CDF-RTM 06-101

Raptor Pilots

RAPTOR TRAINING MANUAL

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DEPARTMENT OF THE COLONIAL DEFENSE FORCES

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CDF FLEET C.A.G. / 8TH FLEET

RAPTOR TRAINING

----------Compliance with this training manual is mandatory----------

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NOTICE:

This training manual is available digitally on the CDF Web Site at: http://www.cdfcommand.com.
If you lack access, contact your Squad's Commanding Officer (C.O.).

This manual describes the specification, maneuvering, mechanics, and procedures for the CDF Raptor. This manual is for general use throughout the Colonial Defense Forces and is a guide for personnel teaching or learning for Raptor Pilot training. This manual applies to all active and reserved unit members. The following chapters provide the pilots with information needed to make the correct decisions during any phase of a search and rescue mission.

SUMMARY OF TESTING:

All Raptor Pilot trainees after learning the above-prescribed courses are required to take the RTM Test and pass with a minimum score of 75% for active status with the Raptor. All pilots will be awarded the "Jr. Wings" with a score rating 75% or better. No "Sr. Wings" are given out to Raptor Pilots since their role is primarily of recon and not combat.
Testing will be a multiple-choice questionnaire given by your CDF C.A.G. and will cover all prescribed courses as listed in the Table of Contents.

A special thanks to everyone that helped make this Raptor Training Manual possible goes out to:

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RT-101 Raptor Specifications

1.1 Technical Data:

The Raptor is a multi-role Reconnaissance & Rescue vehicle used by the Colonial Defense Forces. It is generally operated by a crew of two or three, the pilot, co-pilot, & the ECO or Electronic Countermeasures Officer. The Raptor is capable of both space and atmospheric flight and is also equipped with a short-range FTL drive engines, allowing it to make multiple short jumps.

Below is a brief description for the Raptor pilot on the following three primary areas for the Raptor.

1. Atmospheric Operations
2. Life Support
3. Specifications

1.1.1 Atmospheric Operations:

The Raptor is designed for flight in atmospheric and space conditions. Raptors are very sluggish and will consume more fuel during atmospheric operations than in the vacuum of space. Once in an atmosphere, the engines must run continuously to retain altitude due to the Raptors configuration, or the pilot will notice poor handling at low speeds. Depending on the composition of the atmosphere, it can also place severe strain on the Raptor's engines.

1.1.2 Life Support:

The Raptor cockpit is pressurized and heated, but must be flown with the pilot wearing the standard issued CDF "Flight Suit" which is capable of providing full life support should the pilot ever have to eject the cockpit from the vehicle. The cockpit section of the Raptor has explosive bolts allowing it to be jettisoned from the main body section in an emergency.

1.1.3 Specifications:

- Dimensions

Length: 8.53 meters
Wingspan: 5.59 meters
Height: 2.90 meters

- Propulsion

2- Voram VM2-D15 upper turbo thrust engines
2- FTL drive engines
2- Reverse thrust motors & multiple RCS points

- Armaments

Dorsal storage bay for 9x HD-70 Lightning Javelin missiles or optional 3 megaton nuclear warhead.
The Raptor has a radar warning system, which detects an opponent's missile solution. Flares and decoy dispensers are provided as a countermeasure.
The raptor also carries multiple communication drones depending on the mission parameters.

- Weight: approx. 50 tons

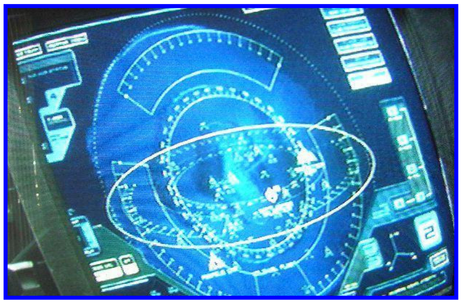
1.2 Avionics:

Below is the instrument panel for the Raptor showing the avionic displays and instrument readings.

The Raptor avionics package is comprised of the following:

1. Dradis (Star Tracker)
2. Compass
3. Radio Magnetic Indicator
4. Tachometer
5. Attitude Indicator
6. Torque Percent Gage
7. Altimeter Indicator
8. Vertical Speed Indicator:
9. Air Speed / Mach Indicator
10. Tactical Master Navigation
11. Heads Up Display
12. Engine Temperature Gage
13. Fuel Gage
14. Special Ops Package
15. Special Ops Package

1.2.1 Dradis (Star Tracker):



Direction, Range, and Distance or "Dradis" is detection, identification and multiple tracking systems. A contact is an object or objects detected by the sensor system. Contacts are typically identified by cross-referencing with an "IFF" system.
The star tracker system is part of the Dradis system. The star tracker is able to track objects such as asteroids and provide line-of-sight vectors for rendezvous calculations. Alignment is accomplished by using the star tracker to measure the line-of-sight vector to at least two objects.

1.2.2 Compass:

Cardinal directions are indicated with the appropriate letter (N-North (000), E-East (090), S- South (180), W-West (270). A number indicating tens of degrees of heading (that is, 33 means 330 degrees) indicates directions between. Large tick marks indicate tens and small marks indicate five degrees.

1.2.3 Radio Magnetic Indicator:

The Radio Magnetic Indicator or "RMI" is the primary navigational instrument in the Raptor. It consists of a rotating compass card and two bearing pointers, one for the Very high frequency Omni directional Radio-range "VOR" and one for the Tactical Air Navigation "TACAN". The magnetic heading is displayed on the compass card beneath the Heading Index. The remaining marks around the compass card are called bench markers. Bench markers divide the compass card into 45-degree segments numbering from 0 to 360 and are referred to by their relation to the Heading Index. The "VOR" is planetary based only.

1.2.4 Tachometer:

This gauge represents the current selected power setting (power indicator). Idle indicates flight idle of the engine. 100 represent 100% power selected. Most vehicles can exceed 100% power through the use of Turbo thrust. The effectiveness of this thrust varies from current situation such as a planets atmosphere or altitude, thus there is a limited supply of thrust that will tend to overheat the engine.

1.2.5 Attitude Indicator:

The attitude indicator or "artificial horizon indicator," is perhaps the single most important instrument on the Raptor. The attitude indicator shows the vehicle's position in relation to a planet's horizon. The tick marks along the top of the instrument are bank angle indicators. Each tick mark represents 30 degrees of bank. In a stall spin (slow speed) or spiral dive (high speed), the attitude indicator will display nose down. The instrument uses a gyroscope so that it always knows "which way is up." The "pull to cage" knob spring aligns the gyro after it has been powered up.

1.2.6 Torque Percent Gauge:

The dial has a maximum reading of 120, with numbers at every multiple of 10.
This gauge indicates the amount of torque being applied from G-forces to the vehicle. For every 1 G the gauge will read 10 T, hence the maximum amount of G-force or torque the vehicle's hull integrity can withstand would be 12 G or 120 T.

1.2.7 Altimeter Indicator:

The altimeter used primarily in planetary flight displays altitude above mean sea level and is indicated uses English units. The large hand indicates altitude in hundreds of feet, the small hand indicates altitude in thousands of feet, and the small red tick indicates altitude in ten thousands (10,000's) of feet.

1.2.8 Vertical Speed Indicator:

This gauge indicates the current rate of climb or descent. This will be related as kilometers per minute.

1.2.9 Air Speed / Mach Indicator:

The speed indicator represents Kilometers per Hour and measures the vehicle's acceleration in the pitch axis for G-Force. The numbers of "G's" indicate the apparent gravitational force being applied to the vehicle and pilot in the pitch axis.

1.2.10 Tactical Master Navigation:

This is the master control switch for the pilots to manual change the various mode statuses for the vehicle by the push of a button. An example of this is where the pilot has the ability to switch armament or to switch on the wireless text screen during radio silence.

1.2.11 Heads Up Display:

This is the main computer monitor. This monitor visually displays the status of the various modes from the tactical master navigation.

1.2.12 Engine Temperature Gauge:

This gauge represent the pressure of lubricates and coolants for the engine. If the engine is damaged by enemy fire, or you fly in a negative G state for too long, the engine will slowly lose pressure. As the pressure drops, the engine temperature will rise until the engine seizes and stops. If pressure drops due to a negative G state, return the vehicle to positive G's to restore normal pressure. There will be three needles on this gauge. The white needle represents the number one (or top) engine, the red needle represents the number 2 (or left) engine, and the yellow needle represents the number 3 (or right) engine. The Temperature Gauge is very important. When overheated, a red warning lamp illuminates to warn of the dangerous condition. The engine will cool slowly to normal temperature at 100% thrust, but will cool much faster if the throttle is retarded to below the line. If overheated due to a loss of pressure, the engines cannot be operated for any period of time without being destroyed. The engines may be reducing thrust, but pressure will continue to decrease.

1.2.13 Fuel Gauge:

Indicates the percentage of maximum fuel load remaining in the vehicle. When fuel reaches a critically low level, a red low fuel light will illuminate on the fuel gauge.

1.3 Profile:

The Raptor is a boxed vehicle built for solely for purpose. The forward section of the craft contains the flight cabin, with side-by-side seats for the pilot and co-pilot. The ECO occupies the rear section of the vehicle during operations. This opens into the main body of the craft which contains bulkhead-mounted racks of electronics equipment and sensors. A large canopy provides good forward and side visibility for the crew.
A large hydraulic door mounted on the port side of the craft provides general entrance into the craft. There is also a floor-mounted hatchway provides a further point of egress. The central door is linked to a pressurized docking skirt that can be extended from the underside of a Raptor, enabling it to dock to the hulls of other vessels. In the case of an assault Colonial Marines can use the skirt to breech a hull and board a hostile vessel. Aft of the pressurized area are the FTL engine and main sub light engines. Winglets on either side of the hull help to give stability during atmospheric maneuvers. RCS thrusters are placed throughout the craft for landing, maneuvering and stabilization.

The raptor is able to perform offensive or defensive tactical operations against the opponent. Below is a brief description of each.

1.3.1 Offensive:

Raptors are normally unarmed as they make for a poor general-purpose fighter. The craft have an internal weapons bay capable of holding both offensive and defensive weapons. They are also capable of carrying heavy external armaments on four wing hard points, two wingtip hard points, and two fuselage hard points on the sides of the Raptor's body. Known weapons carried include:

- nuclear missiles
- bombs/munitions pods
- quad racks of missiles
- multiple-tube rocket batteries mounted on the fuselage points
- external cannons

1.3.2 Defensive:

The Raptor's contours provide it a reduced DRADIS signature to avoid detection. In addition, the craft carry an assortment of pods to aid in communications or defense.

- 6 decoy drones
- 4 communication drones
- 4 sets of flares
- 4 chaff pods

The communication drone extends or augments the range or clarity of wireless communication between ships. Communication drones apparently carry a combustible solid-fuel engine to propel itself.

2.1 CDF Terms:

This is a comprised list of terminology that should be learned and used daily by the pilot. The list is as follows:

Combat Air Patrol – Also known as **CAP** is a patrol launched in a defensive pattern and ready to respond to all incoming threats.
Direction, Range, & Distance – DRADIS is the central part of the navigation system that is used to track multiple craft's positions at any given time.
Electronic Countermeasures Officer – ECO operates the computer equipment, including scanning and detection equipment along with countermeasures.
Electronic Counter Measures – ECM is a device used to confuse or disable detection from the opponent's tracking system.
Eyeball – Is the pilot with primary visual identification responsibility of the opponents.
Faster Than Light – FTL is the method used for interstellar travel for the Colonies.
Gimbal - Is a mechanical device that allows the rotation of an object in multiple dimensions. Gimbal lock occurs when all three gyros hit the limits of their ability to move within the craft.
HOTAS – is the hand on throttle and stick, configured throttle and side stick controller for the pilot in the RAPTOR.
Identification Friend or Foe – IFF is a transponder-based system of aircraft identification, used to distinguish friendly craft from enemy craft.
Launch System Operator – or the **LSO** is the personnel in charge of launching and landing vessels aboard a Battlestar.
Light Landing Device – Also called the **LLD** or "The Ball" is a system of lights and mirrors mounted on the stern of the flight pods of a Battlestar and is an automated landing system used to help pilots land.
Reaction Control System – RCS – The Reaction Control System are small engine thrusters positions at various points on the vehicle for roll, yaw, and pitch maneuvers in space, is designed to provide a spacecraft with guidance and steering by providing thrust in any desired direction or combination of directions.
Roger That - Will comply with received instructions.
Status - Request for a pilot's tactical situation; response is normally "offensive," "defensive," or "neutral." May be suffixed by position and heading.
Stranger - Unidentified traffic that is not participant in the mission.
Support - Is the act of assisting a vehicle in defensive maneuvers during engagement by an opponent while maintaining overall battle situation awareness.
Swallow - Is a decoy drone used to lure enemy heat-seeking missiles away from a Colonial vessel, typically it is launched by the ECO as part of a Raptor's ECM suite.
Visual – Sighting of a friendly or unknown friendly craft.
Wave Off – is called by the LSO if a vessels approach is off course and not able to call the ball.
Zipper - Acknowledge radio transmissions with two clicks of the mic button.

