CDF-VTM 06-101.1

Viper Pilots

VIPER MK II TRAINING MANUAL

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DEPARTMENT OF THE COLONIAL DEFENSE FORCE

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

VIPER MK II 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 Viper MK II Fighter. This manual is for general use throughout the Colonial Defense Force and is a guide for personnel teaching or learning for Viper 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 tactical mission.

SUMMARY OF TESTING:

All Viper Pilot trainees after learning the above-prescribed courses are required to take the VTM Test and pass with a minimum score of 75% for active status with the Viper MK II fighter. All pilots will be awarded the "Jr. Wings" with a score rating 75% or better and the "Sr. Wings" with a score rating of 99% to 100%. A Perfect score of 100% places the pilot into the top 10% Ace Rank which is better known as the "Top Gun".

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 Viper Training Manual possible goes out to:

Battlestar Wiki	http://www.battlestarwiki.org
Colonial Defense Force	http://www.cdfcommand.com
Gabriel C. Koerner	http://gabekoerner.com/fx/splash.htm
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Chapter 1

VT-101 Viper MK II Specifications

1.1 Technical Data:

The Viper MK II is the main interceptor fighter for the Colonial Defense Force. Created to be extremely fast and maneuverable for protection of the twelve colonies, this single seated fighter is capable of both space and planetary flight.

Below is a brief description for the Viper pilot on the following three primary areas for the Viper MK II.

1. Atmospheric Operations
2. Life Support
3. Specifications

1.1.1 Atmospheric Operations:

The Viper is designed for flight in atmospheric and space conditions. Vipers will consume more fuel during atmospheric operations than in the vacuum of space. Once in an atmosphere, the engines must run continuously to retain airflow over the wing lifting surfaces due to the Viper's wing 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 Viper's engines.

1.1.2 Life Support:

The Viper 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 from the fighter. The life support systems are built-in to the back of the pilot's seat itself, together with the flight harness. Following an ejection from the fighter, the back of the seat separates automatically and effectively becomes a backpack which incorporates a parachute for the pilot within the atmosphere of a planet. For further information on the Pilots backpack refer to: **Chapter 8: VT-108 Viper MK II Space and Planetary Gear.**

1.1.3 Specifications:

- Dimensions

Length: 8.4082 meters
Wingspan: 4.7168 meters
Height: 2.7247 m (in flight, without landing gear. Landing gear adds approximately 0.5m.)

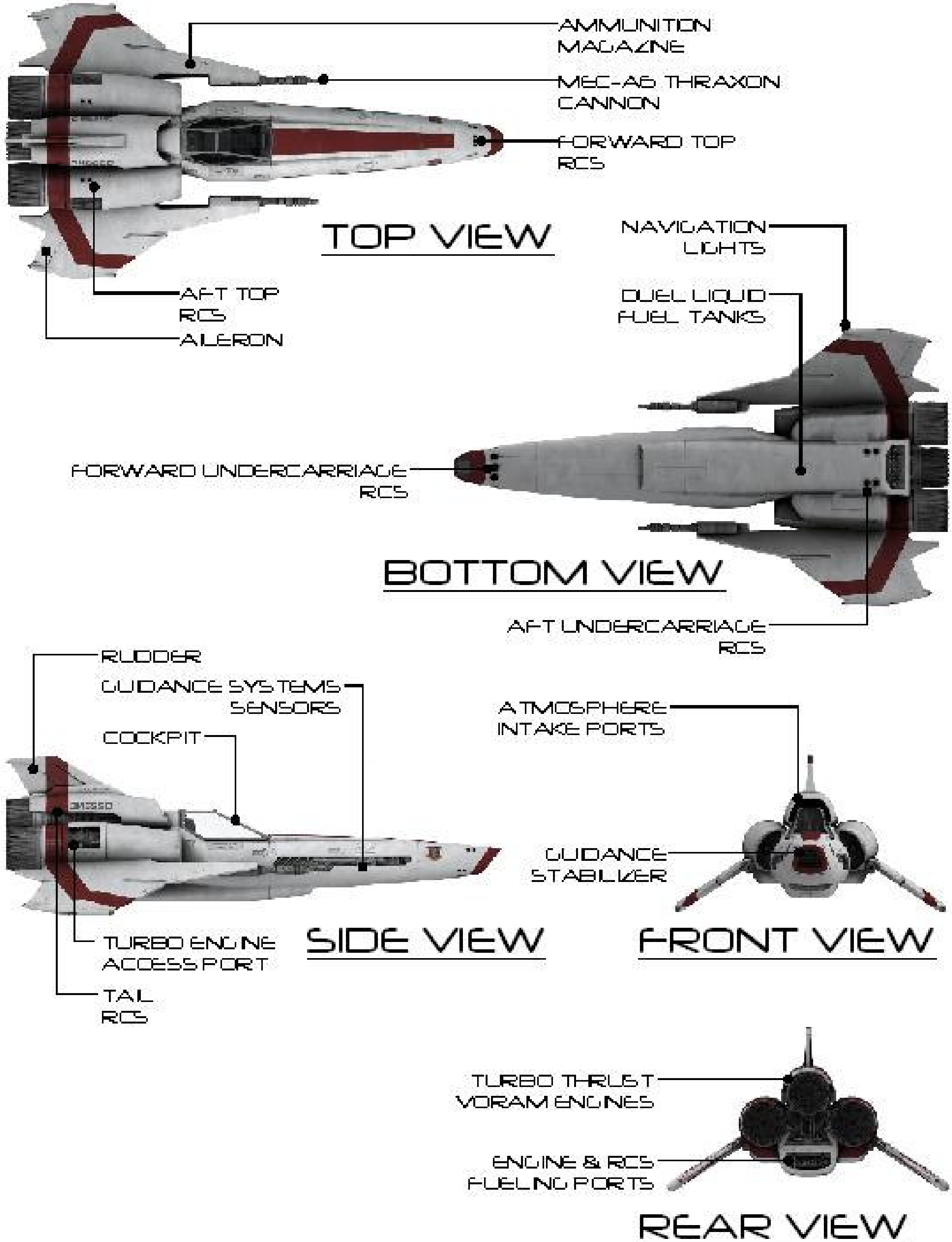
- Propulsion

1- Voram VM2-D15 upper turbo thrust engine
2- Voram VM3-D22 turbo thrust engines
2- Reverse thrust motors & multiple RCS points

- Armaments

2- MEC-A6 30mm Thraxon mass accelerator cannons "MAC" mounted in the wing with round magazines capable of firing 20 rounds per second.
Dorsal storage bay for 8x HD-70 Lightning Javelin missiles or optional 50 megaton nuclear warhead.
The weapon hard points for mounting missiles and ammunitions pods are under the wings.
The Viper MK II has a radar warning system, which detects an opponent's missile solution. Flares and decoy dispensers are provided as a countermeasure.

VIPER MK II FIGHTER



1.2 Avionics:

Below is the instrument panel for the Viper MK II showing the avionic displays and instrument readings.

The Viper MK II 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. Angle of Attack Indicator
10. Gun Counter
11. Air Speed / Mach Indicator
12. Tactical Master Navigation
13. Heads Up Display
14. Engine Temperature Gage
15. Fuel Gage

1.1.1 Dradis (Star Tracker):

Direction, Range, and Distance or “Dradis” is a detection, identification and multiple tracking system. 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.

1.1.2 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.

1.1.3 Radio Magnetic Indicator:

The Radio Magnetic Indicator or “RMI” is the primary navigational instrument in the Viper MK II. 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.

1.1.4 Tachometer:

This gauge represents the current selected power setting (power indicator). Idle indicates flight idle of the engine. 100 represent 100% power selected. Most fighters 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.

1.1.5 Attitude Indicator:

The attitude indicator or "artificial horizon indicator," is perhaps the single most important instrument to Viper MK II. The attitude indicator shows the fighter'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.

1.1.6 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 fighter. For every 1 G the gauge will read 10 T, hence the maximum amount of G-force or torque the fighter's hull integrity can withstand would be 10 G or 120 T.

1.1.7 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.

1.1.8 Vertical Speed Indicator:

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

1.1.9 Angle of Attack Indicator:

This displays the angle of the fighter during engagement of an opponent. This is also important to the pilot during landing procedures.

1.1.10 Gun Counter:

This counter acts as an ammunition indicator for the weapons on the fighter and this counter can display a numeric percentage remaining of ammunition or the actual number of rounds available via the pilot's discretion by switching the mode status.

1.1.11 Air Speed / Mach Indicator:

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

1.1.12 Tactical Master Navigation:

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

1.1.13 Heads Up Display:

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

1.1.14: 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 fighter 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.

1.1.15 Fuel Gauge:

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

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:

Alert Fighter – A rotating group of Vipers that are constantly ready for immediate launch. Their function is to act as support for the **Combat Air Patrol** or **CAP**.

Bolter – is called by the LSO for the pilot to not land and leave the flight pod and go around for another landing pass.

Commander Air Group – Better referred to as **CAG** and is the Commander in charge of all squadrons assigned to a Battlestar with the CDF fleet.

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 Counter Measures – ECM is a device used to confuse or disable detection from the opponent's tracking system.

Engage - Maneuvering with the intent of achieving a kill. If no additional information is provided such as bearing or range then engaged implies visual/radar acquisition of the target.

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. FTL engines are not installed in the Viper MK II and generally used on larger ships such as a Battlestar.

HOTAS – is the hand on throttle and stick, configured throttle and side stick controller for the pilot in the VIPER MK II.

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 fighter 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 an 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 fighter in defensive maneuvers during engagement by an opponent while maintaining overall battle situation awareness.

Visual – Sighting of a friendly or unknown friendly craft.

Wave Off – is called by the LSO if a vessels approach if off course and not able to call the ball.

Wedge - Tactical formation of two or more fighters with the lead in front and the other fighters laterally displaced on either side behind the leader's wing line.

Zipper - Acknowledge radio transmissions with two clicks of the mic button.

