarks or trademarks of Microsoft Corporation. Other company or product names mentioned herein may be trademarks or registered trademarks of their respective owners. Software features and manual contents are subject to change without notice.

Portions of this manual have been inspired or adapted from the original real-world X-15 and X-15A-2 utility flight manuals published during the 1950s and 1960s by the U.S. Air Force and North American Aviation. NASA and AFFTC photos have been used in some sections for comparison and illustration purposes only and are the property of their respective owners as credited. Xtreme Prototypes is not affiliated with NASA, North American Aviation (Boeing), the U.S. Air Force, or any other company, entity or government organization related to the X-15 research program. This product is neither sponsored nor endorsed by NASA.

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