2.2 Design Platform:

The uses of vehicles in war in co-operation with other arms are many, but the efficient performance of their missions in every case depends on their ability to gain and maintain a position from which they can see the opponent's dispositions and movements. Gaining and keeping supremacy in the air or space can only achieve these results. The more complete the supremacy, the more far-reaching will be the results. The Raptor is designed to fulfill a number of roles to help keep supremacy. Below is a list of operation roles the Raptor can undertake:

1. **Reconnaissance Operations**
2. **Airborne warning & Control**
3. **Marine Assault**
4. **Rescue & Evac**
5. **General Transport**
6. **Perimeter Patrol**

2.2.1 Reconnaissance Operations:

Reconnaissance seeks to collect information about an enemy. This includes types of enemy units, locations, numbers, and intentions or activity. Thus reconnaissance is a fundamental tactic which helps to build an intelligence picture.

In the role of reconnaissance the Raptor can operate independently of, or in concert with, other Raptors and Vipers

As a recon, Raptors can:

- Undertake short and medium-range scans to detect electromagnetic, heat or other signatures from other vessels
- Scan planetary surfaces for signs of life, energy output, or to assess mineral or other content / location
- Scout ahead of its parent warship in other planetary or celestial systems for any signs of hostile intent or stellar conditions prior to the parent ship's arrival
- Undertake search & rescue operations after an engagement with Cylon forces.

Every Raptor should be sent out with a definite objective. The successful performance of which will not only help to gain air or space supremacy by the observation of the opponent, but will also induce the opponent to act on the defensive in the air or space, or further the course of operations.

2.2.2 Airborne Warning & Control:

Electronic countermeasures, or ECM, are any sort of electrical or electronic device designed entirely to confuse enemy detection systems. They may be used both offensively or defensively in any method to deny targeting information to an enemy. The system may make it seem that there are hundreds of separate targets, or make the real target seem to disappear or move about randomly.

The Raptor contains a full suite of electronic countermeasure and monitoring systems including:

- Jam wireless or relay transmissions (by wireless or optically) from other spacecraft
- Scramble control signals used by guided weapons
- Undertake IFF operations for Viper squadrons
- Electronic signature decoys

The ECO operates the computer equipment, including scanning and detection equipment along with electronic countermeasures.

2.2.3 Marine Assault:

As a transport vehicle, a Raptor is capable of carrying around eight to ten adults in addition to the Raptor's crew. As a marine Assault vehicle the Raptor it can carry a squad of marines plus their equipment.

2.2.4 Rescue & Evac:

Personnel recovery has become an increasingly important mission receiving added emphasis from Colonial policy makers and Colonial Defense Forces HQ. In many missions, Raptors were among the first to arrive. Raptor pilots must always be ready to support combat operations.

The primary operational task of rescue is to locate, communicate with, and recover downed crews and isolated personnel. This primary task can be broken into three sub-tasks.

- Locating the crew or isolated personnel (survivor) by visual or electronic search methods to pinpoint the survivor's location and permit recovery.
- Communicating with the survivor by wireless or visual signaling to conduct authentication.
- Recover the survivor and provide the survivor necessary medical assistance.

The Raptor provides short-range search and recovery of crew or isolated personnel in up to a medium threat environment, day or night. The threat environments that Raptors assets operate within can be adjusted by the use of supporting Vipers, which will provide air-to-air and air-to-ground support.

2.2.5 General Transport:

Is simply the process of moving people, goods, or equipment for purposes of military objectives.

2.2.6 Perimeter Patrol:

Is a patrol launched in a defensive pattern and ready to respond to all incoming threats. A patrol may be sent to investigate feature of interest or to find and engage the opponent.

The patrol is an essential tool for scouting out any possible engagement by the opponent.

2.3 Principles of Reconnaissance:

The success of a stealth recon mission in the air or space depends on two main factors, the principles of these are as listed below:

1. Surprise
2. Maneuver

2.3.1 Surprise:

Surprise has always been one of the most important factors of success in the recon. Although it might at first appear that surprise is not possible in the air or space, in reality this is by no means the case. It must be remembered that the vehicle is working in three dimensions, that the pilot's view must always be more or less obstructed by the wings and body of the vehicle, and that consequently it is often just as easy for multiple vehicles to approach unseen.

To achieve surprise it is necessary to see the opponent first. Being able to spot an opponent in the air or space is no easy thing and in reality can be very difficult but necessary, and can be achieved through proper training.

In space the pilot cannot hear the opponent's engines to help find it's position. However, the pilot does have the ability to see in all directions along the X, Y, & Z axis. Add to the equation that in space there is little to no obstruction to the pilot's view, which makes the task of spotting the opponent that much easier.

Every pilot should be trained to search the sky of a planet when flying, in a methodical manner. A useful method for this is as follows:

The pilot should divide the sky into three sectors by means of the top plane and center sections struts and sweep each sector thoroughly. From port wing tip to center section search straight ahead and then repeat the same from center section to starboard wing tip. From starboard wing tip take a steady sweep straight upwards to port wing tip. In addition it is essential to keep a good lookout to the rear, both above and below the tail. This can be done by occasionally swinging from side to side. Thus avoiding a surprise attack. The results of a concentrated search of this description are surprising, while a pilot who just sweeps the sky at random will see little or nothing.

In addition to seeing the opponent it is necessary to recognize that it is in fact an opponent and not a friendly. A close study of the silhouette should assist the pilot in determining an opponent to a friendly. If observed when attempting a surprise, it is often best to turn away in the hope of disguising the fact that an attack was forthcoming. Flat turns may cause the opponent to lose sight of a vehicle even after being spotted since it exposes fewer surfaces to the opponents view than standard banking turns.

2.3.2 The Power of Maneuver:

To take full advantage of a maneuver the highest degree of skill in flying and controlling the vehicle is of the first importance. A pilot who has full confidence can put the vehicle into any position suitable to the need of the moment. The second essential is that the pilot should know the vehicle and how to get the best performance out of it.

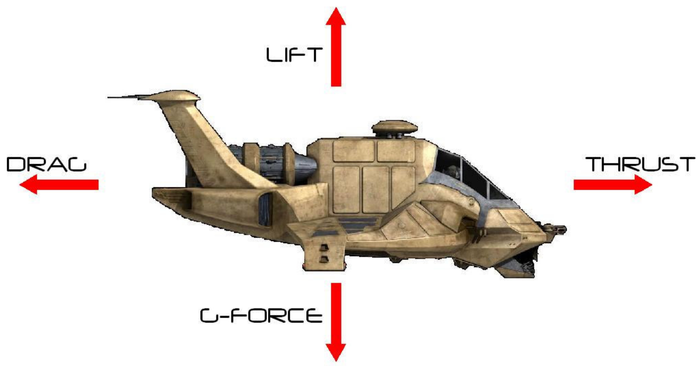
The pilot should always be aware of the fuel capacity of the vehicle and its speed to conserve the most fuel.

3.1 The Physics of Flight:

There are four basic forces at work when a vehicle is in flight:

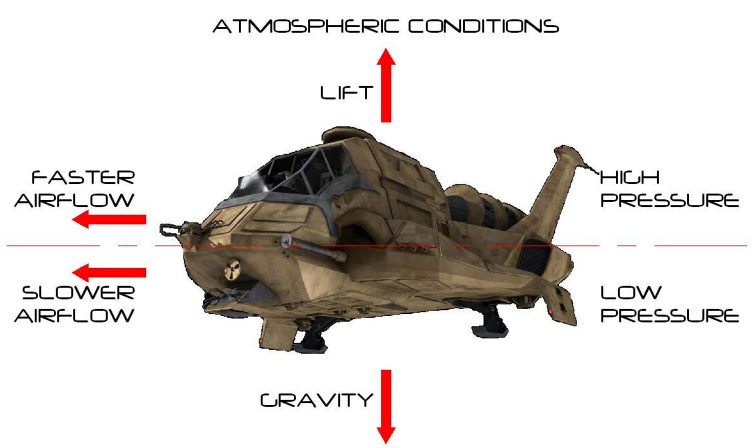
1. Lift
2. Thrust
3. G-Force / Gravity
4. Drag

Of these four forces, only gravity is constant (unchanging), the remaining three forces can be altered or affected by the pilot.
When a vehicle is flying level at a constant speed, all four of these forces are in balance or equilibrium.



3.1.1 Lift:

Lift is achieved through the cross-sectional shape (airfoil design) of the wing.
As the wing moves through the air, the airfoil's shape causes the air moving over the wing to travel faster than the air moving under the wing. The slower airflow beneath the wing generates more pressure, while the faster airflow above generates less. This difference in pressure results in lift.
Lift will vary dynamically depending on the speed a vehicle is traveling at.



3.1.2 Thrust:

When the propeller on the vehicle engine rotates, it pulls in air from in front of the vehicle and pushes it back towards the tail. The force generated by this is thrust. Thrust gives the vehicle forward momentum, and in turn, creates lift on the lifting surfaces (mainly the wings). Generally, the greater the thrust, the greater the speed. Thrust is controlled increasing or decreasing the revolutions-per-minute (rpm) of the engine by using the throttle.

3.1.3 G-Force:

Gravity affects all objects within a planet's gravitational field - G-force. When a person is standing still on the surface, they are experiencing One G (one times the force of gravity). When a pilot in a vehicle changes its orientation rapidly (tight turns, loops, etc.), the vehicle will undergo additional G-forces. These may be positive or negative G-forces.

- **Positive G-Forces**

Positive G's are generated when a vehicle pitches upwards (the nose pulls up). For example, when the vehicle turns quickly or pulls up sharply. The physical effect of Positive G's on a pilot is a possible black out.

A black out is caused by the increased effort the heart must generate to counter the G-forces and still supply the brain with sufficient blood. When the G-forces are too great, the pilot will slowly lose vision due to this lack of blood supply. When prolonged, the blackout can cause a loss of consciousness.

- **Negative G-Forces**

Negative G's are generated when a vehicle pitches downwards (the nose goes down). For example, a sharp dive or similar maneuver that unloads the vehicle of the force of gravity. Excessive Negative G's will cause a pilot to red out.

A Red out is the effect of excessive blood being pumped to the pilot's brain, causing distorted vision.

3.1.4 Drag:

As a vehicle is propelled forward by thrust, an undesirable effect is also created: resistance. When the vehicle travels through the air, its frontal area pushes against the air in front of it, and air flowing over the vehicle causes friction. This is known as drag.

Drag can be increased and decreased depending on the conditions. These include lowering flaps and/or landing gear, and carrying external stores, such as missiles.

3.1.4.a Compressibility:

When a vehicle approaches the speed of sound, the airflow over the wings of the vehicle can actually exceed the speed of sound. This transonic airflow creates a shockwave and a barrier that disrupts the flow of air over the control surfaces. This causes a dramatic loss in control efficiency and is known as compression. Compression usually occurs between Mach 0.7 to 0.9. Mach 1.0 is the speed of sound. The actual speed of sound varies at different altitudes, depending on air density.

The practical effect of compression on a vehicle is a lack of control. The ailerons and/or elevators lock up, and moving the joystick has little effect on the vehicle. If you experience compression in a dive, you may not be able to recover. To counter compression, speed must be reduced. Increasing drag and decreasing thrust will slow the vehicle. Once the vehicle slows, control will be regained.