2.2 The Necessity of Fighting:

The uses of fighters 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. To seek out and destroy the opponent's forces must therefore be the guiding principle of our tactics in the air or space. These results can only be achieved by gaining and keeping supremacy in the air or space. The more complete the supremacy, the more far-reaching will be the results. The struggle for superiority takes the form with a series of combat, and it is by the effect of success in each combat that supremacy over the enemy is gained. The following is a break down of the necessity of fighting into sub-categories to achieve supremacy for easier explanation.

1. Offensive Tactics
2. Objective Choices
3. Offensive Patrol
4. Roles of the Viper MK II

2.2.1 Offensive Tactics:

Offensive tactics are essential in aerial fighting for the following reasons
1.To gain the Superiority.
2.Because the field of action of fighters is over is of hostile forces, we must, therefore, attack in order to enable others to accomplish their missions, and prevent those of the opponent from accomplishing theirs.
3.Because the fighter is essentially a weapon of attack and not defense.

2.2.2 Objective Choices:

An offensive is conducted by the following means listed:
1. Offensive patrols.
2. Attack with bombs and cannon fire of the opponent's deployments on the immediate front in coordination with operations on the ground.
3. Attacks on centers of military importance at a distance from the battlefront with a view to inflicting material damage and delay of the opponent’s production and transport of war material.

2.2.3 Offensive Patrol:

The purpose of an offensive patrol is to find and defeat the opponent's fighters. Their normal sphere of action extends for approximately 20 kilometers behind the hostile battle line.

2.2.4 Roles of the Viper MK II:

The Viper MK II at present is for offensive purposes but can be divided into four main categories:

1. Perimeter Patrol
2. Fighters
3. Fighter reconnaissance
4. Bombers

2.2.4.1 Perimeter Patrol:

Every patrol 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 destruction 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.

2.2.4.2 Fighters:

The Viper MK II is a single seated fighter, which makes it fast and easy to maneuver.
The armament consists of two cannons, whose axis of fire is directed forward and is usually in a fixed position in relation to the path of the fighter. Single seated fighters are essentially adapted for offensive action and surprise. In defense they are dependent on their handiness, speed and power during maneuvers. They have no advantage over a hostile single seated opponent with regards to armament. On the other hand, provided they are superior in speed and climb to their adversary, they can attack superior numbers with impunity since they can break off the combat at will in case of necessity.

2.2.4.3 Fighter Reconnaissance:

The first duty is to gain information. They do not go out with the intent to fight, but must be capable of doing so since fighting will often be necessary to obtain the required information.

2.2.4.4 Bombers:

When bombing, the requirements for armament are similar to those of fighter reconnaissance. The type of bomb carried will vary from mission to mission, also the greater weight of bombs they can carry the better the devastation will be.

2.3 Principles of Fighting:

The success of offensive tactics in the air depends on three main factors, the principles of these are as listed below:

1. Surprise
2. The Power of Maneuver
3. Effective Use of Weapons

2.3.1 Surprise:

Surprise has always been one of the most important factors of success in the combat. 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 fighter is working in three dimensions, that the pilot's view must always be more or less obstructed by the wings and body of the fighter, and that consequently it is often just as easy for multiple fighters to approach unseen. Fighting in smaller formations is however rapidly becoming the normal rule, and surprise is more difficult from a full squadron in formation, though by no means impossible.

Even when in view surprise is possible to a pilot who is thoroughly at home in the air or space, and can place the fighter by a steep dive, sharp turn, or into a position on the opponent's blind spot.

A surprise attack is much more demoralizing than any other form of attack and often results in the pilot diving straight away, or to put the fighter into such a position that it forms an almost stationary position for a few seconds, proving the pilot an easy shot.

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 fighter even after being spotted since it exposes fewer surfaces to the opponents view than standard banking turns.

2.2.2 The Power of Maneuver:

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

Good formation can only be carried out by pilots who know how to use their throttle. The leader must always fly throttle down or the formation will straggle. While in a turn they must make constant use of their throttle to maintain station and twist, turn and wheel without confusion or loss of distance.
The pilot should always be aware of the fuel capacity of the fighter and its speed to conserve the most fuel.

2.3.3 Effective use of Weapons:

The essentials for successful fighting are the skills in handling the fighter and a high degree of proficiency in the use of the fighter's primary cannons. Of these two essentials, the second is of even more importance than the first. Many pilots, who have not had excellent skills in piloting a fighter, have had the greatest success with their skill in the use of the weapons.
Every pilot who is called upon to use a fighter must have the basic knowledge of its mechanism. This demands constant training and practice both on the ground and in the air.
Pilots should always know exactly how their cannons are shooting, and they should be tried on a target at least once a day. With the fighter's cannons out of action a pilot is helpless for both offense and defense.
Shooting is complicated by the fact that both fighter and opponent are moving at variable speeds and on variable courses. Consequently, the pilot cannot hope to be dead on the target for more than a few seconds at a time, and it is essential to have excellent hand and eye coordination.
Tracer ammunition is of some assistance, but must be used in conjunction with the sights, and not in place of them. Not more than one bullet in three should be a tracer. Too much reliance must not be placed on tracer ammunition at anything beyond short range. The principle should be to use the sights whenever possible at all ranges.
It is necessary to hit the opponent in a vital spot. The eye should fall automatically on the sight and the hand close on the trigger. By holding the right arm firmly against the body and working only from the elbow the fighter can be held much steadier in a dive.

2.4 Rules of Fighting:

Below is a checklist of the six common rules when fighting. Read them, learn, then, and remember them and you will make it back to base after every conflict.

2.4.1 Before you takeoff

- ✓ think twice about where you are taking off from
- ✓ think twice about where you are going

2.4.2 Pick your fight

- ✓ Do not fight when you are outnumbered
- ✓ Always evaluate possible threats
- ✓ Never underestimate your opponent
- ✓ Whatever the odds, always stay with your wingman

2.4.3 How to fight

- ✓ Surprise your opponent and kill him
- ✓ Fly in from low six
- ✓ Always outnumber you opponent
- ✓ Try using the sun or other objects to conceal yourself
- ✓ Save ammo, get close for the kill
- ✓ Kill the weaker opponent and retreat from the stronger opponent
- ✓ Stay Alert and don't get surprised
- ✓ Watch your six, three, nine, overhead...
- ✓ Stay aware at all times
- ✓ Check your six every 20 seconds

2.4.4 Evasive flying

- ✓ Never pull up with opponent on your 6
- ✓ When evading, do not fly straight
- ✓ Make gentle evasive moves to spoil his aim and still keep your speed
- ✓ Always be aware of where the nearest base or group of fighters is
- ✓ Call for help to get the opponent off of your 6

2.4.5 A damaged fighter

- ✓ Do not attack a target with a damaged fighter
- ✓ If you lose a control surface, cease fighting and head back to base
- ✓ If you are missing both elevator use trim controls
- ✓ If you are missing both ailerons, use rudder to roll
- ✓ Without the vertical stabilizer you can still fly for a while towards friendly
- ✓ Bail out and save your life before your fighter explodes
- ✓ Make sure you are aligned before you touch down on the deck
- ✓ Do not slow down with nose down or you will hit the deck
- ✓ Do not use flaps when landing
- ✓ Land fast; do not reduce speed as this may stall the fighter.

2.4.6 Being a wingman:

- ✓ Keep 10 to15 meters from your leader
- ✓ Keep behind your leader in a dive to finish off any opponent that has avoided him
- ✓ Keep a 50 meter altitude advantage over your wingman
- ✓ Always follow your leader
- ✓ Always watch and protect your leader
- ✓ Keep watch on your 6 at all times
- ✓ Communicate your intentions before you execute them
- ✓ Save your ammo
- ✓ Never get into your leader's gun path
- ✓ If your leader is damaged or out of ammo, take the lead

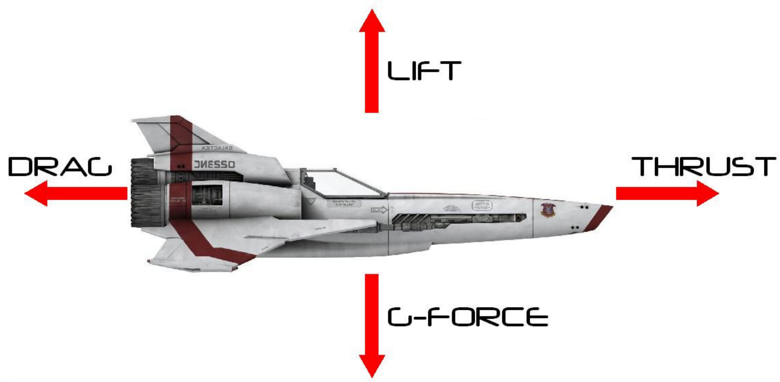
3.1 The Physics of Flight:

There are four basic forces at work when a fighter 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 fighter is flying level at a constant speed, all four of these forces are in balance or equilibrium.

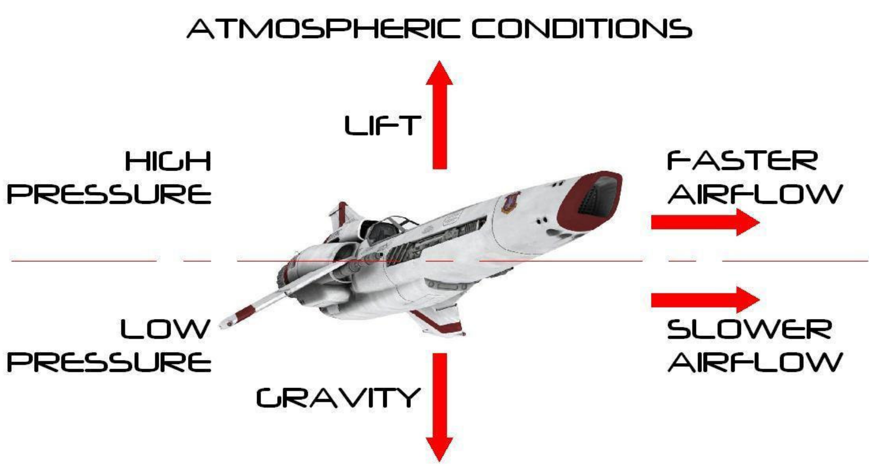


3.1.1 Lift:

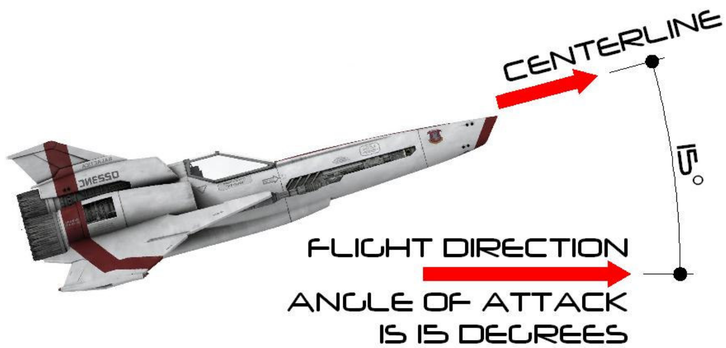
Lift is achieved through the cross-sectional shape (airfoil design) of the wing.

