SECRET

STARFLEET MARINE CORPS

AEROSPACE BRANCH MANUAL

Revision 1209

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SECRET

STARFLEET MARINE CORPS

Aerospace Manual

2010 Edition

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Contents

Part 1 – Introduction

Welcome Aboard!

Welcome to the Aerospace Branch Guidebook of the STARFLEET Marine Corps (SFMC). This publication is intended primarily for members of the SFMC, which is a component of STARFLEET, The International Star Trek Fan Association, Inc. (SFI). However, anyone with an interest in our part of the Star Trek universe is invited to look and learn.

This manual serves as a handy reference work for members of the Aerospace Branch, covering equipment, tactics, missions, and organization. It is a one book source for the new member wherein they can get the information they need to role-play as a member of the Aerospace Branch. The majority of this work is obviously fictional in nature, but the references to uniforms and insignia of the SFMC are Accurate

Copyright and Disclaimer

Pronoun Disclaimer

The pronouns "he, his, him," etc. are used for convenience as the standard English-language convention for unknown gender pronouns.

Dedication

To the men and women who have fought for freedom, above their countrymen. "In the Air Force or the Navy, the Fighter pilots are the Heroes, the 'Top Dogs' of their branch. That's not me. I'm a Marine Aviator, and my job is to help my buddies on the ground; by attacking enemy ground units or keeping enemy aircraft away from our guys. I'm a ground support element for the Infantry, and I'm the best in the world at what I do."

—20th Century USMC Pilot

Acknowledgements

This guidebook is the 4th revision of the manual produced by Eric Schulman & TRACOM. The 3rd revision of the manual was produced by Chris Esquibel and company in 2006 and the original & 1st revised manuals were produced by Matt Kelley and company in 1998. Back then, Matt said:

This manual represents in excess of a thousand man-hours of work, and would not have been possible without the combined efforts of the following people:

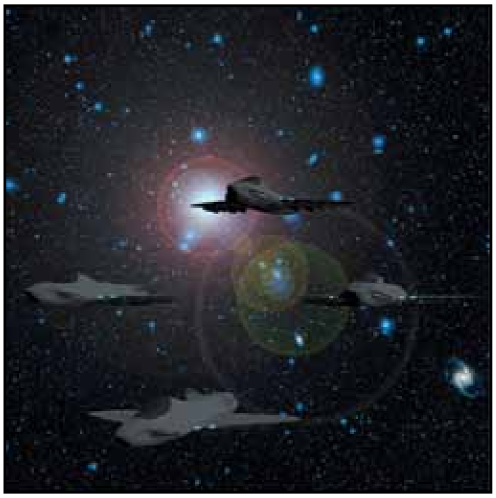
Randy Bisig, for a great deal of technical assistance with graphics, Kevin Burke, for many of the original concepts used to create the Aerospace materials, Scott Akers, for providing me with archival material on old SFMC aerospace craft names, Jeremy Trent, for saving Tiger Three and for keeping track of the body counts in my manuals, CPT. (Ret.) Ken Goldberg, USMC, for the dedication and opening quote for this manual, and Jerry Pournelle, for taking me 'a step farther out' with his writing.

On top of that, I'd like to thank Michael McGowan for reading the text and developing the new aerospace craft and weapons and James Jones for creating the wonderful pictures!

Reporting Authority

The governing authority for training information is the Commanding Officer, Training and Doctrine Command (COTRACOM). Send questions, comments, or suggestions to: tracom@sfi-sfmc.org

Part 2 – Story: High Guard



High above Sorenson's World, four tiny ships coasted along. An observer on the planet below would just barely be able to make out the blink of navigation lights as they moved clear of the planet's rock filled rings. A pair of pairs, one slightly behind the other, and lower. Routine and hardly worth the effort to spot, unless you were young and dreamed of flying through space. Tanner Leesen was seven years old and dreamed exactly that. His older brother -was a fighter pilot, part of Space Combat Command.

Brennan Leesen was one of the very few selected for such honor. He had scored high on all of the tests, high enough that the Starfleet Marine cadre who trained SCC decided he was good enough to fly on the regular patrols. Tanner was so proud of his big brother he could almost burst. He never missed a chance to talk to Brennan when he came home on leave. When Brennan went back to training, Tanner watched for the lights every night. As he followed them with his eyes, he wished he was seventeen instead of seven and wondered which of the little lights was Brennan.

"Tiger Lead, I'm still getting that distortion on the edge of my screen, sir," called Tiger Four.