3.2 Vehicle Control Surface:

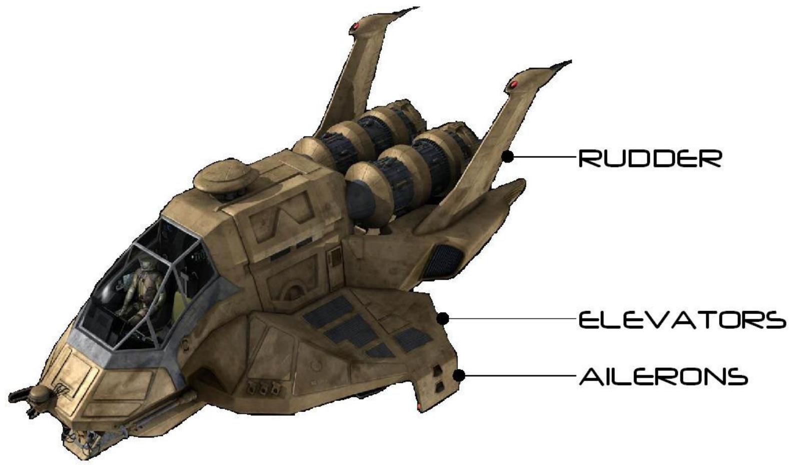
A vehicle maintains control in flight with its control surfaces. These three controls are:

1. Roll, which is controlled by the Ailerons

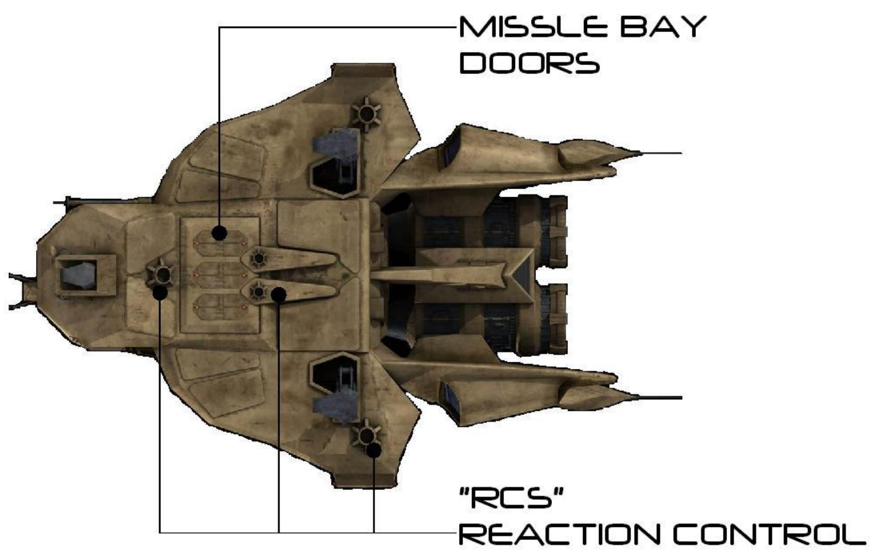
2. Yaw, which is controlled by the Rudder

3. Pitch, which is controlled by the Elevators

Coordinated use of these control surfaces allows you to perform complex maneuvers.

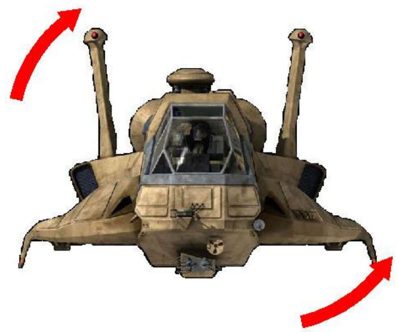


In space these surfaces are controlled by the vehicle's mini-thruster packs or "RCS" which are computer linked to the vehicle control stick and foot pedals. The firing of the "RCS" thrusters in various combinations will accurately rotate the vehicle on a dime in any direction the pilot chooses. The pilot manually controls the amount of thrust produced simply by the amount of pressure applied to the foot pedal and control stick. It is because of the various "RCS" placements on the vehicle that gives the pilot the ability to control roll, yaw, and pitch with fast accuracy.



3.2.1 Roll:

The Ailerons, located on the outer part of the trailing edge of the wings, control the roll or bank of the vehicle. The two ailerons (one on each wing), work in opposite directions to each other. When the left one is raised, the right one is lowered. The roll or bank of the vehicle is controlled by the side to side movement of the control stick.



3.2.2 Yaw:

On the trailing edge of the vertical stabilizer is the Rudder. This controls the yaw or the left/right sliding movements of the vehicle. This is controlled by the foot pedals.

3.2.3 Pitch:

The pitch, or the up and down movement of the vehicle is controlled by the Elevator. It is located on the trailing edge of the horizontal tail assembly and is controlled by the forward and backward movement of the control stick. Pulling the joystick back will move the elevator up, causing the nose of the vehicle to point up. Similarly, pushing the joystick forward will move the elevator down and pitch the nose down.

3.3 The Physics of Trim:

The Flaps are located on the underside of the trailing edge of the wings, inboard of the ailerons. This set of control surfaces, when lowered, changes the cross sectional shape (airfoil) of the wing. By lowering the flaps, more surface area on the wing is created, thus increasing lift. This enables you to lower your stall speed and increase your Angle-of-Trim "AoT". However, the flaps also increase the drag on the vehicle, which reduces speed. Flaps are most commonly used for take off and landing.

The Landing Gear on the vehicles is retractable. Retracting the landing gear smoothes out the overall vehicle profile, thus decreasing drag and increasing performance while in the atmosphere of a planet.

3.4 Space Navigation:

Space Navigation is comprised of two aspects:

1. Knowledge and prediction of the position and velocity, this is orbit determination.
2. Firing the engines to alter the vehicle's velocity, this is flight path control.

Orbit determination involves finding the vehicle's orbital elements and accounting for perturbations to its natural orbit. Flight path control involves firing the vehicle's propulsion system to alter the velocity. Comparing the accurately determined vehicle's trajectory with knowledge of the destination object's orbit is the bases for determining what velocity changes are needed. Measurements a pilot can make from the vehicle's motion are:

1. Its distance or range from a planet
2. The component of its velocity that is directly toward or away from a planet

By repeatedly acquiring data, a mathematical model may be constructed showing the vehicle's location on an X, Y, & Z axis.

The basic factors involved in acquiring the types of navigation data mentioned above are described as listed.

3.4.a Velocity Measurement:
Measurements taking from the on-board computer provide the radial component of a vehicle's planet relative velocity.

3.4.b Distance Measurement:
A range pulse is also added to the on-board computer and its transmission time recorded. When the computer receives the range pulse, the time is recorded. When the pulse is received in the on-board computer, its true elapsed time at light-speed is determined, and the vehicle's distance is then computed.

3.4.c Angular Measurement:
The vehicle's position in space is expressed using angular quantities. When the vehicle is close to a planet, the tracking antenna acquires the vehicle's signal in relationship to a planet.

3.4.1 Orbit Determination:
The process of the vehicles orbit determination is described in terms of a "state vector" or "position and velocity" based upon the types of observations and measurements described. If the vehicle is en route to a planet, the orbit is heliocentric. If it is in orbit about a planet, the orbit determination is made with respect to that planet. Orbit determination is a process built from the results of previous solutions.
Many different data inputs are selected as appropriate for input to the on-board computer. The inputs include the various types of navigation data previously described, as well as data such as the mass of the sun and planets, their movement, along with the effects of solar winds and other non-gravitational effects.

3.4.2 Flight Path Control:
Once a vehicle's solar or planetary orbital parameters are known, they are compared to those desired by the on-board computer and corrected if there are discrepancies. This is also called a "Trajectory Correction Maneuver or TCM". This adjustment involves computing the direction and magnitude of the vector required to correct to the desired trajectory.

3.4.3 Orbit Trim Maneuvers:
Small changes in the vehicle's orbit around a planet may be desired for the purpose of adjusting an instrument's field-of-view, improving sensitivity of a gravity field survey, or preventing too much orbital decay. "Orbit Trim Maneuvers or OTM" are carried out generally in the same manner as "TCM".
To make a change increasing the altitude, an "OTM" would increase the vehicle's velocity and decrease the altitude. An "OTM" would be executed reducing the vehicle's velocity. Slight changes in the orbital plane's orientation can also be corrected with "OTM".

4.1 General Overview:

The CDF R&R is a specific task performed by raptors to affect the recovery of distressed personnel during a military operation. R&R is the term also for operations focusing on recovering captured, missing, or isolated personnel from danger. The CDF organizes, trains, and equips personnel to conduct R&R operations on any of the twelve colonies.
CDF combat rescue philosophy is based on maintaining a capability to recover combat aircrews and other isolated personnel. This philosophy assumes rescue forces, like other combat forces, will be placed at risk to recover personnel.

4.1.1 Control:

The CDF has traditionally been tasked to conduct the recon & rescue or "R&R" mission in support of operations joint air & space requirements. The CDF also has an established a Control structure within the "R&R" to support any military operations. The "R&R" responsibilities relating to a military operation is as listed below:

- Establishing an "R&R" office of primary responsibility with clearly defined responsibilities.
- Ensuring all CDF personnel committed to a hostile environment are familiar with tactics employed by rescue forces during recovery operations.
- Ensuring intelligence data to support planning and training for recon and recovery "R&R" is available and disseminated to all personnel who have the potential of becoming isolated.
- Providing mutual support to other Service rescue operations as directed by the CDF.
- Providing command and theater-specific rescue tactics, planning, and intelligence data to subordinate commands and gained units.
- Preparing rescue concept of operations plans or annexes to operations or directives.
- Providing the CDF with R&R component capabilities, limitations, and standard operating procedures for dissemination to other components, as appropriate.

The history of rescue is as old as the brotherhood of humankind.

No matter what area, or circumstance is involved, rescue has always been one of the great human interest stories. Be it a survivor drifting aimlessly in space, or a lone pilot lost and injured on a barren and inhospitable planet, there is no saga quite as inspiring, as exhilarating or as dramatic as that of risking serious injury or death itself to help someone in trouble. Rescue is a compelling, all encompassing human instinct. In crises people pull together as never before, often performing deeds far beyond their normal capacities when a life is in the balance.

So it has always been and will always be. Such is the nature of humankind.

4.2 Combat Search & Rescue:

A Combat Search and Rescue Task Force or "CSR" is a supporting package of military assets tailored to meet a specific "CSR" requirement. The following is list of the commonly used packages along with a brief description of each.

- Recovery Vehicles
- Rescue Escort
- Rescue Combat Air Patrol
- Rescue Specialist
- Special Tactical Team

4.2.1 Recovery Vehicles:

This provides a backup mission aircraft and offers mutual support should the primary recovery vehicle encounter problems. The secondary recovery vehicle should be prepared to assume lead responsibilities and accomplish the recovery should the lead aircraft abort the mission or be unable to perform primary recovery responsibilities. Recovery vehicles may also be positioned to conduct operations from space orbits.

4.2.2 Rescue Escort:

A limited number of Rescue Escort or "RE" aircraft should be dedicated and made available to the "CSR" operations mission. Rescue Escort aircraft protect rescue assets from surface threats to, from, and in the objective area. The Rescue Escort aircraft also provide navigation assistance, armed escort, and assist in locating and authenticating isolated personnel.

4.2.3 Rescue Combat Air Patrol:

Rescue Combat Air Patrol or "RCAP" aircraft are air superiority assets assigned to protect the "CSR" from airborne threats while route to and from the objective. Once established the "RCAP" aircraft maintain patrol over the objective area. RCAP aircraft may also assist Rescue Escort aircraft in locating and authenticating isolated personnel.

4.2.4 Rescue Specialist:

The Rescue Specialists or "RS" are trained in emergency trauma medicine, harsh environment survival, and assisted evasion techniques. They provide a rapid response capability and are trained to operate in the mountain, desert, arctic, urban, jungle and water, day or night. Their training includes survival, evasion, resistance, and escape, emergency trauma and field medical care.

4.2.5 Special Tactical Team:

Special Tactics Teams or "STT" are ground combat forces assigned to CDF Special Operations Command. They are composed of combat controllers and rescue specialist specifically organized, trained, and equipped to facilitate and expedite the utilization of aviation assets and provide the CSR expert advice when requested through appropriate CDF command channels.

Special Tactics Teams provide medical treatment at the paramedic level; facilitate movement and extraction for the recovery of personnel. This may include unconventional assisted recoveries involving selected area for evasion servicing and hand-over operations.