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 fighter is traveling at.



3.1.1.a Angle of Attack:
The angle at which the wings meet the airflow also greatly affects the amount of lift generated. This angle is known as the Angle of Attack "AoA". It is commonly thought that "AoA" is the angle of the fighter relative to the ground - this is incorrect. The "AoA" is the angle of the wing relative to airflow, which can be a very different angle, depending on the attitude of the fighter.
For example, if you are flying at 300 mph on a level course, your "AoA" is normally close to zero (actually about 5°) since your wing is pointed in the same direction as your fighter is traveling. Picture a fighter on a landing glide. The pilot maintains a nose-up attitude to help slow the fighter, while the actual direction the fighter is traveling is in a slope down toward the runway.
Thus "AoA" is the angle between where the wing is pointed and the glide slope the fighter is on.
Angle of Attack is critical to all fighters because the "AoA" greatly affect the flow of air across the wings. If you exceed your maximum "AoA", you interrupt the flow of air over one or both wings and you induce a stall. This is at high and low speeds. Despite flying at 300 kilometers, you can pull the fighter into a turn that interrupts airflow and will quickly cause a dangerous stall.



3.1.2 Thrust:
When the propeller on the fighter engine rotates, it pulls in air from in front of the fighter and pushes it back towards the tail. The force generated by this is thrust. Thrust gives the fighter 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 fighter changes its orientation rapidly (tight turns, loops, etc.), the fighter will undergo additional G-forces. These may be positive or negative G-forces.

- **Positive G-Forces**

Positive G's are generated when a fighter pitches upwards (the nose pulls up). For example, when the fighter 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 fighter pitches downwards (the nose goes down). For example, a sharp dive or similar maneuver that unloads the fighter 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 fighter is propelled forward by thrust, an undesirable effect is also created: resistance. When the fighter travels through the air, its frontal area pushes against the air in front of it, and air flowing over the fighter causes friction. This is known as drag.

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

3.1.4.a Compressibility:

When a fighter approaches the speed of sound, the airflow over the wings of the fighter 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 fighter is a lack of control. The ailerons and/or elevators lock up, and moving the joystick has little effect on the fighter. 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 fighter. Once the fighter slows, control will be regained.

3.2 Fighter Control Surface:

A fighter 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

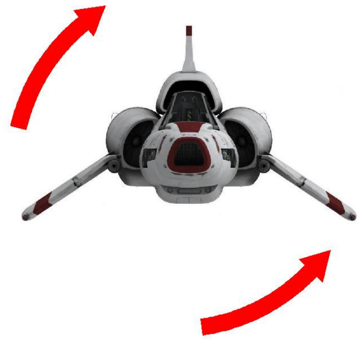
3. Pitch, which is controlled by the Elevators

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

In space these surfaces are controlled by the fighter's mini-thruster packs or "RCS" which are computer linked to the fighter control stick and foot pedals. The firing of the "RCS" thrusters in various combinations will accurately rotate the fighter 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 fighter 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 fighter. 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 fighter 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 fighter. This is controlled by the foot pedals.

3.2.3 Pitch:

The pitch, or the up and down movement of the fighter 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 fighter 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-Attack “AoA”. However, the flaps also increase the drag on the fighter, which reduces speed. Flaps are most commonly used for take off and landing.
The Landing Gear on the fighters is retractable. Retracting the landing gear smoothes out the overall fighter 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 fighter's velocity, this is flight path control.
Orbit determination involves finding the fighter's orbital elements and accounting for perturbations to its natural orbit. Flight path control involves firing the fighter's propulsion system to alter the velocity. Comparing the accurately determined fighter'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 fighter'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 fighter'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 fighter'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 fighter's distance is then computed.

3.4.c Angular Measurement:

The fighter's position in space is expressed using angular quantities. When the fighter is close to a planet, the tracking antenna acquires the fighter's signal in relationship to a planet.

3.4.1 Orbit Determination:

The process of the fighters 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 fighter 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 fighter'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:

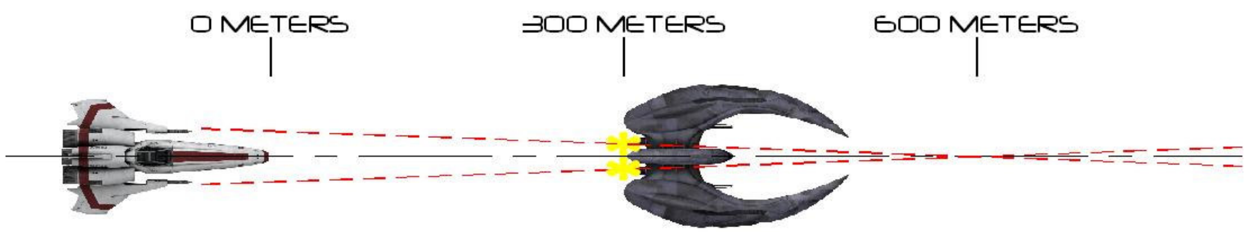
Small changes in the fighter's orbit around a planet may be desired for the purpose of adjusting an instrument's field-of-view, improving sensitivity of a gravity field survey, or preventing too much orbital decay. “Orbit Trim Maneuvers or OTM” are carried out generally in the same manner as “TCM”.
To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

4.1 Convergence Basics:

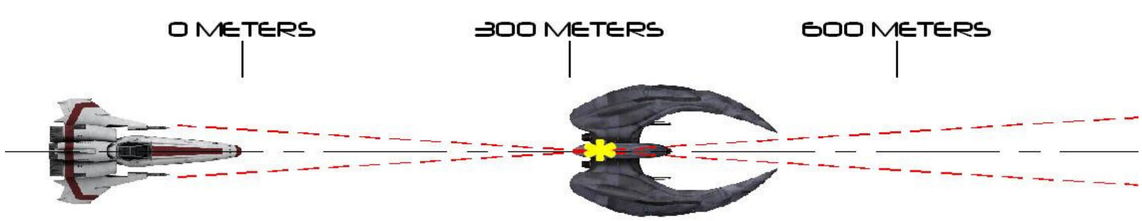
In the arena of combat, getting into position for a good shot is often called **"achieving a firing solution."** It can happen in a second, or it may take several seconds. The manner in which you achieve this position differs from conflict to conflict, so it's important that you develop good skills of combat maneuvers.

Convergence means coming together. Fixed guns on combat fighters are aimed slightly inwards, so that the armament meets at a point in front of the fighter. This is to concentrate as much firepower as possible in the smallest space on the enemy fighter.

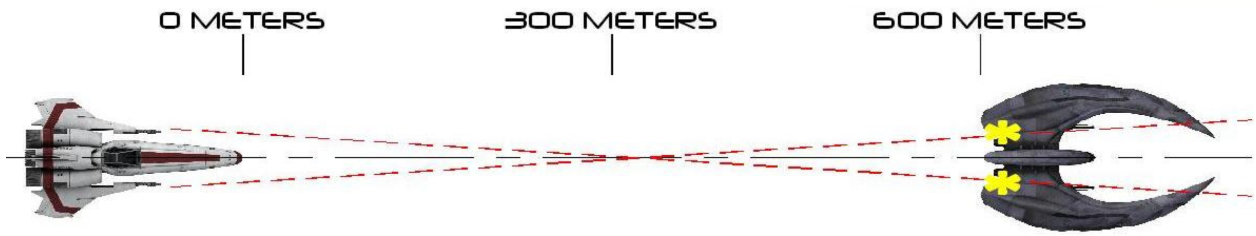
In the example below, a fighter with cannons has its convergence set to 600 meters. It is firing at a fighter that is 300 meters away. The two banks of cannons are hitting different places on the enemy fighter. This is not the best way to attack an enemy. In this example, the convergence is set too high for this attack.



In the next example (below), the convergence is set correctly. This fighter with cannons has its convergence set to 300 meters. The enemy that it is firing at is only 300 meters away. The two banks of cannons are hitting the same place on the enemy fighter. This is the best way of doing it. The pilot is packing a good punch on the enemy, and can expect maximum effect for the attack.



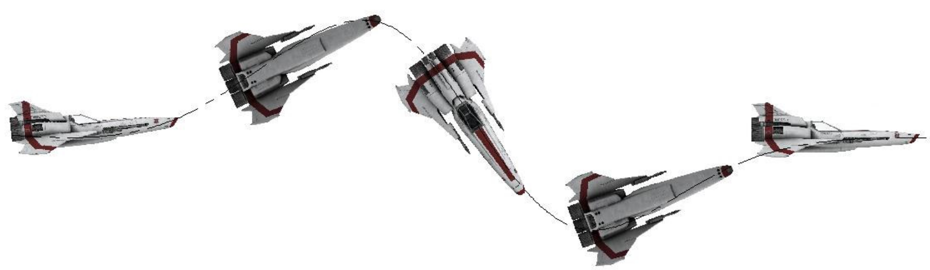
This is probably the worst scenario. In the example below, a fighter with cannons has its convergence set to 300 meters. It is firing at a fighter that is 600 meters away. The two banks of cannons are hitting wildly different places on the enemy fighter. If the enemy was any further away, the two streams of fire might actually pass either side of the enemy without touching. If you have to fire at distances of double (or more) of your set convergence, try to aim slightly to one side of the enemy. That way, one of cannons might hit the enemy fighter.