"I'm not picking anything up," replied the pilot in the forward SCC fighter. He looked out the right side of his cockpit at the fighter alongside. They were close enough to see each other's expressions, and he smiled as Tiger Two rolled his eyes and shook his head. He leaned back and called, "Tiger Three, what about you? Any problems?"

"Nothing on my scope, Lead," replied an older, deeper voice. "Tiger Four, you're lagging behind me a bit. Maybe ionization from my exhaust is causing it. Try closing it up a bit and see if it clears."

Tiger Lead nodded his head at that, and keyed his comlink again. "Tiger Four close up on Three, try and fly like Tiger Two is doing." He grinned at his wingman again, as Two shook his head and mouthed some words silently.

I know, it'll be a long time before some green kid flies like you, nodded Tiger Lead.

In the last fighter, Brennan Leesen frowned at the order and wiggled the display knob again. It was weird, how the distortion seemed to come and go. He looked ahead and to his left, examining the exhaust from Tiger Three. It can't be that, or Three would be getting distortion from the other flight, he thought.

"Sir, regulations say that we should never fly any closer than ten meters to another fighter—" he was cut off by an irritated voice; it was Tiger Two on the general channel.

"Four, that's for fighters with their shields up. We know the regulations better than you do, Cadet, so either close it up or quit worrying about sensor splash."

"Ease up, Two," said Tiger Lead. "Three, he's your wingman...why don't you explain things?"

"Don't worry, Bren," said Tiger Three to his wingman. "Close formation flying is for parades or funerals, son, and I don't need either one right now, OK?"

Brennan was stung by Two's words, but he smiled at Three's comment. Three was the oldest of the four men, and Brennan was the youngest. Three never seemed to get upset or raise his voice, and he never got frustrated with the cadets, no matter how many times he had to explain the most basic concepts. He switched over to the ship-to-ship channel, designating it as secure and linked to Tiger Three. When the light turned amber, he spoke. "Thank you, sir. It's got to be the equipment, sir. The distortion is gone now, but we haven't changed position relative to each other. So it can't be sensor splash from your exhaust."

Three paused as a vague sense of unease came over him. A thought drifted in the back of his head, something important, but he couldn't pin it down. He reached out and tapped his nose thrusters, allowing Tiger Four to move alongside. He watched his own sensor display, but saw nothing unusual. Brennan was still talking, and Three missed the first part of what he said.

"...be a problem with the passive modulators, I suppose, but the diagnostics show normal. Maybe plasma conductivity from the atmosphere, since we're almost skinning the atmosphere?"

Three selected various sensors and watched the results as he tried to get a grasp on the thought hovering in the back of his mind. His sense of unease increased every second, and he tuned Brennan out as he concentrated.

Passive...plasma...atmosphere...important...

Tanner Leesen blinked as he saw another glowing spot in the atmosphere. It was behind the tiny flight of fighters and kept appearing and disappearing. He squinted at the light, and then gasped as he realized it was a ship. It looked like SCC had a new kind of ship on patrol!

He ran into the house past his startled Aunt, leaping up the stairs two at a time. He crashed into his room and ran to the bookcase, pulling a textbook off the shelf and charging back outside.

"Tanner!" scolded his Aunt as he ran past her again, headed out onto the balcony this time. He flipped through the pages of the book his brother had given him, frowning as he looked for the ship he'd seen. He stopped as he found it, and frowned. He turned his eyes to the sky again, his face so serious that it prompted his Aunt to pick up the book herself. He pointed to the glowing spot as it appeared again, "There it is!" Behind him, his Aunt dropped the book and gasped.

The distortion came onto Tiger Three's sensor display as Tiger Four called "There it is again, Three do you see it?"

The thought resolved itself into two words as Three's sense of unease blossomed into fear.

Cloaked Ship!

“Break-Break-Break!” shouted Three into his comlink as he pushed the stick forward and left. Even as he did, two impossibly bright lights passed between his fighter and Tiger Four. The lights slashed into the lead pair of fighters, striking, then penetrating. Tiger Lead and Tiger Two exploded into a mass of charged particles as burning gases flared brightly and then vanished. As Tiger Three and Four scattered wildly, disrupter fire flashed out, narrowly missing Four as he accelerated. As he turned and climbed, a Bird-of-Prey rolled in behind him and opened fire again.