4.3 Planning & Support:

The CSR is integral to combat operations and must be considered across the full range of military operations. Operations should be coordinated throughout and with other component liaisons. CDF personnel conducting or supporting CSR operations should be thoroughly familiar with the rules of engagement as laid out in the CDF Operations Manual. During these operations, organizational structures and responsibilities may not be as clearly defined as during war, thereby increasing the potential for confusion. Below is a breakdown of key components to insure proper planning & Support for the CSR.

- Intelligence
- Communications
- Security
- Conditions

4.3.1 Intelligence:

Successful CSR operations require timely and accurate intelligence support. Since the CDF rescue mission is throughout the twelve colonies. The threat level en route to and at the objective area determines the appropriate CSR response, including tactics, personnel, force composition, and support. Intelligence personnel must continuously update known and suspected opponent's ground, air, and space threats to CSR forces. They must be familiar with the target area's geography and the local population's social and political climate.

4.3.2 Communications:

Rapid, reliable, and secure wireless is one of the most critical elements of a successful CSR operation. Wireless systems should provide redundant capabilities for secure data and voice transmission. Knowledge of the opponent's wireless equipment and procedures could facilitate effective use of the communication spectrum. All personnel should employ wireless deception countermeasures to degrade a potential intruder's effectiveness.

4.3.3 Security:

Security of information is vital to CSR forces from initial planning stages through recovery and operations termination. Security denies the opponent with information about friendly capabilities and intentions, including advance notice of operations unique training, joint preparations, deployment, and employment.

Commanders and operations planners should consider including military deception in deployment and battle plans and individual missions.

4.3.4 Conditions:

CDF CSR forces require timely and accurate weather support during all phases of planning, deployment, employment, and redeployment. This allows CSR forces to use weather conditions to their advantage. Astronomical conditions, including sunrise, sunset, moonrise, moon phase, predicted ambient light, and hydrographic data will affect the CSR operations much the same as weather data.

4.4 Medical Aid:

The Rescue Officers first priority is medical aid measures and care for the sick and injured until further medical attention can be obtained. At all time it is to be remembers that medical aid is temporary to save lives and to prevent further injuries and to preserve vitalities. These measures are not meant to replace proper medical diagnostics and treatment.

4.4.1 General Rules:

Below is a list of general rules that is to be followed by the Rescue Officer.

- Take charge of the situation quickly and act efficiently.
- Move the injured quickly and safely to a location were medical aid can be performed.
- Limit your preliminary assessment to searching for airway, breathing, and circulation conditions on the injured.
- Examine the injured for fractured in the skull, neck, and ribs. Fractures may pierce vital tissue or blood vessels.
- Keep the injured reassured and comfortable if possible. The injured will endure pain better if confident in your abilities and the situation.

4.4.2 Types of Wounds:

There are six types of tissue wounds as listed below with a brief description.

Abrasion - A scraped area on the skin or on a mucous membrane, resulting from injury or irritation.

Incisions - A cut into a body tissue or organ, especially one made by sharp instruments or objects.

Lacerations - A jagged or torn wound or cut. Dull objects usually make these wounds.

Punctures – Are caused by objects that penetrate into the tissue.

Avulsions - The forcible tearing away of tissue from the body. Bleeding will be heavy.

Amputation – Is the removal of a body part. Bleeding will be heavy and shock is certain for the injured.

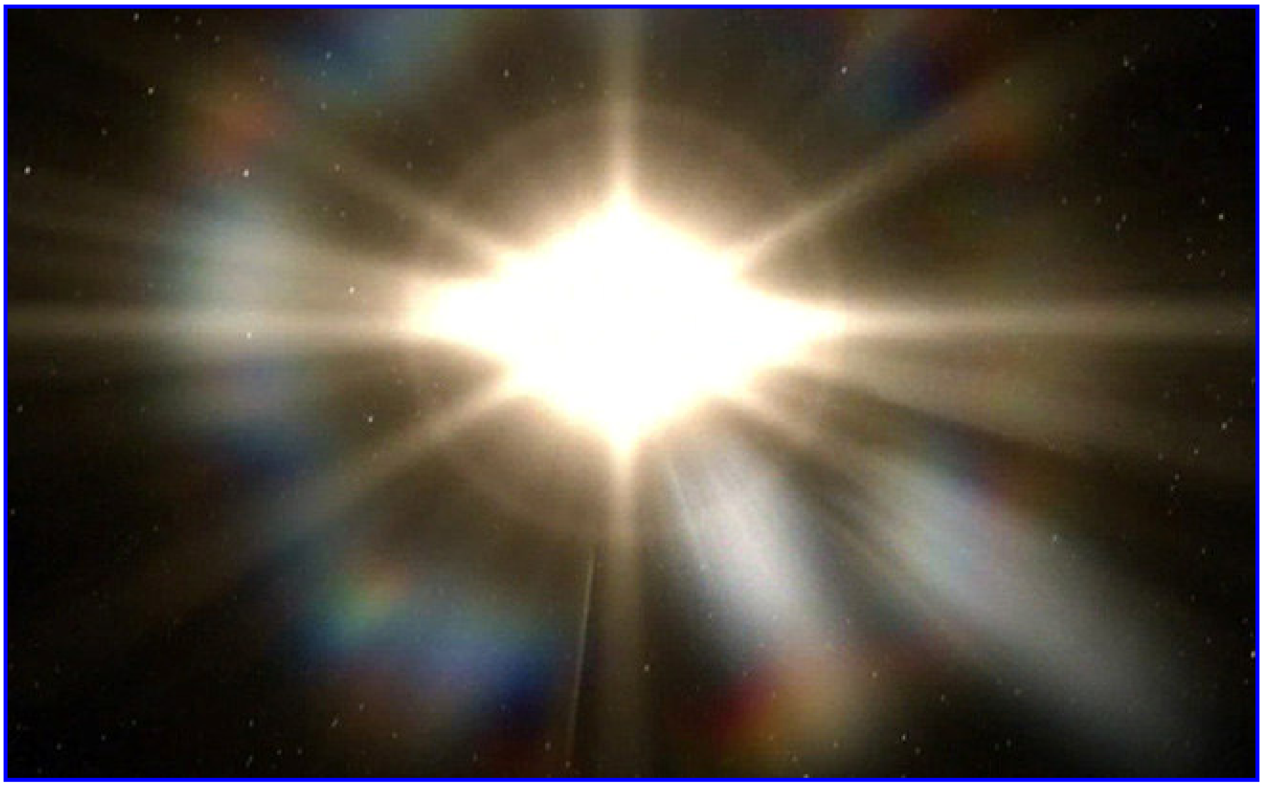
4.4.3 Principles of Wound Suturing:

Wounds are closed either primarily or secondary. A primary closure is within a short time from when the wound was inflicted. A secondary closure is delayed for up to several days.
In general a wound less than 6 hours old can be closed without the danger of infection. Wounds that are up to 24 hours old should not be closed due to the high chance of infection. Look for redness of the tissue, discharge of pus, and high fever from the injured as signs of infection. These wounds will require warm dressing for up to 7 days before closure of the wound may be performed.

For a more in depth explanation of Medical Aid treatments and procures you will need to refer to your Colonial Defense Forces Medical Manual. CDF-MM 07-101

5.1 Operations:

A Raptor is to be able to make approximately ten FTL jumps with an estimated distance of 22 light years before refueling. This is a variable due to payload weight and astronavigation location. Sub light propulsion is the normal and convenient method for intra-solar system travel from planet to planet within the Twelve Colonies. FTL jump drives can be used within an atmosphere but only in an emergency, and is often referred to as "Intra-atmospheric jump". A sonic boom is heard after an atmospheric jump followed by a brief fire ring flare floating in the atmosphere from the rapid suctions of air.



It is reported that FTL jumps will induce nausea, discomfort, and vertigo in some people, approximately 20% of humans. This is due to the visual confusion while standing on a ship and nearby objects move with a motion that is different from motion of the ship.

5.2 Technology:

The technology behind FTL systems is such where ships can jump with a high degree of accuracy allowing ships to rendezvous in space and even plot a jump into a synchronous orbit directly above a given point on a planet's surface. FTL drives are "spun up" using an electromagnetic energy that creates a field around the Raptor which is needed to activate the engines and create a wormhole for faster than light travel.
The FTL drive technology is based on the use of M-Theory that essentially enable the "jump drive systems" to fold space which reduces the distance between any two points.

5.2.1 Acceleration:

A key point concerning the use of jump drives is that they do not break the fundamental limiting factor of our universe which is the speed of light. Ships can not accelerate to faster-than-light velocities, but rather create corridors thru space to reduce the distance to their final destination. This technology is the reason for the impression of faster-than-light travel and travel is virtually instantaneous.

5.2.2 Propulsion:

Propulsion is managed from the fuel tylium. A Ship can travel at sub light speeds of approximately 186,282 miles per second.
If you use the equation: D = S(T) or (Distance=Speed x Time)
(3 x 10^8 m/s) (the speed of light) x 1800 s (30 minutes * 60 seconds/minute) = 5.4 x 10^11 meters or 335, 500, 000 miles.
This simply means that a ship travels over 335.5 million miles in 30 minutes. This is approximately 3.5 astronomical units.

5.2.3 Fuel:

Raptors use cold RCS systems, utilizing a high specific-impulse tylium fuel mixture. The tylium fuel spontaneously ignite when their two components come into contact with each other. Although the fuel is difficult to handle, the tylium engine is easy to control and very reliable.
The engine can be precisely controlled with only two valves, one for each fuel component. This simplifies the control system and eliminates points of failure. With no complex starting procedure the thrust is predictable which gives the direction and velocity of the engines very accurate calculations.

Some common tylium fuel combinations are:

- Tylium + Hydrazine-nitric acid (toxic but stable)
- Tylium + Aniline-nitric acid (unstable, explosive)
- Tylium + Hydrogen peroxide-aniline (dust-sensitive, explosive)
- Tylium + Nitrogen tetroxide (by far the most common hypergolic fuel, less reactive than others, but by no means inert)

5.3 Navigation:

Navigators must be careful when plotting a FTL jump path in order to keep a safe distance from planets and other large astral objects.
A set of Jump Coordinates used to execute an FTL Jump tells the Jump drive to fold space along a vector of three dimensions:

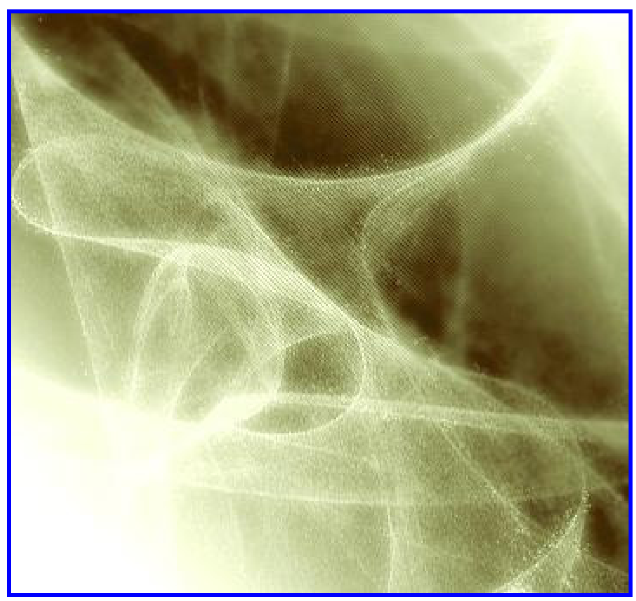
- Elevation
- Rotation
- Distance

Here the dimension of distance would represent more than just a straight line plotted through three-dimensional space but the amount of space curvature that the jump drive would have to fold. A possible algorithm for jump calculations would therefore necessitate first and foremost the figuring out of the exact location of the ship, relative to its intended point of arrival after the jump. This is done by identifying, fixing and triangulating several stars as shown below.

1) The ship's position relative to the intended point of arrival would be plotted on a three-dimensional Cartesian coordinate system, using the ship as its point of origin, which is [0x/0y/0z].
2) The positions of any known stellar bodies and other obstacles would have to be plotted on that coordinate system also in order to establish where to jump and where not to jump.
3) The point of arrival would also need to be plotted. The hard part in making a single jump over long distances would therefore lie not so much in getting the jump drive to fold space correctly, as it would in correctly figuring out where possible obstacles such as a sun or a black hole are located and then adjusting the direction of the jump accordingly so the ship can arrive in a clear volume of space.