4.2 Barrel Roll:

The Barrel Roll derives its name from the flight path the fighter performs, circumscribing the shape of a barrel as the fighter rolls round a central axis. It is an energy management maneuver possessing both offensive and defensive potential.

Offensively, use the barrel roll if you are overtaking an enemy too quickly. Defensively, use the barrel roll to force your opponent to overshoot and pass you. Initiate a barrel roll by rolling slightly and applying pitch. Keep the nose pitched to spiral around the axis of your flight path.



4.2.1 Offensive Barrel Roll:

If you find yourself traveling too fast, you may both overshoot your opponent and fly directly into their gun envelope. This happens because your closure rate is too high, causing you to overtake your target. The barrel roll provides an effective solution by wasting speed. If you can't bleed enough speed with a barrel roll, pull back harder on the stick and execute a roll opposite the direction of your current turn. The increase in pitch reduces speed, and the roll out turns you away from your opponent and keeps you from overshooting. As you complete the roll you will be back on your original course, but at a slower speed.

4.2.2 Defensive Barrel Rolls:

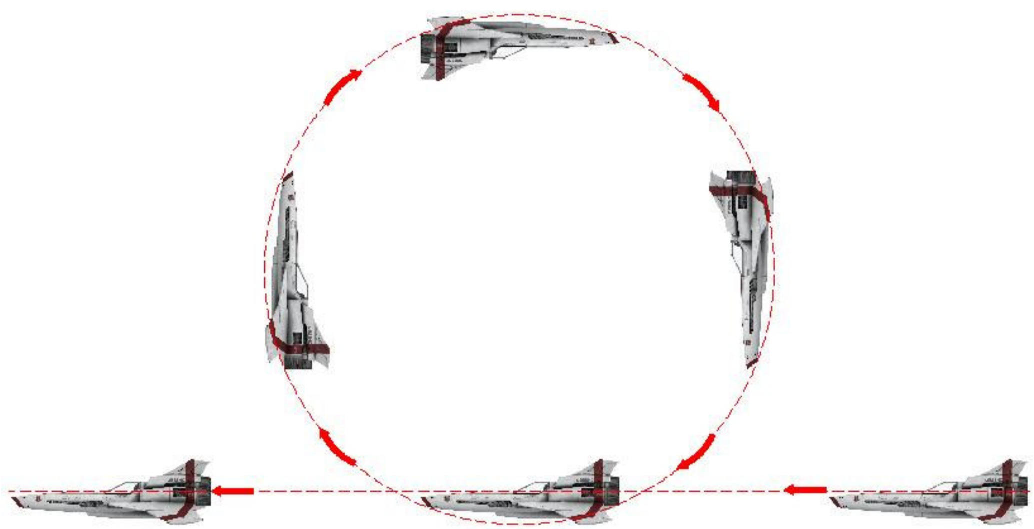
Defensively, the barrel roll can be used to force a quickly approaching opponent to overshoot. It can also maintain enough angle-off-tail to put you out of their lethal cone of fire. Defensive barrel rolls must be carefully timed, however. Initiate the roll too soon and your opponent will follow you through it. Start too late and your opponent will have several shot opportunities before you begin the turn. Perfect timing requires that you surprise your opponent, thus reducing your opponent reaction time.

4.3 Chandelle:

The Chandelle is a climbing turn. This turn can range from 90 to 180 degrees and is a low-G move that is used to conserve as much energy as possible. Execute the Chandelle by banking to one side to start the turn, and pull the stick back gently to climb while you are turning. Once you have finished the turn you will be at a higher altitude and at a different heading. Center the stick and recover to straight and level flight to complete the Chandelle.

4.4 Loop:

A loop is a simple maneuver to perform in the fighter. Pull back and maintain a gentle Back pressure. Watch the horizon in your up-view, and adjust any deviation from the true heading with a touch of rudder. Exit the loop at the entry level and in the same direction.



4.5 Scissors:

The Scissors maneuver is a situation where two fighters are attempting to gain an offensive advantage by using turns to get behind each other. Since both fighters are attempting the same outcome, the resultant maneuver flow looks like a series of flight path reversals. The result is typically a contest of who can fly the slowest. The importance of energy management becomes critical for the pilot, since the pilot who can best preserve energy will be the victor of the two fighters. The opportunity for a scissors begins with the opponent overshooting the pilot's flight path, and the opponent is unable to stay within the pilot's turn radius and flies through or overshoots.

4.6 Wing Over:

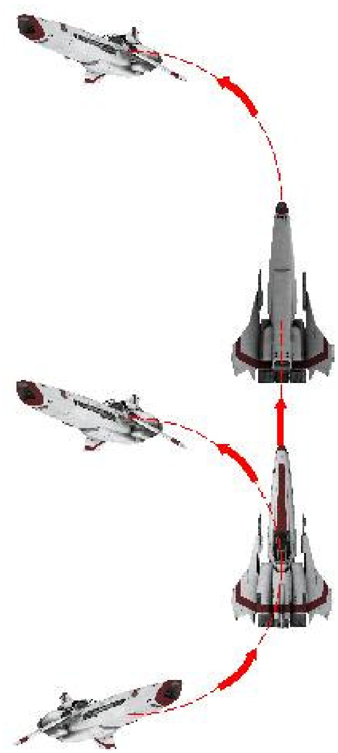
The Wing Over is a maneuver for attitude and position recovery after a diving attack on the opponent. Start this maneuver by entering into a climb. Rather than use the elevator to perform the 180-degree turn, apply full rudder in the direction of the turn to yaw the fighter over so the nose of the fighter is pointing down in the opposite direction from the climb.

4.7 Break Turn:

This is an evasive maneuver when the opponent is hard on the pilot's six o'clock. The pilot is to turn as hard as possible in the direction of the attacker will increase deflection quickly, and make the pilot a harder target for the opponent. Execute the Break by pulling hard on the joystick to the left or right, and then pulling back on the joystick to tighten the turn. This will force an overshoot by the pilot's opponent.

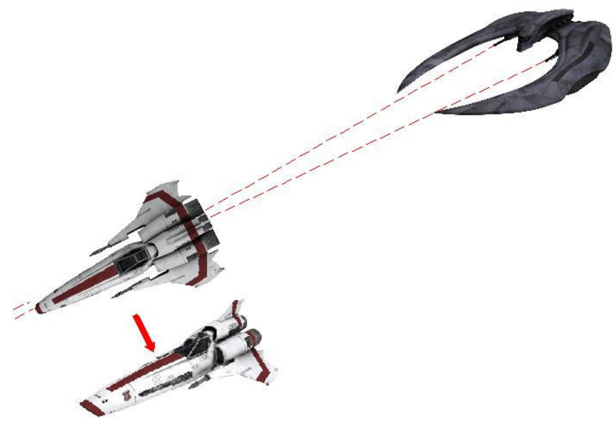
4.8 Immelman Turn:

This maneuver is used to increase altitude and reverse direction and can be used as an offensive or defensive move. It is a high-thrust maneuver that changes your bearing while increasing your altitude. By pitching the nose up and climbing, you can execute one-half of a loop. To execute this maneuver, invert into a roll. This leaves you flying in a different direction, but at a higher altitude. Once your wings are level, perform a half-roll again to reassume a horizontal position. Fighter can broaden this maneuver by making a vertical climb, then using an aileron roll to complete the half loop.



4.9 Skid:

The skid is a lateral slide with a gradual loss of altitude, which is commonly used as a defensive maneuver to throw off the opponent. This maneuver can be performed without incurring a large increase in speed or change of direction, while trading in only a small amount of altitude. The pilot should execute the Skid by dipping one wing and applying opposite rudder. The fighter will skid in the direction of the dipped wing. While in this maneuver, the fighter will sink, or lose altitude. Because the actual direction of travel is different to the direction that the fighter is pointing, it will throw off the opponents firing solution.



4.10 Split-Ess:

Use the Split-Ess to increase airspeed or bleed off altitude. The Split-Ess maneuver is a diving half-loop that is useful when you want to disengage a threat. It is a high altitude maneuver that requires a lot of vertical space. During a turn, invert by rolling, then immediately pull back on the stick to go into a dive. Your fighter will rapidly accelerate and gain speed. Pull back on the stick until the fighter levels out and eases into level flight. You will be un-inverted, with higher speed and lower altitude. This maneuver has the advantage of providing a quick burst of speed. Rolling while inverted produces the fighter's lift vector to gravity, thus increasing the force of acceleration and adding speed.

5.1 Spiral Dive:

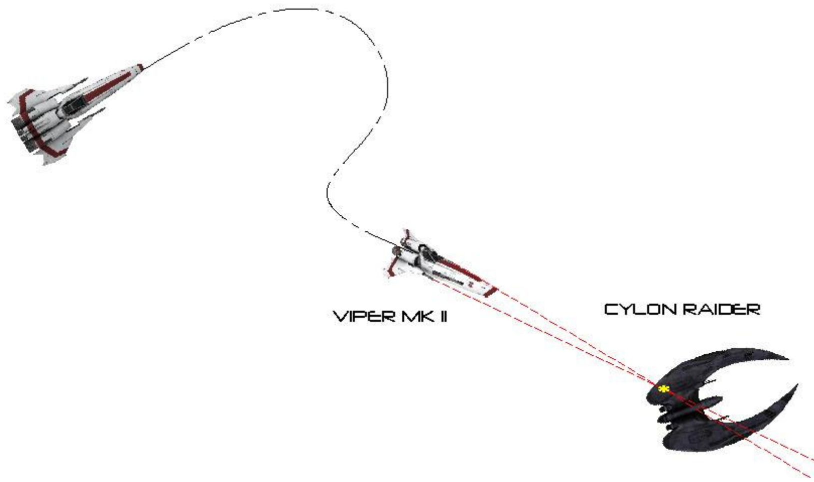
Spiral dive is used only as a last resort, and only if your fighter has the superior turn radius. Fall into a steep dive, and then make a hard G-turn. Throttle back midway through the turn and invert. Pull the nose up hard to maneuver onto the opponent. The pilot is to carry out this maneuver by leading the opponent into a steep dive with each fighter side by side that forces the opponent into an overshoot position. End the dive quickly by taking advantage of your fighter's superior turn radius and pulling hard pitch. As the fighter comes out of the turn, reduce throttle, invert with a 180º roll, and pull up sharply again, the opponent will be forced in front for a clear firing solution.