“Mayday! Mayday! Mayday!” shouted Tiger Four, “Tiger Flight is under attack!” He cringed as disrupter bolts flashed by, realizing as he did so that he had forgotten to change channels. He heard Three’s voice in his headset, speaking rapidly on the secure ship-to-ship channel.

“Forget it, Four, they’re jamming us! Dump your power into thrust and get moving. She’s bigger and better armed than we are, speed is our only edge. Go, kid, go!”

Stabbing his throttle to Zone Five, Brennan hauled back on the stick and grunted as the inertial dampers compensated a fraction of a second slower than his engines did. He nudged the stick to the right, triggering thrusters that rolled him over on one wing. The Bird overshot and came about in a wide turn, guns still blazing into empty space. He worked the stick around, looking over his shoulder in time to see Tiger Three pouring fire into the Bird’s rear flank. Although it appeared undamaged, the bigger ship rolled left and turned towards Three, presenting its underside to Brennan. He snapped off a shot, but was rewarded only with a buzzing tone indicating his guns were still on safe! He flipped the cover off the switch and toggled the weapon systems as his targeting system activated. He jinked past the big ship, almost too fast for the eye to follow and dived into the atmosphere.

“C’mon, c’mon,” he said under his breath as he looked through his visor at the glowing green lines indicating his heading, and the glowing red square representing the Bird of Prey. If he could get the bigger ship to follow him into the atmosphere, it would be at a disadvantage. He snarled as the Bird turned to engage Tiger Three again. Turning hard, he climbed back out of the atmosphere and brought the Bird into his sights. A brighter red diamond appeared inside the square indicating a target lock.

“Tiger Four, engaging!” he said as he pressed the firing stud. His beams pulsed out, walking across the bigger ship’s shields. He frowned as the hits failed to penetrate, instead making little spots on the shield that quickly faded. He turned away from the target as disrupter bolts began streaming towards him. Tiger Three passed under the Bird, missing with most of his shots as it whirled to fire on Brennan.

“Four, this is getting us nowhere fast,” called Tiger Three. “His shields are tough, and I’m almost out of juice. Let’s concentrate our fire on the same point— make your shots count.”

With a start, Brennan checked his power levels. The display read sixty percent, then changed to fifty four percent as he fired another burst at the Bird-of-Prey. The charge packs that powered the fighter were designed for many hours of standard use, but they were rapidly depleted under situations of maximum thrust and constant firing.

Three's right, if we don't do something soon, we'll run out of power and then it's all over.

Tanner watched the sky without a word, his attention focused on the flashes and streaks overhead. His aunt was in the house, talking excitedly to someone over the video screen, but Tanner ignored her. He decided that there were two fighters left, and they were harrying the bigger ship without much success, but it wasn't fast enough shoot down the fighters. He remembered his brother showing him the cockpit of his fighter and explaining the gauges and indicators. Tactical fighters had limited endurance, he had said, but excellent maneuverability.

"We can't dance the night away," Brennan had grinned, "but we can whirl and twirl with the best of them while we do!" Tanner had believed his big brother, and now he watched as the little ships danced with the bigger one.

"This must be a pirate, Four," called Tiger Three, "or he would have used a couple of proximity fused torpedoes to clear us away. Let's see how well he does against two of us at once."

"Roger that, Three," replied Brennan as he slid into place alongside the other fighter. The two fighters were slipping and dodging around each other as they swung around and accelerated towards the larger ship.

"Power levels at thirteen percent here. What've you got left, kid?"

"Twenty six percent, sir."

"One gun pass for me, two for you. If we don't get through his shields in this pass, I'm going put some English on him, and then you take your last pass at him."

"Sir, what's English?"

"You'll know it when you see it, son," replied Three grimly. "Here we go, you've got the lead!"

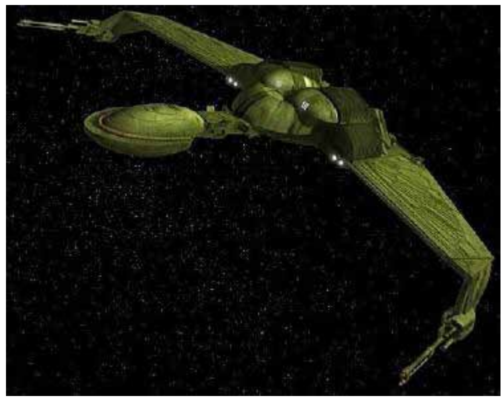
Brennan selected a point just below the bridge of the enemy ship and poured fire into it, scissoring his ship around as he did, trying to keep the enemy guns from tracking him. His ship wove a tight spiral as it closed the range, pounding the Bird's shields until they glowed red with energy. The Bird-of-Prey didn't even try to evade. Instead, it increased its volume of fire, flinging sheets of disrupter energy outwards as it went head to head with the two fighters. As Brennan completed his run, there was a flash and a bang as a disrupter bolt struck home. He pulled off sharply, missing the other ship by less than a meter.