5.4 M-Theory:

M-Theory or master theory is the unification of the five string theory mathematical formulas which enables FTL drives thru the creation of an electromagnetic field around the craft which produces a wormhole or fold in space for space travel.



5.4.1 Wormhole:

In physics a wormhole is simply a short cut thru space. A wormhole is able to connect distant locations in the universe by bending space time, allowing travel between them that is faster than it would take light to make the journey through normal space. While traveling through a wormhole, subluminal (slower-than-light) speeds are used. If two points are connected by a wormhole, the time taken to traverse it would be less than the time it would take a light beam to make the journey if it took a path through the space outside the wormhole.
A simple example of a wormhole formula is the following:

$$ds^2 = -c^2\left(1 - \frac{2GM}{c^2 r}\right)dt^2 + \left(1 - \frac{2GM}{c^2 r}\right)^{-1} dr^2 + r^2 d\Omega^2$$

Therefore, when you bend space time, you travel faster than light by shrinking space time in front of you and expanding it behind you.

5.4.2 Superstring theory:

This is a very short and simplified explanation to the Superstring Theory and is the explanation of all of the particles and fundamental forces of nature in one theory by modeling them as vibrations of tiny super symmetric strings.
It is this theory that brings the theories of quantum gravity together. Superstring theory is shorthand for "super symmetric string theory" because unlike earlier string theory, it is the version of string theory that incorporates fermions and super symmetry. The deepest problem in theoretical physics is harmonizing the theory of general relativity, which describes gravitation and applies to large-scale structures (stars, galaxies, super clusters), with quantum mechanics which describes the other three fundamental forces acting on the microscopic scale.
The development of a quantum field theory of a force invariably results in infinite and therefore useless probabilities. Physicists have developed mathematical techniques to eliminate these infinities which work for the electromagnetic, strong nuclear and weak nuclear forces, and gravity. Thus the development of a quantum theory of gravity must come about by different means than were used for the other forces.
The basic rule is that the fundamental constituents of reality are strings of the Planck length (about 10^{-35} m) which vibrate at resonant frequencies. The tension of a string (8.9×10^{42} n.) is about 10^{40} times the tension of an average piano string (735 n.). The graviton messenger particle of the gravitational force, is a string with wave amplitude zero. Another key insight provided by the theory is that no measurable differences can be detected between strings that wrap around dimensions smaller than themselves and those that move along larger dimensions. Singularities are avoided because the observed consequences of "big crunches" never reach zero size. In fact, should the universe begin a "big crunch" sort of process, string theory dictates that the universe could never be smaller than the size of a string, at which point it would actually begin expanding.

6.1 Take-off and Landing:

The Raptor is designed to be launched from a Battlestar's flight deck. The following description is a short explanation of the parameters for launching and landing of the Raptor.

6.1.2 Flight Deck:

Most Battlestars have been upgraded with onboard-automated approach controls to bring a vehicle in on landing. However pilots show know how to use "Hands on Approach" were the vehicle is manually flown and landing on the flight deck.
To help guide the pilot in on landing there is a Light Landing Device "LLD" which is commonly referred to as "The Ball" by the pilots. The "LLD" is a system of mirrors and lights that is mounted on a cantilevered platform on the stern of the flight-landing pod. There are five lenses in the "LLD" that are faceted in a way that if a pilot's approach is off the appropriate glide slope trajectory, the center lens will not be lit. If the glide slope is too high the top lens will be lit, too far to the left or port side and that side of the lens will be lit.
When a pilot is half a kilometer from the flight land pod, the Launch System Operator "LSO" will ask to call "The Ball". If the pilot sees the center light the reply is "Ball Called". If "The Ball" is not called and the glide slope trajectory cannot be corrected, a "Wave-Off" is called by the "LSO" which the pilot must then do a fly-by and try again for a proper landing. If after the pilot calls "The ball" and past the "Wave-Off" or landing threshold and the proper trajectory is lost, the "LSO or the pilot will call "Bolter" which is a increase of power for a fly-thru the flight landing deck for another try at landing.

6.2 Check list:

The Raptor checklist is to ensure that the pilot will properly check all systems prior to flight. It forms the basis of procedural standardization in the cockpit. The checklist is sub-divided into specific categories.

CDF-RTM-0601-06

RAPTOR PREFLIGHT CHECKLIST

1 COCKPIT

1. CABIN AIR INTAKE ____________ NORMAL
2. LANDING LIGHTS ____________ OPERATIONAL
3. LANDING CHOKES ____________ REMOVED
4. WIRELESS ARRAY ____________ OPERATIONAL
5. CIRCUIT BREAKERS ____________ CHECK
6. RCS MODE SWITCH ____________ ROTATIONAL
7. ARMAMENT ____________ LOADED
8. DOCK COLLAR ____________ SECURED / LOCKED

2 WING SECTIONS

1. POSITION / STROBE LIGHTS ____________ CHECK
2. AILERONS ____________ OPERATIONAL
3. RUDDER ____________ FREE MOVEMENT
4. WING TIPS ____________ NO VISIBLE CRACKS
5. FUEL PORTS ____________ CLEAR
6. PORT HATCH ____________ SECURED / LOCKED

3 CABIN

1. MISSION DOCUMENTS ____________ ONBOARD
2. AVIONICS ____________ OPERATIONAL
3. WIRELESS ____________ NO STATIC
4. FUEL CELLS ____________ FULL
5. ELECTRONIC BREAKERS ____________ ALL GREEN
6. FTL ____________ OPERATIONAL
7. BATTERIES ____________ FULL CHARGE
8. MAIN ENGINES ____________ ENGAGED
9. FLAPS & RUDDER ____________ CONTROL
10. DRADIS ____________ OPERATIONAL

4 LAUNCH CHECK

1. FLIGHT DECK ____________ CLEAR
2. BLAST DOORS ____________ OPEN
3. READY DISPLAY ____________ ALL GREEN
4. L.S.O. ____________ ALL CLEAR
5. ENGINES ____________ ALL GREEN
6. TAC / NAV ____________ ACTIVATED

THE DECK OFFICER, PILOT, OR THE L.S.O. HAS THE AUTHORITY TO SCRUB A FLIGHT IF ANY OF THE ABOVE DO NOT CHECK.

DAILY MAINTENANCE CHECK OF THE RAPTOR IS TO BE PERFORMED BY THE ASSIGNED DECK CREW. IT IS THE PILOTS RESPONSIBILITY TO INSURE THAT THESE CHECKS HAVE BEEN PERFORMED PRIOR TO PREFLIGHT CHECK LIST.

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6.3 Stalls and Spins:

Any time you push the vehicle to the limits of its performance you have to be aware of the possibility of stalling the vehicle. High performance turns and maneuvers at the edge of "the envelope" of the vehicle's capabilities need to be performed with care. If you push the vehicle beyond its abilities, the vehicle will stall. The experienced pilot learns the limits of vehicle and learns to "fly the edge of the envelope".
If you push the vehicle too hard you can stall the vehicle and cause the vehicle to enter a spin. The pilot has to react quickly to regain control of his vehicle, or it may enter a spin from which the vehicle cannot recover.
Below is a short summary of conditions with in the atmosphere of a planet.

6.3.1 Stall:

Is caused when you increase the angle of trim on the wing, usually by pulling up sharply on the nose of the vehicle. Airflow strikes the bottom of the wing and is disrupted too much to generate lift, causing the vehicle to fall. The pilot must force the nose back down, then attempt to level the flight to begin developing lift under the wings again. All of this takes time, which is why low altitude stalls usually results in a crash. Remember to always have your Angle of Trim for the vehicle at 5 degrees.
If the wing meets the air at an angle that is greater than 5 degrees this causes a decrease in lift. The vehicle stalls and loses altitude rapidly. The Raptor is equipped with a “stickshaker” that vibrates the joystick when the vehicle is nearing an aerodynamic stall.

6.3.2 Spin:

Is an aggravated stall that occurs when one side of the vehicle stalls before the other. Normally this happens when the vehicle is maneuvering near the critical angle of trim and then stalls, as in a steeply banked turn. The stalled side will lose lift and drop, while the lift and drag on the other side will induce the vehicle to rotate. The result is a corkscrew descent, which may turn into a “flat spin” where both wings are not able to generate any lift and the control surfaces are unable to influence the vehicle’s attitude. Once a flat spin occurs, it usually results in a crash, as the pilot is unable to get the nose down and regain lift. Pilots are trained to take immediate action in the case of a spin, in order to prevent a flat spin. The Raptor is equipped with spin-recovery systems to aid the pilot in getting the vehicle back under control.

6.3.3 Flameout:

There is always the possibility of one or more engines failing, either from damage or malfunction. Restarting a failed engine may or may not work, and a flameout in a critical maneuver can cause a crash. Fortunately, flameouts rarely occur thanks to redundant power systems.

6.3.4 Foreign Objects:

Foreign Object Damage, or FOD, refers to an object striking and damaging the vehicle. This is usually along the leading edge of the control surface. This destroys the vehicle’s ability to generate lift, resulting in a crash. Other times it may mean an object striking the canopy, blinding the pilot by shattering the windscreen or penetrating and injuring the pilot. Raptors are particularly vulnerable to this during takeoff/landing, when speed and lift must be carefully controlled. Ground fire, birds and debris can all cause FOD.

7.1 Orbital mechanics:

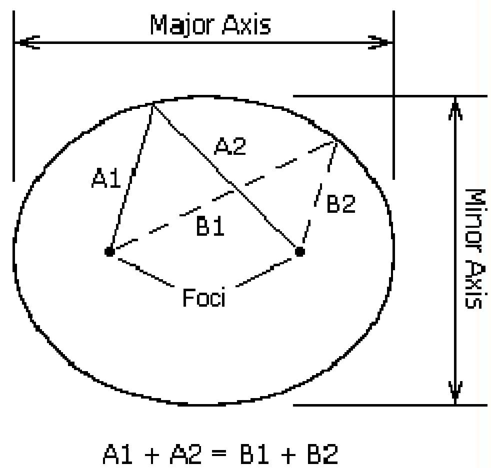
Also called flight mechanics, is the study of the motions of artificial satellites and space vehicles moving under the influence of forces such as gravity, atmospheric drag, thrust, etc. Orbital mechanics is a modern offshoot of celestial mechanics, which is the study of the motions of natural celestial bodies such as the moon and planets. The engineering applications of orbital mechanics include ascent trajectories, reentry and landing, rendezvous computations, and lunar and interplanetary trajectories.

7.1.1 Orbital Elements:

To mathematically describe an orbit one must define six quantities, called orbital elements. They are

- Semi-Major Axis, a
- Eccentricity, e
- Inclination, i
- Argument of Periapsis, ω
- Time of Periapsis Passage, T
- Longitude of Ascending Node, Ω

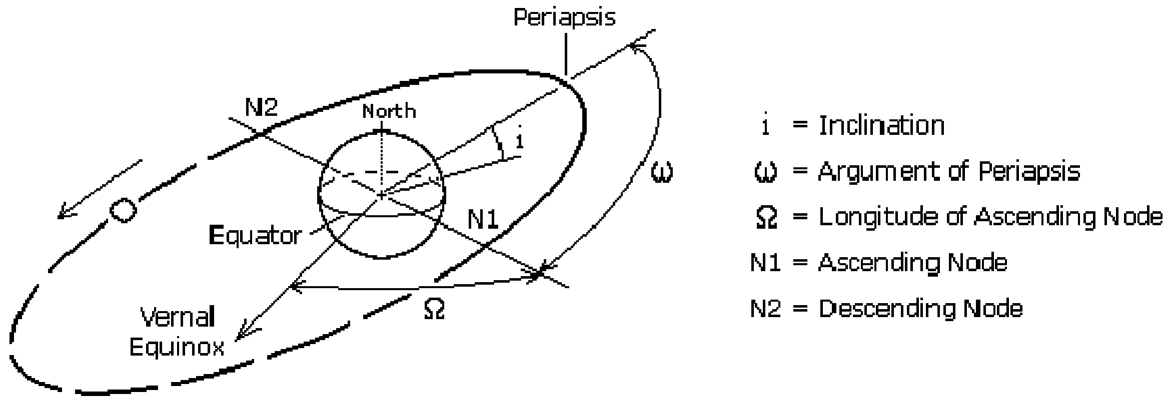
An orbiting satellite follows an oval shaped path known as an ellipse with the body being orbited, called the primary, and located at one of two points called foci. An ellipse is defined to be a curve with the following property: for each point on an ellipse, the sum of its distances from two fixed points, called foci, is constant (see figure to right). The longest and shortest lines that can be drawn through the center of an ellipse are called the major axis and minor axis, respectively. The semi-major axis is one-half of the major axis and represents a satellite's mean distance from its primary. Eccentricity is the distance between the foci divided by the length of the major axis and is a number between zero and one. An eccentricity of zero indicates a circle.