5.2 High-Speed Yo-Yo:

Use the high-speed yo-yo to reduce speed and bring the opponent into your firing solution. Perform by relaxing a turn, then pulling up into a sharp climb. Invert, and then apply pitch to slide back down onto the enemy's tail at a reduced speed. The high-speed yo-yo is a basic component of offensive combat and reduces speed while increasing the distance between you and your opponent. This maneuver begins during a turning fight when the pilot is in a aggressive position behind the opponent, but is stuck in lag pursuit and unable to bring your nose to bear. Roll out slightly when your opponent initiates a break turn, then pull the nose up. At the apex of the climb, invert and roll back down onto your opponent's six o'clock position. This will place the fighter further behind the opponent and in a better firing solution.

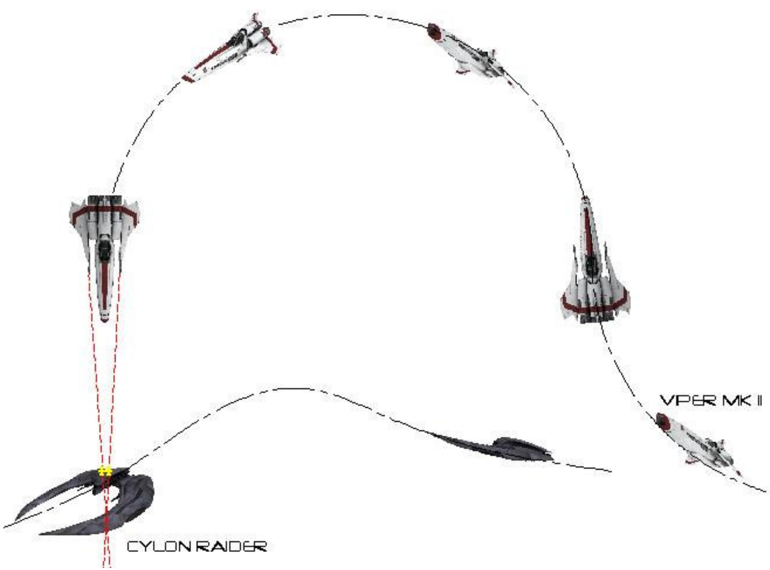
5.3 Overhead Attack:

The Overhead attack gives the pilot a high percentage of obtaining a firing solution on the opponent. The pilot needs to climb to an altitude higher than the opponent, then rolls the fighter 180-degress before initiating into a dive.



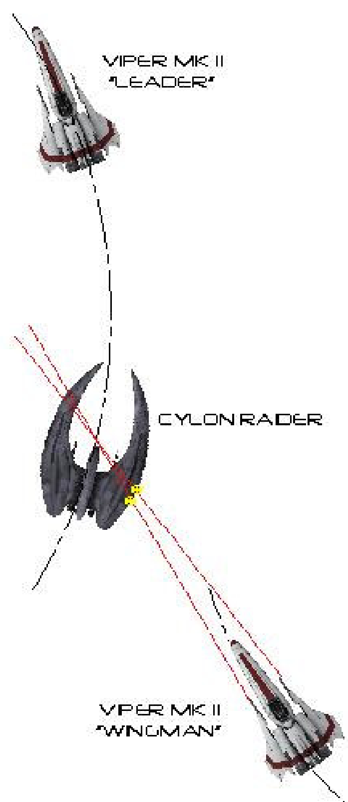
5.4 Hammerhead :

The hammerhead is a 180 degree reversal of course from a vertical climb and dive. The pilot is to climb vertically until your speed is reduced. Then apply the rudder and increase thrust to yaw the fighter over and down into a diving vector with the opponent. This maneuver requires perfect timing to gain the edge on the opponent and acquire a firing solution.



5.5 Sandwich:

The Sandwich maneuver is designed for the wingman. An opponent attacking from the rear quarter outside the formation breaks in for an attack. If the opponent follows the leader, the wingman is able to slide neatly into place behind the opponent for a rear quarter firing solution.



6.1 Take-off and Landing:

The Viper MK II is designed to be launched from a Battlestar's automatic launch tubes, but is also capable of independent take off from a flight deck. The following description is a short explanation of the parameters for launching and landing of the Viper MK II.

6.1.1 Launch Tubes:

Vipers are assigned to a launch tube aboard a Battlestar that provides a quick action automatic launch thru the tube. The viper is magnetically clamped to a rail gun shuttle that fires the fighter thru the tube by the use of sequenced acceleration coils. Once clear of the tube, the fighter uses its own power from the main turbo thrust engines for control and maneuverability.

6.1.2 Flight Deck:

Most Battlestars have been upgraded with onboard-automated approach controls to bring a fighter in on landing. However pilots show know how to use "Hands on Approach" were the fighter 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 fighter 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 fighter checklist is sub-divided into specific categories.

VIPER MK II FIGHTER PREFLIGHT CHECKLIST

☐ NOSE SECTION

1. CABIN AIR INTAKE ________ CLEAR
2. LANDING LIGHTS ________ OPERATIONAL
3. LANDING CHOKES ________ REMOVED
4. COMMUNICATION ARRAY ________ OPERATIONAL
5. SIDE PORTS ________ CHECK
6. ARMAMENTS ________ LOADED / CLEAR

☐ 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. AMMO LOCKERS ________ LOADED / LOCKED

☐ CABIN

1. MISSION DOCUMENTS ________ ONBOARD
2. AVIONICS ________ OPERATIONAL
3. WIRELESS ________ NO STATIC
4. FUEL GAGE ________ FULL
5. ELECTRONIC BREAKERS ________ ALL GREEN
6. AMMO GAUGE ________ FULL LOAD
7. CANOPY LOCKED ________ LOCKED / NO CRACKS
8. MAIN ENGINES ________ RUNNING SMOOTH
9. FLAPS & RUDDER ________ CONTROL
10. DRADIS ________ OPERATIONAL

☐ LAUNCH TUBE CHECK

1. TUBE ________ CLEAR
2. BLAST DOORS ________ CLOSED
3. READY DISPLAY ________ GREEN
4. L.S.O. ________ ALL CLEAR
5. ENGINES ________ ALL GREEN
6. LAUNCH POSITION ________ ON TRACK

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 FIGHTER 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 CHECKLIST.

6.3 Stalls and Spins:

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

6.4 Squad Formation:

Any mission that requires the use of fighters for its objective, or for the accomplishment of which fighters may normally be expected, must usually be carried out by a number squadrons. The number required is dependent on the amount of opposition likely to be encountered so that no individual should have more than a limited number of units under his immediate control.
When air and space combat became general it was discovered that two fighters when working together had a better chance of bringing a combat to a decisive conclusion than that of a solo fighter. The next step was for two or more pairs to work together and this quickly became the accepted practice.
The main difficulty is control of the fighters by the leader due to communicating efficiently in space. This limits the number of fighters that can be controlled by the leader to no more than 10 fighters to a squadron.

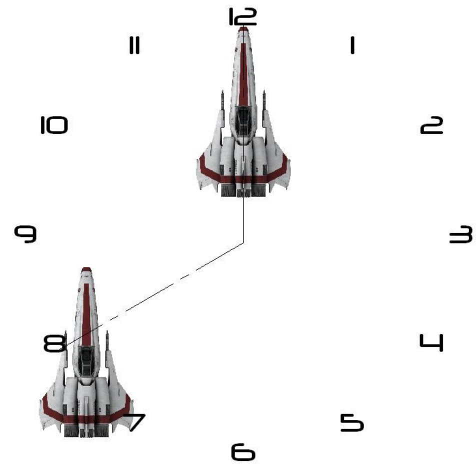
6.4.1 Follow the Leader:

Drill should commence in flight formation for each squadron by the Squad Leader leading the flight. The Squadron Leader should lead and drill the whole squad in three different flight maneuvers. Each maneuver in the air or space should be performed with as little as a span and a half between wing tips. In combat it is better to keep a distance of 80 to a 100 meters to insure the pilots are not devoting too much of their attention away for their opponents.

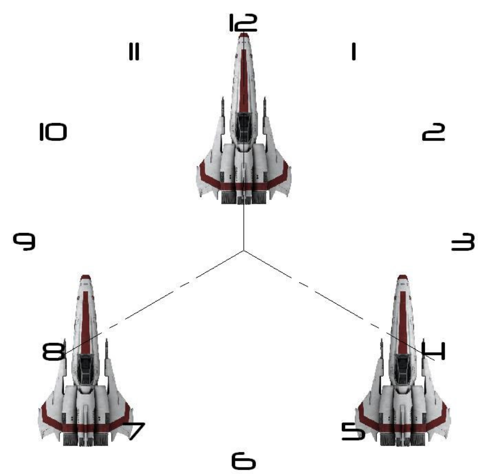
- One of the first essentials of successful formation flying is that every pilot thoroughly understands the use of the joystick. Since it is used constantly throughout the flight all pilots should be trained to do so instinctively. The throttle must be used to keep station. If a pilot attempts to do so by sharp turns instead of by using the throttle the formation will be put into disorder.
- The formation adopted must be a quick and easy maneuver by the squadron as a whole.
- A leader and the wingman must be appointed.
- Pilots must clearly understand how the formation is to reform after a fight

6.4.2 Standard Formation:

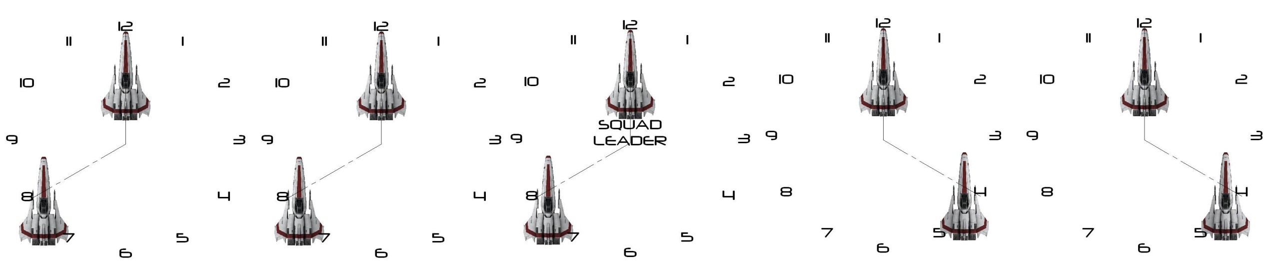
The standard formation or “Double Formation” for a fighter on a Combat Air Patrol or “CAP” is composed of two fighters. The Leader is in the lead at high noon with the Wingman following behind at the 8 o’clock position as illustrated below.