Alarms were sounding inside his helmet, and he shut them off with a curse. His master caution panel blinked: "STBD WPS FAIL" and "TGT SYS FAIL". The hit had shorted his starboard weapons, and his targeting system had shut down. The news got worse as the short spread through the starboard avionics bay: "STBD BUS B OVERVOLT" and "APU 2 FAIL HIGH" joined the blinking lights on the caution panel. He was forced to shut down most electrical activity on the right side of his fighter lest he lose what little power he had left.

He banked left, using his thrusters to tighten the turn even more and saw Three finishing his run. Behind Three, the Bird turned, tracking him with disrupter fire. The shields of the larger ship glowed brightly, but the energy began to dissipate even as he watched. Tiger Three suddenly banked and rolled, performing a split-S maneuver that reversed his direction and set the fighter onto a collision course with the Bird-of-Prey.

At the last moment, the fighter rolled away and slammed itself belly first along the Bird's damaged shields. There was a tremendous shower of energy discharges as the two shields interacted and shorted out. Brennan watched in horror as Three's fighter came apart into huge chunks of flaming debris. He tensed as he realized that one of the larger pieces was an ejection pod.

The Bird's shields are down, he realized suddenly.



Brennan pointed the nose of his fighter at the Bird-of-Prey, noting without emotion that it was suffering a series of small internal explosions. It began to accelerate, turning away from the planet as it did. He waited until the ship almost filled his entire view before he touched the firing stud and pumped three bursts of energy into it. He turned his fighter homeward as the Bird-of-Prey began to slow, it's Engineering section venting into space as the warp core began to disintegrate. His master caution panel blinked like a casino marquee. "BINGO PWR" was shortly replaced by "EMG PWR," then "MSTR UNDERVOLT" joined the list. He checked his power and saw a red numeral three blinking. He throttled back, shutting down his weapons and nonessential systems. As he relaxed, he became aware of comm. traffic from the planet below.

"...Tiger Flight, Tiger Flight, this is Showboat, say your status, over...Tiger Flight this is Showboat, do you copy?... Tiger Flight this is Showboat, say your status..."

He keyed the comlink and acknowledged the signal from the SCC controller. His voice was quiet and firm as he spoke.

"Showboat, Tiger Four. One enemy vessel destroyed, three friendly casualties. Scramble SAR for one escape pod recovery at these coordinates." He downloaded his sensor data. "I am on joker power-."
"SAR 1 on the way. Understand you have joker power, are you declaring an emergency?"

"Affirmative, Showboat. I'll never make the airfield on what I've got. Tiger Four declaring emergency." As soon as his computer heard him say that, his position, speed and heading were automatically transmitted on the search and rescue, or SAR, frequency and would continue to be transmitted every ten seconds until a tractor-capable ship could retrieve his injured craft.

He nudged his fighter into a slow curving course towards the escape pod. It appeared intact, and Brennan did a slow roll and brought his canopy near the pod. Looking out, he saw Three hold up a clenched fist, thumb extended. Relaxing with a smile, he leaned back into the seat and closed his eyes. He heard the SCC controller vectoring fighters towards his location.

"Tiger Four, Showboat. SAR 1 and 2 and Panther Flight en route to relieve you, ETA six minutes. "

Brennan checked his power levels again. Enough to last twenty minutes or so. Plenty of time, he thought, unless I run into another Bird. He keyed the comlink and spoke, the words ringing clearly over the channel.

"Roger Showboat, this is Tiger Flight," he said as he switched his sensors back to scan mode, "we'll hold the high ground until you get here."

Part 3 - History & Traditions

Although many cultures had a hand in developing Starfleet and the SFMC, it is considered to have evolved primarily from the experiences of Earth. Historically speaking, many races suffered far worse than Earth in regards to war, both planetary and interstellar. Likewise, some races had far-reaching technological advances long before Earth. Humans, however, are unsurpassed in their ability to adapt, improvise and learn. Combined with a love for fresh challenges and a talent for finding unusual solutions to problems, humans always seem to be 'a step farther out' than other races in the Federation.