Inclination is the angular distance between a satellite's orbital plane and the equator of its primary (or the ecliptic plane in the case of heliocentric, or sun centered, orbits). An inclination of zero degrees indicates an orbit about the primary's equator in the same direction as the primary's rotation, a direction called prograde (or direct). An inclination of 90 degrees indicates a polar orbit. An inclination of 180 degrees indicates a retrograde equatorial orbit. A retrograde orbit is one in which a satellite moves in a direction opposite to the rotation of its primary.

Periapsis is the point in an orbit closest to the primary. The opposite of periapsis, the farthest point in an orbit, is called apoapsis. Periapsis and apoapsis are usually modified to apply to the body being orbited, such as perihelion and aphelion for the Sun, perigee and apogee for Planet, perijove and apojove for Jupiter, perilune and apolune for the Moon, etc. The argument of periapsis is the angular distance between the ascending node and the point of periapsis (see figure below). The time of periapsis passage is the time in which a satellite moves through its point of periapsis.

Nodes are the points where an orbit crosses a plane, such as a satellite crossing the Planet's equatorial plane. If the satellite crosses the plane going from south to north, the node is the ascending node; if moving from north to south, it is the descending node. The longitude of the ascending node is the node's celestial longitude. Celestial longitude is analogous to longitude on Planet and is measured in degrees counter-clockwise from zero with zero longitude being in the direction of the vernal equinox.



In general, three observations of an object in orbit are required to calculate the six orbital elements. Two other quantities often used to describe orbits are period and true anomaly. Period, P, is the length of time required for a satellite to complete one orbit. True anomaly, v, is the angular distance of a point in an orbit past the point of periapsis, measured in degrees.

7.2 Types of Orbits:

1. Geosynchronous orbits
2. Polar orbits
3. Walking orbits
4. Sun synchronous orbits
5. Molniya orbits
6. Hohmann transfer orbits

For a spacecraft to achieve planetary orbit, it must be launched to an elevation above the planet's atmosphere and accelerated to orbital velocity. The most energy efficient orbit, that is one that requires the least amount of propellant, is a direct low inclination orbit. To achieve such an orbit, a spacecraft is launched in an eastward direction from a site near the planet's equator. The advantage being that the rotational speed of the planet contributes to the spacecraft's final orbital speed. Launching a spacecraft in a direction other than east, or from a site far from the equator, results in an orbit of higher inclination. High inclination orbits are less able to take advantage of the initial speed provided by the planet's rotation, thus the launch spacecraft must provide a greater part, or all, of the energy required to attain orbital velocity. Although high inclination orbits are less energy efficient, they do have advantages over equatorial orbits for certain applications. Below is described the six types of orbits with the advantages of each:

7.2.1 Geosynchronous orbits:

(GEO) are circular orbits around the Planet having a period of 24 hours. A geosynchronous orbit with an inclination of zero degrees is called a geostationary orbit. A spacecraft in a geostationary orbit appears to hang motionless above one position on the Planet's equator. For this reason, they are ideal for some types of communication and meteorological satellites. A spacecraft in an inclined geosynchronous orbit will appear to follow a regular figure-8 pattern in the sky once every orbit. To attain geosynchronous orbit, a spacecraft is first launched into an elliptical orbit with an apogee of 35,786 km (22,236 miles) called a geosynchronous transfer orbit (GTO). Firing the spacecraft's engine at apogee then circularizes the orbit.

7.2.2 Polar orbits:

(PO) are orbits with an inclination of 90 degrees. Polar orbits are useful for satellites that carry out mapping and/or surveillance operations because as the planet rotates the spacecraft has access to virtually every point on the planet's surface.

7.2.3 Walking orbits:

An orbiting satellite is subjected to a great many gravitational influences. First, planets are not perfectly spherical and they have slightly uneven mass distribution. These fluctuations have an effect on a spacecraft's trajectory. Also, the sun, moon, and planets contribute a gravitational influence on an orbiting satellite. With proper planning it is possible to design an orbit that takes advantage of these influences to induce a precession in the satellite's orbital plane. The resulting orbit is called a walking orbit, or precessing orbit.

7.2.4 Sun synchronous orbits:

(SSO) are walking orbits whose orbital plane precesses with the same period as the planet's solar orbit period. In such an orbit, a satellite crosses periapsis at about the same local time every orbit. This is useful if a satellite is carrying instruments that depend on a certain angle of solar illumination on the planet's surface. In order to maintain an exact synchronous timing, it may be necessary to conduct occasional propulsive maneuvers to adjust the orbit.

7.2.5 Molniya orbits:

Are highly eccentric orbits with periods of approximately 12 hours (2 revolutions per day). The orbital inclination is chosen so the rate of change of perigee is zero, thus both apogee and perigee can be maintained over fixed latitudes. This condition occurs at inclinations of 63.4 degrees and 116.6 degrees. For these orbits the argument of perigee is typically placed in the southern hemisphere, so the satellite remains above the northern hemisphere near apogee for approximately 11 hours per orbit. This orientation can provide good ground coverage at high northern latitudes.

7.2.6 Hohmann transfer orbits:

Are interplanetary trajectories whose advantage is that they consume the least possible amount of propellant. A Hohmann transfer orbit to an outer planet, such as Mars, is achieved by launching a spacecraft and accelerating it in the direction of Planet's revolution around the sun until it breaks free of the Planet's gravity and reaches a velocity which places it in a sun orbit with an aphelion equal to the orbit of the outer planet. Upon reaching its destination, the spacecraft must decelerate so that the planet's gravity can capture it into a planetary orbit.

To send a spacecraft to an inner planet, such as Venus, the spacecraft is launched and accelerated in the direction opposite of Planet's revolution around the sun (i.e. decelerated) until it achieves a sun orbit with a perihelion equal to the orbit of the inner planet. It should be noted that the spacecraft continues to move in the same direction as Planet, only more slowly.

To reach a planet requires that the spacecraft be inserted into an interplanetary trajectory at the correct time so that the spacecraft arrives at the planet's orbit when the planet will be at the point where the spacecraft will intercept it. This task is comparable to a quarterback "leading" his receiver so that the football and receiver arrive at the same point at the same time. The interval of time in which a spacecraft must be launched in order to complete its mission is called a launch window.

7.3 Laws of Motion and Universal Gravitation:

The laws of motion describe the relationship between the motion of a particle and the forces acting on it. The first law states that if no forces are acting, a body at rest will remain at rest, and a body in motion will remain in motion in a straight line. Thus, if no forces are acting, the velocity (both magnitude and direction) will remain constant.

The second law tells us that if a force is applied there will be a change in velocity, i.e. an acceleration, proportional to the magnitude of the force and in the direction in which the force is applied.

The third law states that if body 1 exerts a force on body 2, then body 2 will exert a force of equal strength, but opposite in direction, on body 1. This law is commonly stated as: "for every action there is an equal and opposite reaction".

In the law of universal gravitation, it is stated that two particles having masses and separated by a distance are attracted to each other with equal and opposite forces directed along the line joining the particles.

7.3.1 Uniform Circular Motion:

In the simple case of free fall, a particle accelerates toward the center of a planet while moving in a straight line. The velocity of the particle changes in magnitude, but not in direction. In the case of uniform circular motion a particle moves in a circle with constant speed. The velocity of the particle changes continuously in direction, but not in magnitude. From the laws we see that since the direction of the velocity is changing, there is acceleration. This acceleration is called "centripetal acceleration" and is directed inward toward the center of the circle.

A satellite in orbit is acted on only by the forces of gravity. The inward acceleration that causes the satellite to move in a circular orbit is the gravitational acceleration caused by the body around which the satellite orbits.

7.3.2 Motions of Planets and Satellites:

Through the study of the motions of bodies in the solar system, three basic laws derived are known as "laws of planetary motion". Using data compiled after years of calculations the following regularities were found:

1. All planets move in elliptical orbits with the sun at one focus.
2. A line joining any planet to the sun sweeps out equal areas in equal times.
3. The square of the period of any planet about the sun is proportional to the cube of the planet's mean distance from the sun.

These laws can be deduced from the laws of motion and the law of universal gravitation.

7.3.3 Launch of a Space Vessel:

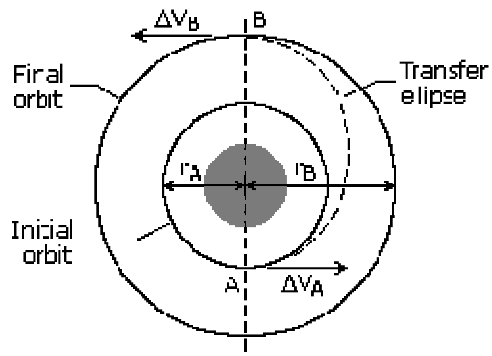
A launch consists of a period of powered flight during which the vessel is lifted above the planet's atmosphere and accelerated to orbital velocity by the engines. Powered flight concludes at burnout that is the boundary of space and the vessel begins its free flight. During free flight the vessel is assumed to be subjected only to the gravitational pull of the planet. As the vessel moves away from the planet, its trajectory may be affected by the gravitational influence of the sun, moon, or another planet.

A vessel's orbit may be determined from the position and the velocity at the beginning of its free flight.

7.4 Orbital Maneuvers:

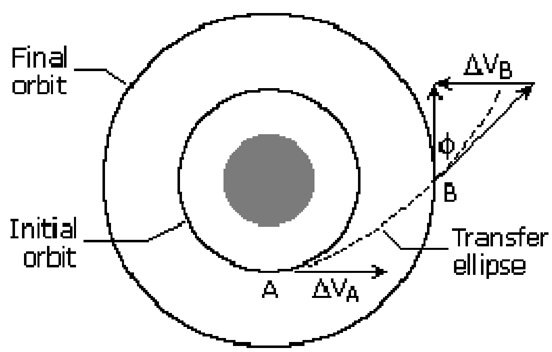
At some point during the flight plan of a vessel, one or more of the orbital elements must be changed. An example of this is the need to transfer from an initial parked orbit to a mission orbit, or rendezvous with and intercept another vessel.

Most frequently, the orbit altitude, plane, or both will need to be changed. To change the orbit of a vessel, velocity vector in magnitude or direction requires adjustment. Most vessels' engines operate for only a short time compared to the orbital period; therefore the maneuver is considered an impulsive change in velocity while the position remains fixed. For this reason, any maneuver changing the orbit of a vessel must occur at a point where the old orbit intersects the new orbit. If the orbits do not intersect, an intermediate orbit that intersects both must be used and will require at least two propulsive burns.

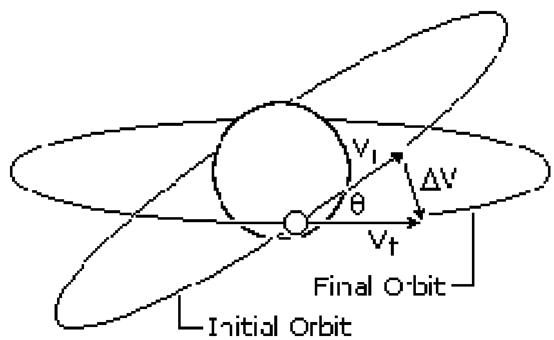


7.4.1 Orbit Altitude Changes:

The most common type of in-plane maneuver changes the size and energy of an orbit, usually from a low-altitude parked orbit to a higher-altitude mission orbit such as a geosynchronous orbit. Because the initial and final orbits do not intersect, the maneuver requires a transfer orbit. The illustration below represents a "Hohmann transfer orbit". In this case, the transfer orbit's ellipse is tangent to both the initial and final orbits. The orbits are tangential, so the velocity vectors are collinear, and the "Hohmann transfer orbit" represents the most fuel-efficient transfer between two circular, coplanar orbits. When transferring from a smaller orbit to a larger orbit, the change in velocity is applied in the direction of motion; when transferring from a larger orbit to a smaller, the change of velocity is opposite to the direction of motion.