It is also common practice for a Combat Air Patrol to be composed of three fighters with in a “Triangle Formation”. Here the Leader is in the lead at high noon with the two Wingman following behind at 8 o’clock & 4 o’clock positions as illustrated below.

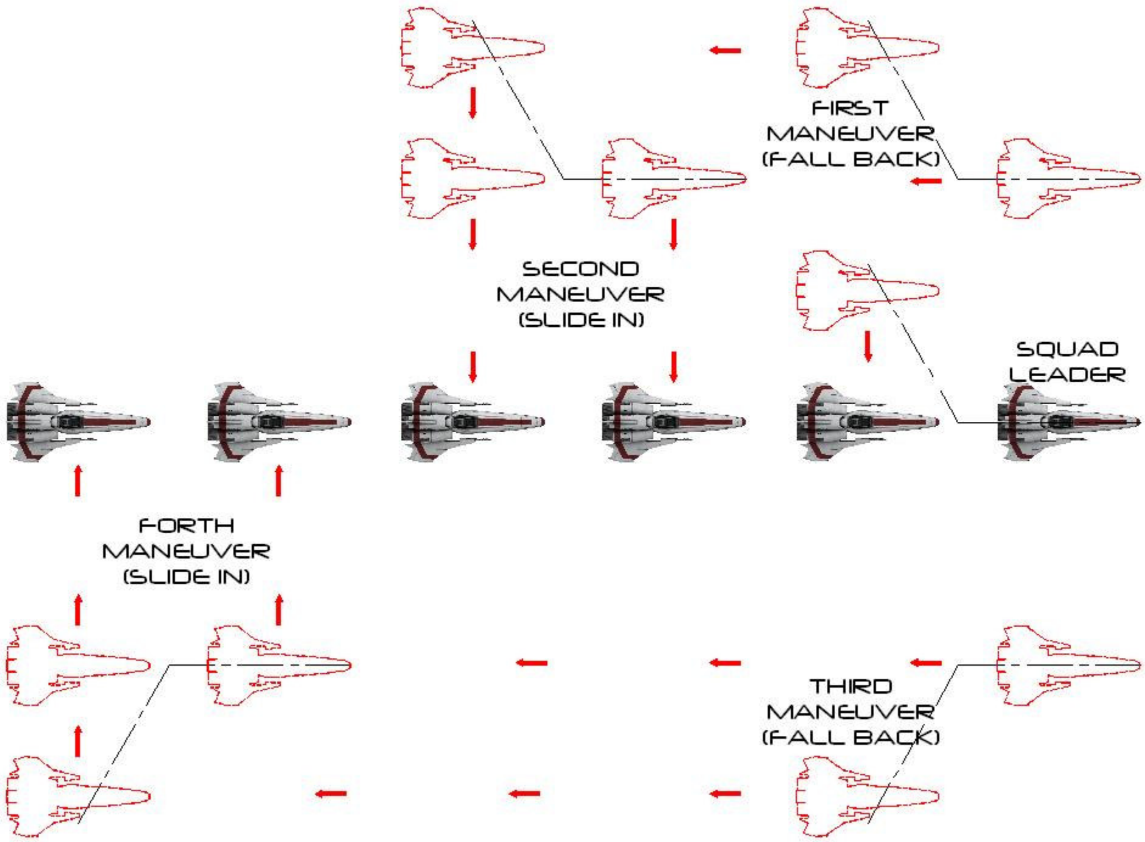


A full Squadron of all ten fighters assigned to Combat Air Patrol ready to engage the opponent would be composed of five “Double Formation” on a straight horizontal line or “Defensive Formation”. Here the leader with the wingman would be centered with the other formations positioned on both sides as illustrated below.

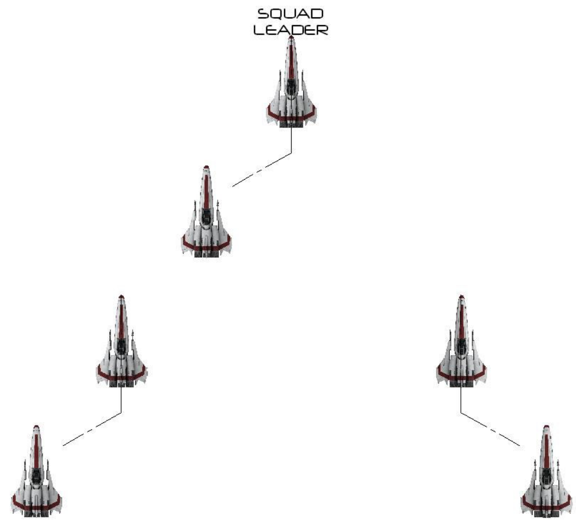


Once the opponents have been spotted and confirmed from the DRADIS, all fighters are to hold their positions until the Leader gives the order to pick targets and engage. At this point each "Double Formation" would veer off to the right and left from the Squad Leader.
There is a few other standard maneuvers that could be ordered by the Squad Leader, these are know as "Head On", "Vee", "Double Column", and "Standard Flank" for engaging the opponent.

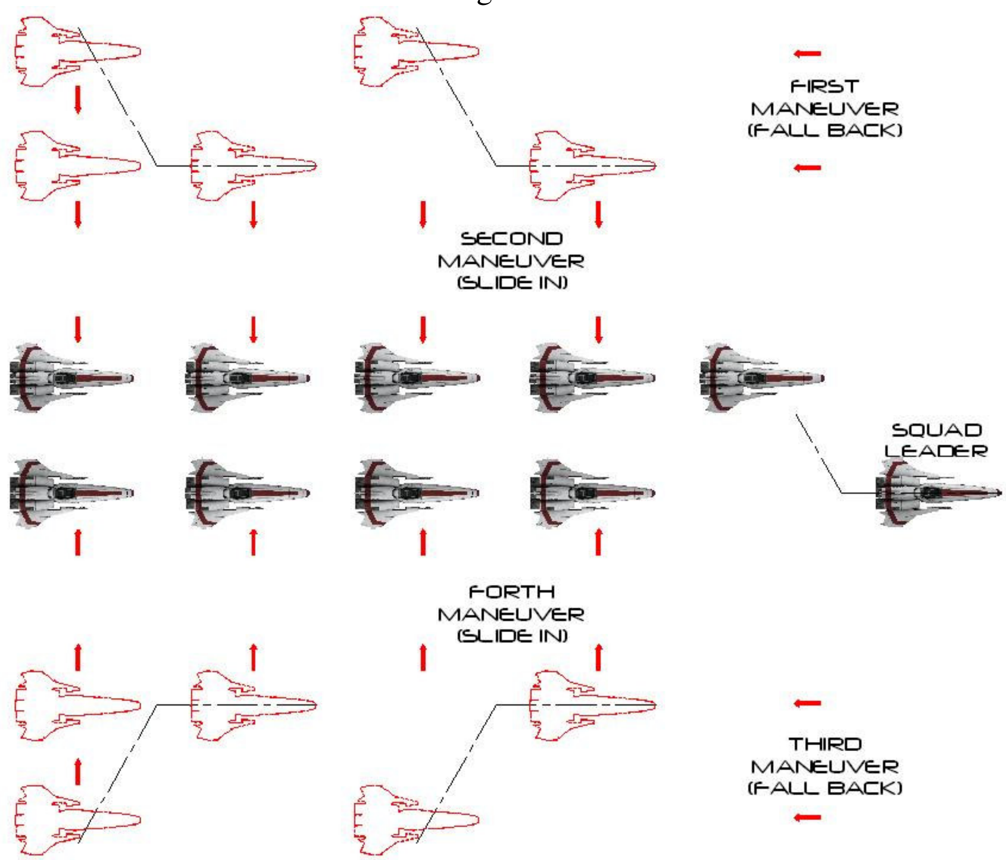
The "Head On" maneuver is where all fighters are to form a single column behind the leader for a straight narrow attack. The "Double Formation" fighters would move in unison from left to right as illustrated below.



The “Vee” maneuver is nothing more than the Squadron moving from a “Defensive Formation” into the shape of the letter “V” with the leader at the front tip of the point just as one would see migratory birds flying. Below is a illustration.