Ordinarily a vessel will make a transfer orbit using the smallest amount of energy, which usually is a "Hohmann transfer orbit". Sometimes the need to transfer a vessel between orbits in less time than that required to complete the "Hohmann transfer orbit". The illustration below shows a faster transfer called the "*One-Tangent Burn"*. In this instance the transfer orbit is tangential to the initial orbit. It intersects the final orbit at an angle equal to the flight path angle of the transfer orbit at the point of intersection. An infinite number of transfer orbits are tangential to the initial orbit and intersect the final orbit at some angle. The transfer may be chosen by specifying the size of the transfer orbit, the angular change of the transfer, or the time required to complete the transfer. The transfer orbit is then defined and calculated for the required velocities.



Another option for changing the size of an orbit is to use electric propulsion to produce a constant low-thrust burn, which results in a spiral transfer.

7.4.2 Orbit Rendezvous:

Orbital transfer becomes more complicated when the vessel to rendezvous with or intercept another vessel is in space. Both the vessels must arrive at the rendezvous point at the same time. This precision demands a phasing orbit to accomplish the maneuver. A phasing orbit is any orbit that results the vessels achieving the desired geometry relative to each other to initiate a "Hohmann transfer orbit". If the initial and final orbits are circular, coplanar, and of different sizes, then the phasing orbit is simply the first vessels orbit. The second vessel remains in the initial orbit until the relative motion between both vessels results in the desired geometry.

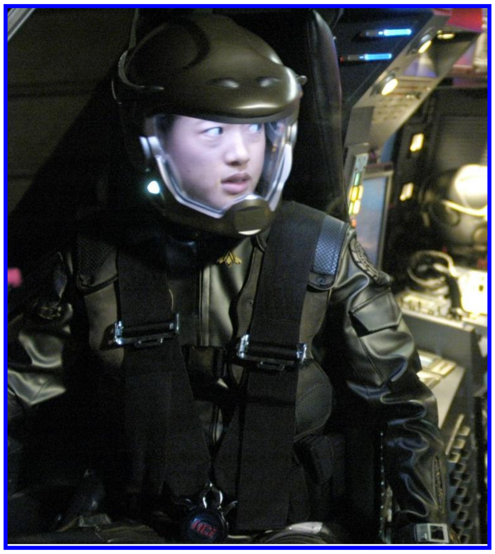
7.4.3 Launch Windows:

Similar to the rendezvous problem is the launch-window problem, or determining the appropriate time to launch from the surface of a planet into the desired orbital plane. Because the orbital plane is fixed in inertial space, the launch window is the time when the launch site on the surface of the planet rotates through the orbital plane. The time of the launch depends on the launch site's latitude and longitude and the satellite orbit's inclination and longitude of ascending node. This is used only for the conservation of fuel for the vessel.

8.1 Flight Gear:

All CDF Raptor pilots wear the standard issue pressure flight suit. This suit is a versatile outfit that has been designed to be as comfortable as it is useful during missions. All pilots are also issued the standard CDF utility belt and side arm.

8.1.1 Flight Suit:



The flight suit is a one-piece jumpsuit with a single zipper from neck to waist in the front. Pressure gloves, which are attached by a soft pressure seal incorporated in the sleeves and the pilot's helmet that is connected to the suit by a hard seal collar. This seal also provides pressure to the suit as a whole when connected. The helmet receives air from a life support unit attached to the pilot's ejection seat. The flight suit can be worn without the helmet or with, and leaving the front helmet movable visor open to the outside air.

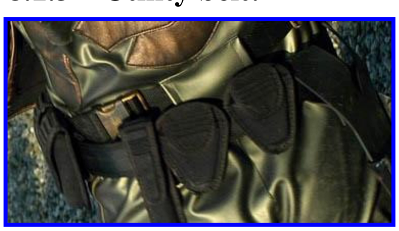
When pilots are not in flight, the suit is able to be unzipped and the top half of the suit rolled down when off-duty or while they are performing hard tasks. Basic crew fatigues should be worn underneath the flight suit that is comprised of the standard gray and black undershirts and green BDU trousers.

The flight suit is suitable as an all-weather gear for all types of harsh or hazardous conditions. There is no significant protection in combat except for the light armored vest worn in conjunction with the flight suit.

8.1.2 Armored Vest:

The light armored vest is a front open style design that can be removed quickly. The vest is made up of three sections to each side of the pilot’s front body and has front fastening clasps for adjustments and hard snap connections to the flight suit. It should be noted that this vest is primarily designed to protect the pilots mid sections only from flying fragmented debris and not high velocity projectiles.

8.1.3 Utility belt:



The utility belt is designed to carry multiple pouches and or accessories that are interchangeable. The standard CDF issued utility belt is comprised of holster and sidearm, double magazine clip, mini-flashlight, handheld GPS, portable USB 4-port for computer access, mini-flare or paint spray, and any additional gear as deemed necessary for missions such as multi tool pliers, radiation dosimeter, or H2O sensor stick.

8.2 Planetary Gear:

Every Raptor has the standard issued CDF survival gear for planetary survival if the pilot is forced to land or ditch the vehicle until rescue is available. The following is a list and description of the provided gear.

8.2.1 Medical Equipment:

Medical equipment is required aboard the Raptor to provide medical care for minor illnesses and injuries. It also provides support for stabilizing severely injured the pilot may have incurred until rescued. The medical equipment consists of two separate kits that have multiple designated pallets:

- Medications and bandage kit “MBK” which is in a blue colored case.
- Emergency medical kit “EMK” which is in a red colored case.

The MBK pallet designators are D, E and F. The D pallet contains medications consisting of pills, capsules and suppositories. The E pallet contains bandage materials for covering or immobilizing body parts. The F pallet contains medications to be administered by topical application.
The EMK pallet designators are A, B, C and G. The A pallet contains medications to be administered by injection. The B pallet contains items for performing minor surgeries. The C pallet contains diagnostic/therapeutic items consisting of instruments for measuring and inspecting the body. The G pallet contains a microbiological test kit for testing for bacterial infections.

8.2.2 Radiation Equipment:

The harmful biological effects of radiation must be minimized through combat missions based on calculated predictions and monitoring of dosage exposures. Preflight requirements include a projection of mission radiation dosage, an assessment of the probability of solar flares during the mission and a radiation exposure history of pilots. In-flight requirements include the carrying of passive dosimeters by the pilot and, in the event of solar flares or other radiation contingencies.

8.2.3 Survival Kit:

The survival kit is a pack of tools and supplies prepared in advance as an aid for the pilot which is stored aboard the Raptor for the pilot to survive until extracted by a rescue team. The following is a list of items the pilot can find with in the survival kit.

1) Tool pouch which has the following:
    - Nylon line
    - Nylon webbing and tape
    - Metal fasteners
    - Spec hook and loop fasteners
    - Stress point anchors and bar tacks
2) Survival Meals
    - 12 pre-made entrees
3) 2 water canteens – 2 qt each
4) Mobile water purifier
    - This lightweight purifier is able to purify 100 liters of water
5) Compass
6) Strobe light
    - This strobe light has a CDF tracking responder and a strobe light that can be seen from 3 kilometers.
7) Shelter
    - Insect Net
    - Sleeping Pad
    - Sleeping Bag
    - Waterproof Tarp
8) Striker fire starter
    - This striker is a one handed device that is spring loaded to produce a very hot shower of sparks
9) Hand help radio
10) Knives
    - Serrated combat knife
    - Machete

8.3 Space EVA Gear:

This section covers the common gear & tools required by the Rescue Specialists during a External Vehicle Activity or "EVA" operation in space. An EVA operation can be dangerous for a number of reasons. The primary one is collision with space debris with a velocity approximately 10 times the speed of a bullet. Another reason for danger is that external environments in the vacuum of space is harsh with varied temperatures, no oxygen, and the threat of radiation.

8.3.1 Vacuum of Space:

While not being an actual perfect vacuum, outer space contains such sparse matter that it can be effectively thought of as one.
A person suddenly exposed to the vacuum would not explode, freeze to death, or die from boiling blood, but would take a short while to die by suffocation. Air would immediately leave the lungs due to the enormous pressure gradient, and so any dissolved oxygen in the blood would empty into the lungs to try to equalize the partial pressure gradient. Once the deoxygenated blood arrived at the brain, death would quickly follow. Water vapor would also rapidly evaporate off from exposed areas such as the lungs and cornea of the eye, cooling the body. Any exposed skin would immediately succumb to sunburn.

8.3.2 Gear Specifications:

The below is a summary of some EVA equipment for the Rescue Specialist. Gear required will vary based on the parameters of each operation.

Bag - EVA:
The EVA bag is used to stow various items in the airlock for possible use during an EVA operation. The EVA Bag contains pockets on the outer & inner shell for different tools and equipment.

Battery Charger:
Each charger has input and output fuse protection as well as over voltage and over current cutoff for the input and output lines. Red and green indicator lights provide feedback on charge status.

Bolt Puller:
The bolt puller is a modified crowbar for EVA use for improved leverage within confined spaces. A tool ring for tethering has been added. The bolt puller is used primarily for prying or un-jamming objects.

Cutters:
The cutter jaws are designed to cut objects up to 1.5" diameter. These cutters is also able to thru carbon graphite composite material with the ease. The cut is so clean as to not leave any debris or jagged edges.

Drive Tool:
The drive tool is used for operation of the hatch manual deployment hinges. The tool will drive the output shaft of the rotary drive actuator to a mechanical stop.

Flashlight:
The flashlight is a small, portable electric lamp powered by dry batteries used as a source for artificial light.

Hammer:
The hammer is a common tool used in EVA use. The hammer is a general purpose tool used disconnect and jam removal.

Hook:
Hooks are used as a latching device for lines and provides a positive lock.

Latch Tool:
The latch tool is used to bypass a failed cargo bay door latch. This tool is designed to duplicate the nominal latch loads on the latch lock and roller.

Line:
Line is a synthetic fiber that has a higher breaking strength than that of steel cable of the same diameter, and remarkably weighs less.

Ratchet Tool:
The ratchet is used loosening / tightening, drilling, and in manual cranking were torque is needed. It has a two speed switch with a four position torque control.

Additional tools will vary for mission operation depending on the situation and parameter requirements.

RT-109 Cylon Raider Specifications

9.1 Know your Enemy:

The latest Cylon Raider is an unmanned vehicle. The main fuselage, which houses the brain, is mounted between two large forward curved wings. This new model is not mechanical but is in fact biomechanical with a very intelligent A.I. onboard.

9.1.1 Specifications:

- Dimensions

Length: 8.94 meters
Wingspan: 5.59 meters
Height: 1.52 meters

- Propulsion

2- Ion drive main thrusters
1-FTL capable drive system

- Armaments

2- Main caliber cannons
24- Conventional missiles
2- Under each wing mounted nuclear missiles
1- Phase array emitter

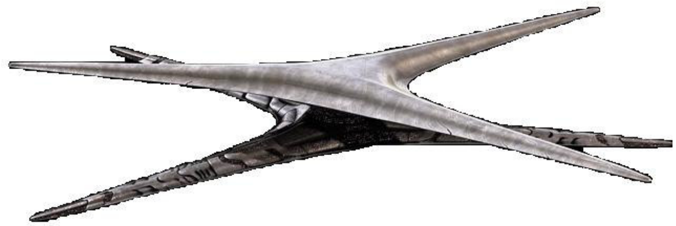
Due to the nature of the Raiders design, this opponent is capable of extreme flight for both acceleration and deceleration maneuvers. Energy transferred to the frame by G-forces is fluid-like, making this Raider a very deadly opponent on both the defensive and offensive.
Like all spacecrafts, maneuverability is defined by the basic principles of pitch, yaw, and roll that simply mean the Raider also has limitations and weakness.
The Cylon Raiders type of wireless communication is unknown at this time; which makes it difficult to determine if wireless jamming is possible during an attack.
Since the Raider has an onboard FTL drive, this makes it a very tricky opponent. It has been reported during C.A.P. that Raiders would jump in and out of the DRADIS range at random locations making it extremely difficult for a “Firing Solution”.

All Raptor Pilots should take extreme caution if engaging this opponent. Pilots always remember to call for viper support and never try to go head to head with this Raider.

Good Hunting Nuggets!

9.2 Cylon Basestar:

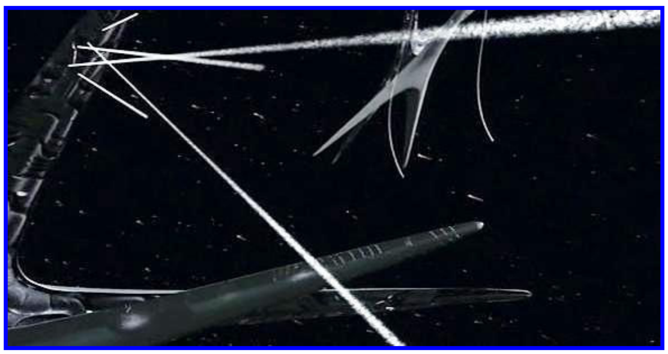
A Cylon Basestar is approximately twice the size of a Colonial Columbia class Battlestar with advanced computer linked technology and equipment. The Basestar also is reported to have a superior FTL jump drive system along with no visible means of engines for sub light propulsion. Basestar's are reported to operate with a complete fleet of Cylon Raiders as its support.



9.2.1 Armament:

A Basestar is capable of launching conventional or nuclear missiles from turrets that are mounted throughout the hubs and central axis that rotate to allow the Basestar to fire in any direction simultaneously.

A Basestar's complement of Raiders is estimated to be more that 700 Cylon Raiders.



9.3 Heavy Raider:

Not much is yet known about this craft. The Heavy Raider is likely autonomous, as evidenced by the Raider-style head. Though there are reports that this might be a Cylon Transport for troops.

9.3.1 Armament:

The main armament of the Heavy Raider seems to consist of a barbette of six cannons mounted under the cockpit area of the vehicle. These cannons are capable of an extremely high rate of fire and are reported to also have the capability of launching missiles.

10.1 Raptor Training Manual Test:

All Raptor Pilot trainees after learning the above-prescribed courses are required to take the RTM Test and pass with a minimum score of 75% for active status with the Raptor. All pilots will be awarded the "Jr. Wings" with a score rating 75% or better. No "Sr. Wings" are given out to Raptor Pilots since their role is primarily of recon and not combat.

The test is a 80 multiple-choice questionnaire given and scored by your CDF C.A.G. Below is the test for the prescribed courses as listed in the Table of contents.

10.1.1 RTM Test Questions:

Chapter 1: RT-101 Raptor Specifications

1) In the Raptor, the life support systems are:
a) only part of the flight suit b) integrated into the cockpit
c) not part of the Raptor's specifications d) none of the above

2) Raptors are very sluggish but will consume less fuel during atmospheric operations:
a) true b) false

3) The Raptor cockpit is pressurized and heated:
a) true b) false

4) The Raptors Dorsal storage bay holds only 3x HD-70 Lightning Javelin missiles:
a) true b) false

5) The Raptor does not has a radar warning system, which detects an opponent's missile solution
a) true b) false

Chapter 2: RT-102 Vocabulary

1) The pilot should always be aware what to conserve the most fuel:
a) fuel capacity b) gravity on the planet
c) speed d) both A & C

2) The Raptor at present is for reconnaissance purposes but can also be used for:
a) patrol b) transport
c) marine assault d) all of the above

3) The term Bolter is what:
a) a fly-by over the battlestar bridge b) an opponent on the run
c) device used to launch Raptors d) called by the LSO for the pilot to not land

4) The success of reconnaissance tactics in the air depends on what main factor:
a) surprise b) maneuverability
c) weapons d) both "A" and "B"

5) The LLD is a system of lights and mirrors mounted on the stern of the flight pods of a Battlestar:
a) true b) false

7) In the role of reconnaissance the Raptor can only:
a) Undertake short and medium-range scans b) Scramble control signals
c) Undertake IFF operation d) all of the above

8) If your vehicle is damaged you need to call the ball or make sure you are aligned before you touch down on the deck:
a) true b) false

9) A patrol launched in a defensive pattern and ready to respond to all incoming threats is:
a) defensive patrol b) responsive patrol
c) perimeter patrol d) none of the above

10) Surprise has always been one of the most important factors of success in the recon:
a) true b) false

Chapter 3: RT-103 Maneuvering

1) There are four basic forces at work when a vehicle is in flight, which is always constant:

a) lift b) thrust

c) g-force / gravity d) drag

2) The Ailerons, located on the outer part of the trailing edge of the wings, control the roll or bank of the vehicle:

a) true b) false

4) If you exceed your maximum "AoT", you interrupt the flow of air over one or both wings and you induce a stall:

a) true b) false

5) The rudder controls the yaw or the left/right sliding movements of the vehicle:

a) true b) false

6) Space Navigation is comprised of two aspects:

a) pitch and roll b) lift and g-force

c) thrust and yawl d) position and velocity

7) The angle between where the wing is pointed and the glide slope the vehicle is:

a) 5 degrees b) 10 degrees

c) 20 degrees d) 15 degrees

8) Compression usually occurs between Mach 0.7 to 0.9:

a) true b) false

9) The actual speed of sound varies at different altitudes, depending on air density.

a) true b) false

10) By repeatedly acquiring data, a mathematical model will show the vehicle's location in:

a) 6 point square reference b) x,y,z axis

c) two dimensional view d) none of the above

12) Negative g-force is the effect of excessive blood being pumped to the pilot's brain:

a) causing headache b) causing noise bleed

c) causing ringing in the ear d) causing distorted vision

14) The process of the vehicles orbit determination is described in terms of a "state vector" or "position and velocity":

a) true b) false

15) To make a change increasing the altitude, an "OTM" would decrease the vehicle's velocity and increase the altitude:

a) true b) false

Chapter 4: RT-104 Reconnaissance & Rescue

1) The CDF organizes, trains, and equips personnel to conduct R&R operations on which of the twelve colonies:

a) Caprica b) Picon
c) Geminon d) any of the twelve

2) The "R&R" responsibilities relating to a military operation is which of the following listed below:

a) Providing mutual support b) Preparing rescue concept of operations
c) Ensuring data to support planning d) all of the above

3) "CSR" is a supporting package of military assets which stands for:

a) Colonial Support of Rescue b) Cylon Surveillance & Recon
c) Combat Search & Rescue d) none of the above

4) The "RS" are trained for which of the following:

a) ground combat b) rescue & surveillance
c) recovery of vehicle d) emergency trauma medicine

5) Which of the following is not a key component for the "CSR" as listed below:

a) Intelligence b) Security
c) Communications d) none of the above

6) A secondary wound closure is delayed for up to several days:

a) true b) false

7) The definition for a Avulsion tissue wound is:

a) jagged or torn wound b) removal of a body part
c) forcible tearing away d) scraped area on the skin

8) The Rescue Officers first priority is medical aid measures and care for the sick and injured:

a) true b) false

9) In general a wound can be closed without the danger of infection is less than:

a) 24 hours b) 12 hours
c) several days d) 6 hours

10) CSR forces not to rely on timely and accurate weather support:

a) true b) false

Chapter 5: RT-105 Faster Than Light

1) A Raptor is to be able to make approximately how many FTL jumps before refueling:

a) ten b) two
c) twenty d) four

2) It is reported that FTL jumps will induce nausea, discomfort, and vertigo in some people:

a) true b) false

3) A set of Jump Coordinates for an FTL Jump requires a vector of two dimensions:

a) true b) false

4) The FTL technology is based on M-theory were space is folded creating a wormhole:

a) true b) false

5) When you fold space time, you travel faster than light by shrinking space time in front of you and expanding it behind you.

a) true b) false

Chapter 6: RT-106 Take-off and Landing Procedures

1) The Raptor is designed to be launch from a Battlestar's launch tubes.

a) true b) false

2) To help guide the pilot in on landing there is a Light Landing Device "LLD" which is commonly referred to as "The Ball"

a) true b) false

3) If "The Ball" is not called and the glide slope trajectory cannot be corrected:

a) a "Wave Off" is called b) a " No ball" is called
c) a "Bolter" is called d) a "Fly-By" is called by the LSO

4) A stall is caused when you increase the angle of trim on the wing, usually by pulling up sharply on the nose:

a) true b) false

5) A flat spin is where both wings are not able to generate any lift:

a) true b) false

Chapter 7: RT-107 Orbital and Atmospheric Procedures

1) To mathematically describe an orbit one must define:
a) three quantities b) four quantities
c) five quantities d) six quantities

2) In the simple case of free fall, a particle accelerates toward the center of a planet while moving in a straight line.
a) true b) false

3) Through the study of the motions of bodies in the solar system which of the following regularities were found:
a) Planets move in elliptical orbits
b) The square of the period of any planet about the sun is proportional to the cube of the planet's mean distance from the sun.
c) A line joining any planet to the sun sweeps out equal areas in equal times.
d) all of the above

4) For a spacecraft to achieve planetary orbit, it must be launched to any elevation within the planet's atmosphere.
a) true b) false

5) Geosynchronous orbits are circular orbits around the Planet having a period of:
a) 24 hours b) 48 hours
c) 72 hours d) 12.5 hours

6) Polar orbits are orbits with an inclination of:
a) 15 degrees b) 30 degrees
c) 45 degrees d) 90 degrees

7) Sun synchronous orbits are walking orbits whose orbital plane precesses with the same period as the planet's solar orbit period.
a) true b) false

8) The second law of motion states that if no forces are acting, a body at rest will remain at rest, and a body in motion will remain in motion in a straight line.
a) true b) false

9) The inward acceleration that causes the satellite to move in a circular orbit is the gravitational acceleration caused by the body around which the satellite orbits.
a) true b) false

10) Powered flight concludes at burnout that is at any elevation within a planets atmosphere and the vessel begins its slingshot into space using the planets gravitational field.
a) true b) false

Chapter 8: RT-108 Raptor Space and Planetary Gear

1) The EVA bag is used to stow various items in the Raptor for use during Rescue operation:
a) true b) false

2) Of the below listed EVA tools, which is used to bypass a failed cargo bay door:
a) ratchet b) drive tool
c) latch tool d) cutters

3) The MBK pallet designators are D, E and F:
a) true b) false

4) The EMK pallet designators are X, Y, and Z:
a) true b) false

5) In-flight requirements include the carrying of passive dosimeters by the pilot:
a) true b) false

6) The pilots' flight suit has its own interior oxygen supply and does not need to be attach to the vehicle for oxygen:
a) true b) false

7) The armored vest worn over the flight suit can protect the pilots mid sections from high velocity projectiles.
a) true b) false

8) The survival kit does not include which of the following item for the vehicle pilot:
a) hand held radio b) pick and shovel
c) 12 days of rations d) waterproof tarp

9) The strobe light provided in the survival kit can be seen for:
a) 1 kilometer b) 10 kilometers
c) 3 kilometers d) 5 kilometers

10) A person suddenly exposed to the vacuum would not explode, freeze to death, or die from boiling blood, but would take a short while to die by suffocation:
a) true b) false

Chapter 9: RT-109 Cylon Raider Specifications

1) The new model of the Cylon Raider is report to have a single Centurion in lieu of three like in the older models:

a) true b) false

2) The Cylon Raider is capably of FTL jump as is the same for the Raptor .

a) true b) false

3) The Cylon Raiders type of wireless communication is unknown at this time; which makes it difficult to determine if wireless jamming is possible during an attack

a) true b) false

4) It is reported that the Raider is limited to only 2 under the wing mounted conventional missiles.

a) true b) false

5) The maximum G-forces that the Raider is capable of withstanding are only 5G.

a) true b) false

6) A Basestar is capable of launching only conventional missiles and not nuclear missiles:

a) true b) false

7) A Basestar's complement of Raiders is estimated to be approximately:

a) 500 b) 7,000
c) 700 d) unknown at this time

8) The main armament of the Heavy Raider seems to consist of missiles only:

a) true b) false

9) There are reports that the Heavy raider might be used for:

a) cylon resurrection b) recon only
c) troop transport d) all of the above

10) The six cannons mounted under the cockpit area on a Heavy Raider has an extremely high rate of fire:

a) true b) false