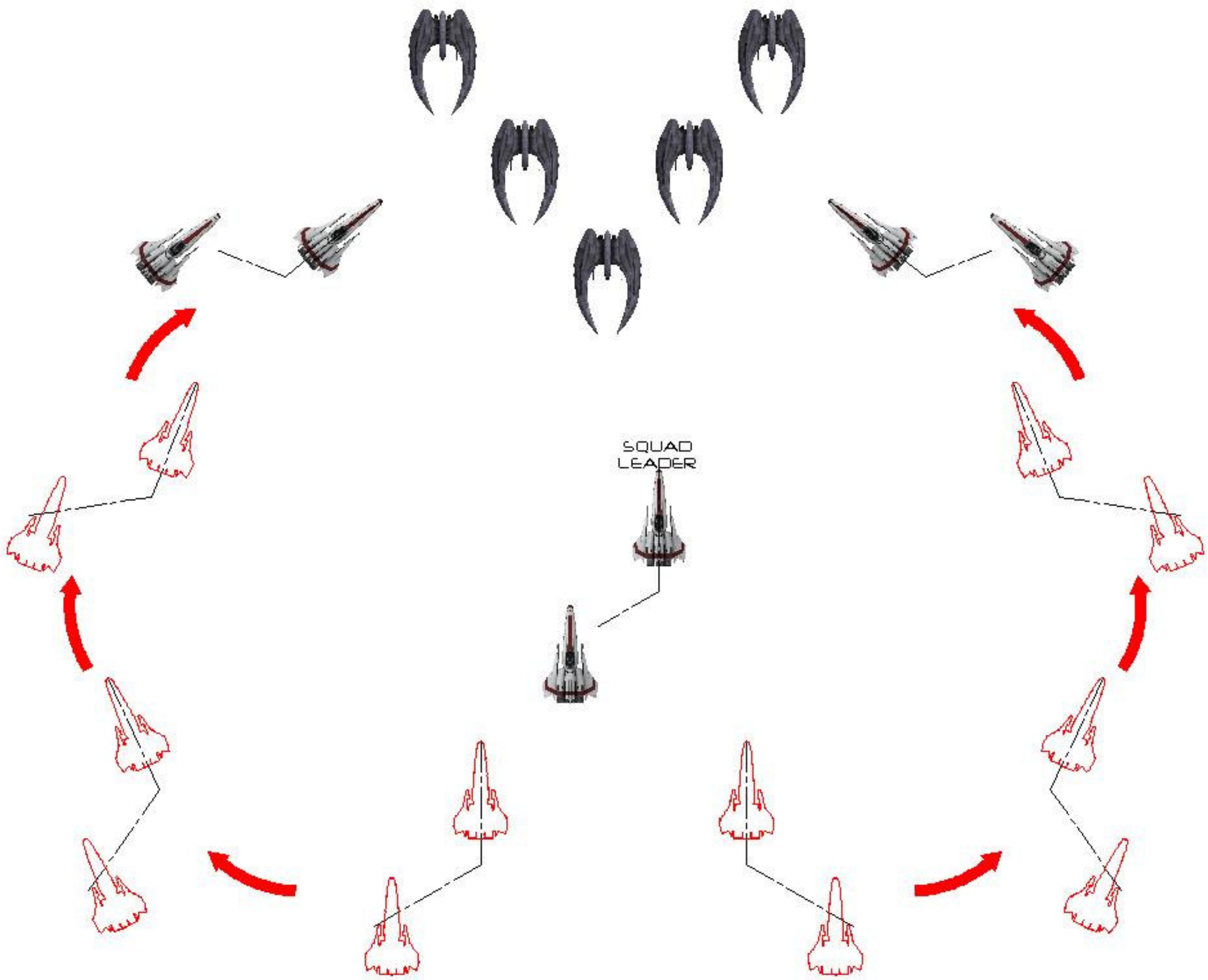


The “Double Column” maneuver is where all fighters are to form two single columns behind the leader. This maneuver is identical to the “Head On” but were all fighters on the left form into a single column and vice versa for the right side as illustrated below.



This maneuver can be affective to help hide the number of fighters being sent in against the opponent. The “Double Column” is also the formation of choice at Colonial Ceremonies with fighter “Fly-Bys”.

The "Standard Flank" maneuver is where the "Combat Air Patrol" moves from a "Defensive Formation" and veers off to the right and left of the Squad Leader. The leader would fly straight in as the other fighters would come around and engage the opponents from the sides or rear as illustrated below.



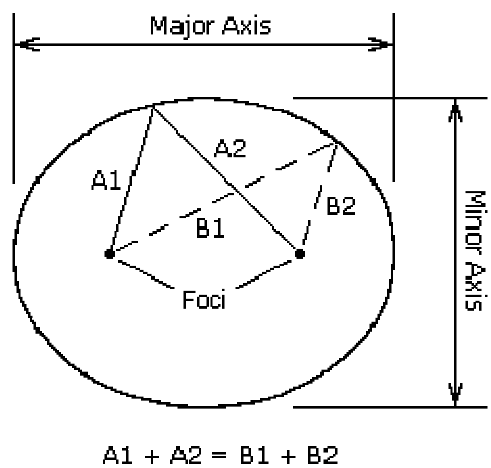
7.1 Orbital mechanics:

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

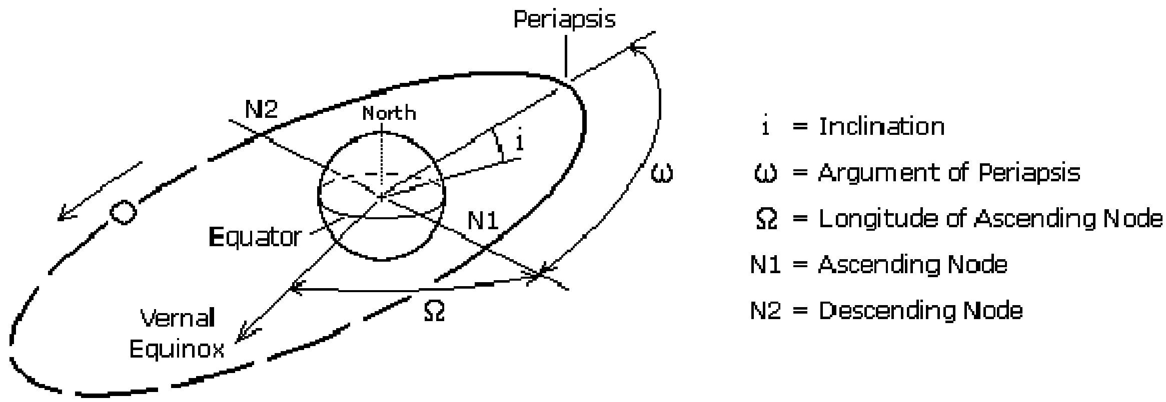


An orbiting satellite follows an oval shaped path known as an ellipse with the body being orbited, called the primary, and located at one of two points called foci. An ellipse is defined to be a curve with the following property: for each point on an ellipse, the sum of its distances from two fixed points, 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.

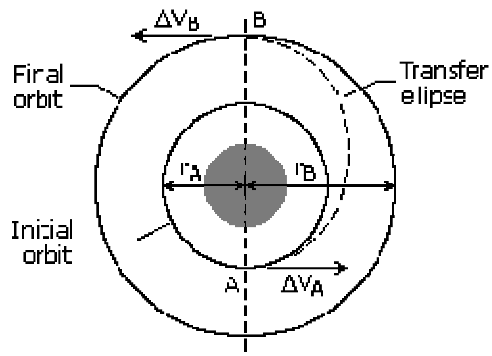
7.3.3 Launch of a Space Vessel:

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:

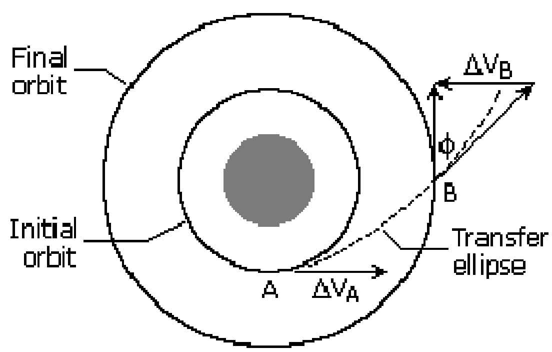
At some point during the flight plan of a vessel, one or more of the orbital elements must be changed. An example of this is the need to transfer from an initial parked orbit to a mission orbit, or rendezvous with and intercept another vessel.

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.

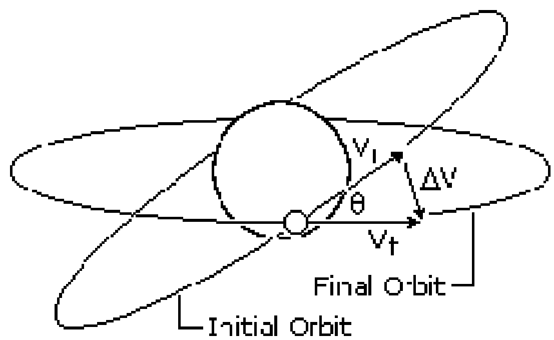


7.4.1 Orbit Altitude Changes:

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

8.2.1 Medical Equipment:

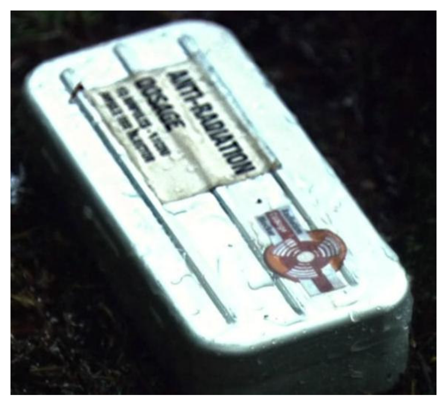
Medical equipment is required aboard the Viper MK II to provide medical care for minor illnesses and injuries. It also provides support for stabilizing severely injured the pilot may have incurred until rescued. The medical equipment consists of two separate kits that have multiple designated pallets:

- 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 viper 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

VT-109 Cylon Raider Specifications

9.1 Know your Enemy:

The latest Cylon Raider is an unmanned fighter. 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 Viper Pilots should take extreme caution when engaging this opponent. Pilots always remember to use you wingman strategically and never try to go head to head with this Raider.

Good Hunting Nuggets!

10.1 Viper Training Manual Test:

All Viper Pilot trainees after learning the above-prescribed courses are required to take the VTM Test and pass with a minimum score of 75% for active status with the Viper MK II fighter. All pilots will be awarded the "Jr. Wings" with a score rating 75% or better and the "Sr. Wings" with a perfect score rating of 100%, which places the pilot into the top 10% Ace Rank.

The test is a 100 multiple-choice questionnaire given and scored by your fleet C.A.G. Below is the test for the prescribed courses as listed in the Table of contents.

10.1.1 VTM Test Questions:

Chapter 1: VT-101 Viper MK II Specifications

1) If engine pressure drops due to a negative G state, return the fighter to positive G's to restore normal pressure
a) true b) false

2) The gun counter can display a numeric percentage remaining of ammunition:
a) true b) false

3) The Radio Magnetic Indicator or "RMI" is:
a) the fighters wireless comm. system b) the primary navigational instrument in the fighter
c) used to locate other vessels d) not part of the Viper MK II

4) The Dradis is detection, identification and multiple tracking system
a) true b) false

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

6) The weapon hard points for mounting missiles and ammunitions pods are:
a) beside the MEC-A6 30mm b) under the wings
c) in the undercarriage below the fuel d) The Viper MK II cannot carry missile pods

7) The Viper cockpit is pressurized and heated:
a) true b) false
8) The MEC-A6 30mm Thraxon mass accelerator cannons is capable of firing:
a) 10 rounds per second b) 20 rounds per second
c) 30 rounds per second d) 40 rounds per second

9) In the Viper MK II the life support systems are:
a) built-in to the back of the pilot's seat b) built in to the forward undercarriage
c) not part of the Viper's specifications d) integrated in with the main thruster engines

10) Due to the Viper's wing configuration, the pilot will notice poor handling at low speeds within an atmosphere than in space:
a) true b) false

Chapter 2: VT-102 Vocabulary

1) A pilot should check their six every:
a) 40 seconds
b) 20 seconds
c) 60 seconds
d) never, that is what a wingman is for

2) In evasive flying a pilot should never pull up with an opponent on there six:
a) true
b) false

3) A wingman should always stay 10 to 15 meters in front of the leader:
a) true
b) false

4) The DRADIS is a cylon transport ship:
a) true
b) false

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

6) To seek out and destroy the opponent's forces must be the guiding principle of our tactics in the air or space:
a) true
b) false

7) The success of offensive tactics in the air depends on what main factor:
a) surprise
b) maneuverability
c) weapons
d) all of the above

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

9) The Viper MK II at present is for offensive purposes but can also be used for:
a) patrol
b) reconnaissance
c) bomber
d) all of the above

10) The acronym C.A.G. stands for:
a) combat air group
b) cylon air group
c) commander air group
d) none of the above

11) While in formation the leader must always fly throttle down or the formation will straggle:
a) true
b) false

12) If your fighter is damaged you do not need to call the ball or make sure you are aligned before you touch down on the deck:
a) true
b) false

13) If your fighter is damaged and you are missing both ailerons, do not use rudder to roll:
a) true
b) false

14) If your fighter is damaged and you are missing both elevators you should use trim controls:
a) true
b) false

15) A pilot should Kill the weaker opponent and run away from the stronger:
a) true
b) false

Chapter 3: VT-103 Maneuvering

1) The rudder controls the yaw or the left/right sliding movements of the fighter:
a) true b) false

2) If you exceed your maximum "AoA", you interrupt the flow of air over one or both wings and you induce a stall:
a) true b) false

3) Positive G's are generated when a fighter pitches downwards:
a) true b) false

4) The Ailerons, located on the outer part of the trailing edge of the wings, control the roll or bank of the fighter:
a) true b) false

5) There are four basic forces at work when a fighter is in flight, which is always constant:
a) lift b) thrust
c) g-force / gravity d) drag

6) When a person is standing still on the surface of a planet they are experiencing:
a) 0.10 g-force b) 0.90 g-force
c) 2.0 g-forces d) 1.0 g-force

7) The actual speed of sound varies at different altitudes, depending on air density.
a) true b) false

8) Compression usually occurs between Mach 0.7 to 0.9:
a) true b) false

9) The faster airflow beneath the wing generates more pressure, while the slower airflow above generates less:
a) true b) false

10) Space Navigation is comprised of two aspects:
a) pitch and roll b) lift and g-force
c) thrust and yawl d) position and velocity

11) To make a change increasing the altitude, an "OTM" would decrease the fighter's velocity and increase the altitude:
a) true b) false

12) The process of the fighters orbit determination is described in terms of a "state vector" or "position and velocity":
a) true b) false

13) The angle at which the wings meet the airflow also greatly affects the amount of lift generated is known as the:
a) angle of lift b) angle of air
c) angle of attack d) none of the above

14) 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

15) The flaps decrease the drag on the fighter, which increase speed:
a) true b) false

Chapter 4: VT-104 Basic Combat

1) The pilot should execute the Skid by keeping wing level and applying roll:
a) true b) false

2) Immelman is used to increase altitude and reverse direction:
a) true b) false

3) To perform The Wing Over maneuver the pilot should apply:
a) full pitch by pulling down
b) full thrust in reverse to flip the fighter
c) full rudder in the direction of the turn
d) full rudder opposite of the turn

4) The break turn is an offensive maneuver from the opponent that is head on.
a) true b) false

5) The scissors maneuver is a situation where two fighters are attempting to gain an offensive advantage by turning to get behind each other
a) true b) false

6) To perform a loop maneuver in the fighter you should:
a) full throttle and pull down
b) hard dive down and to the right
c) full hard to side on stick for 180 degrees
d) Pull back and maintain a gentle back pressure

7) The Chandelle is a diving turn. That turn can range from 0 to 90 degrees and is a high-G move that is used to conserve as much energy as possible
a) true b) false

8) Defensively, use the barrel roll to force your opponent to overshoot and pass you:
a) true b) false

9) Convergence means coming together of fixed guns on an opponent:
a) true b) false

10) In the arena of combat, getting into position for a good shot is often called:
a) dead on
b) hard lock
c) bulls eye
d) achieving a firing solution

11) Use the Split-Ess to decrease airspeed and increase altitude.
a) true b) false

12) In a scissors maneuver the opponent is unable to stay within the pilot's turn radius and flies through or overshoots.
a) true b) false

13) As you complete a barrel roll you will be:
a) facing 90 degree from course
b) back on your original course
c) facing 180 degree from course
d) at a 30 to 60 degree from your opponent

14) Fixed guns on combat fighters are:
a) aimed slightly outward
b) aimed slightly inwards
c) aimed straight ahead
d) are not fixed and can rotate for tracking

15) During a Split-Ess turn, invert by rolling, then immediately pull back on the stick to go into a dive.
a) true b) false

Chapter 5: VT-105 Advanced Combat

1) At the apex of the climb in a high-speed yo-yo, invert and roll back down onto your opponent's six o'clock position.
a) true b) false

2) The hammerhead is a 90 degree reversal of course
a) true b) false

3) Achieving a “Firing solution” means the pilot is trying to put the opponent into the wingman’s vector for a good shot
a) true b) false

4) The high-speed yo-yo will place the fighter further behind the opponent and in a better firing solution.
a) true b) false

5) If the opponent follows the leader, the wingman is able to slide neatly into place behind the opponent.
a) true b) false

6) The Sandwich maneuver is designed for:
a) the leader b) the wingman
c) other squad formations d) a battlestar’s firing solution

7) The Overhead attack gives the pilot a high percentage of obtaining a firing solution on the opponent.
a) true b) false

8) The high-speed yo-yo begins during a turning fight when the pilot is in an aggressive position behind the opponent.
a) true b) false

9) Use the high-speed yo-yo to reduce speed and bring the opponent:
a) on a 90 degree course from you b) right up on your left or right side
c) into your firing solution d) into a course for your wingman

10) Spiral dive is used only as a last resort, and only if your fighter does not have superior turn radius.
a) true b) false

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

1) The “Standard Flank” maneuver is where the Combat Air Patrol” moves from a “Offensive Formation” and veer off to the right only of the Squad Leader.
a) true b) false

2) The “Double Column” maneuver is where all fighters are to form two single columns behind the leader.
a) true b) false

3) In combat it is better to keep a distance of:
a) 50 to 70 meters b) 80 to a 100 meters
c) always 100 meters d) 500 meters or more

4) The Leader is in the lead at high noon with the Wingman following:
a) at the 3 o’clock b) at the 6 o’clock
c) at the 8 o’clock d) at the 2 o’clock or 10 o’clock

5) It common practice for a Combat Air Patrol to be composed of:
a) 2 or 3 fighters b) 5 fighters
c) a full squadron d) only 1 fighter

6) The “Vee” maneuver is nothing more than the Squadron moving from a “Defensive Formation” into the shape of the letter “V” with the leader at the right rear point.
a) true b) false

7) A full Squadron of all ten fighters assigned to Combat Air Patrol ready to engage the opponent would be composed of:
a) ten “C.A.P. Formation” b) two “V formation”
c) five “Double Formation” d) one “Double Column”

8) 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

9) 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

10) The Viper MK II is designed to be launch from a Battlestar’s flight deck.
a) true b) false

Chapter 7: VT-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) For a spacecraft to achieve planetary orbit, it must be launched to any elevation within the planet's atmosphere.
a) true b) false

3) 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

4) 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

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) 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

8) The first 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) 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

10) 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

Chapter 8: VT-108 Viper MK II Space and Planetary Gear

1) Emergency medical kit or "EMK" case is colored:

a) red
b) blue
c) green
d) yellow

2) Medications and bandage kit or "MBK" case is colored:

a) red
b) blue
c) green
d) yellow

3) The EMK pallet designators are X, Y, and Z:

a) true
b) false

4) In-flight requirements include the carrying of passive dosimeters by the pilot:

a) true
b) false

5) The MBK pallet designators are D, E and F:

a) true
b) false

6) In-flight requirements include the carrying of passive dosimeters by the pilot and, in the event of solar flares or other radiation contingencies.

a) true
b) false

7) The armored vest worn over the flight suit can protect the pilots mid sections high velocity projectiles.

a) true
b) false

8) The pilot's flight suit has its own interior oxygen supply and does not need to be attached to the fighter for oxygen:

a) true
b) false

9) The survival kit does not include which of the following item for the fighter pilot:

a) hand held radio
b) pick and shovel
c) 12 days of rations
d) waterproof tarp

10) The strobe light provided in the survival kit can be seen for:

a) 1 kilometer
b) 10 kilometers
c) 3 kilometers
d) 5 kilometers

Chapter 9: VT-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 maximum G-forces that the Raider is capable of withstanding is only 5G.

a) true b) false

3) The Raider has the same type or wireless as the MK II; which makes it jam able.

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 Cylon Raider is capably of FTL jump as is the same for the Viper MK II.

a) true b) false