Earth has always been considered a leader in the matters of the United Federation of Planets. Nowhere is this more evident than Starfleet and the Starfleet Marine Corps. This is why so much of the material you will see in the next few months will have a human viewpoint. No one flies aerospace better than the humans of Earth. No one fights aerospace better than the Corps.

—Colonel Martin F. Shaeffer, SFMC
Aerospace Combat College

Development of Aerospace Flight

The roots of flight in general stretch across a hundred worlds and go centuries deep. However, the history of flight on Earth is fairly typical of the progression of beings from the ground to the stars.

Mythical Flight

Daedelus helps his son Icarus to take flight in this ancient Earth painting.

Man has always wanted to fly. Legends from the very earliest times bear witness to this. Perhaps the most famous of these legends is the ancient Greek myth concerning Icarus. He and his father fashioned wings from feathers and wax, which enabled them to fly. Icarus flew too close to the sun however, which melted the wax and caused him to fall to his death.

Free Flight

Man's interest in flight continued, in both fictional storytelling and in practical experiments by such historical figures as Leonardo DaVinci. Drawings, models and full-scale attempts at flying machines of all types went on throughout mankind's early history. The first successful flights were unmanned hot air balloons, developed in France. Later, French balloonists would make several manned flights in hot air balloons. Although these were significant points in history, they were not much of a success in their day. One balloon flight ended in a disaster, as peasants armed with pitchforks and muskets 'killed a monster that held a man in its clutches' as the balloon came to a landing in a field. The pilot was uninjured, but his balloon was thoroughly destroyed by the terrified mob.

Mechanical Flight
It was not until a successful flight at Kitty Hawk by two Americans, Orville and Wilbur Wright, that the dream of powered flight became a reality. From that humble beginning came a whole new era of manned flight. Propeller driven aircraft quickly became a standard sight, and modern air transportation became a reality in the early years of the 20th century. During World War Two, the drive to create faster and deadlier aircraft led to the mating of rocket engines to aircraft. This in turn led to the development and fielding of jet propelled aircraft, which quickly became the standard for all commercial and military aircraft.

Jet Flight
As jet engines became more powerful and more compact, military aircraft became faster and more agile while commercial aircraft became larger and more economical. High altitude, high-speed aircraft like the SR-71 and X-15 helped redefine the standards for aircraft. This in turn led to the development of the Space Shuttle, the first true aerospace vehicle. It took off from a vertical launch position, like a standard rocket, but maneuvered under it's own power in space and then glided safely to Earth during reentry. It could be reused many times, unlike previous spacecraft of the 20th century.

Pre-Warp Propulsion
The Jet Propulsion Laboratory (JPL) was devoted to the design of unmanned spacecraft. JPL was owned by the United States government and operated by the California Institute of Technology under a contract from the National Aeronautics and Space Administration. Among JPL's many projects were the Viking, Magellan, and Galileo probes and Deep Space 1. A historical landmark for Earth, Deep Space 1 marked the first use of solar electric propulsion on a deep-space mission. Its primary propulsion system was a single xenon ion engine, which provided impulse power for the craft. To fuel the engine, xenon atoms were bombarded by electrons, which knocked–away one electron from each xenon atom, giving it a net positive charge and changing it into an ion. This early craft was low powered compared to modern systems; the maximum power output of Deep Space 1 was 2500 watts, with 2100 watts required to power the ion engine alone.

In addition to the ion engine, other early methods of space flight included solar sail propulsion and plasma sail propulsion. A solar sail is actually a large mirror that reflects sunlight. Momentum is caused by the photons of light bouncing off of the sail. Because such a large amount of photons are emitted and thus constantly hitting the sail, there is a constant pressure resulting in steady motion and acceleration.

This enables the craft to travel within a solar system without needing engines and large amounts of fuel. While NASA experts on Earth initially dismissed the concept of a solar sail as risky, others pursued this form of propulsion, and it was used on other worlds, including Bajor. The plasma sail does not use sunlight, but solar wind, which consists of charged particles that flow constantly off the sun. It uses a magnet to create a magnetic field around the craft, which is inflated by the injection of plasma. The solar wind bounces off the magnetic field lines, thus propelling the craft.

Aerospace Flight

Earth's first true aerospace vehicle, the Space Shuttle was the focus of much of Earth's space program at the turn of the 21st century.

From the humble beginnings of the Space Shuttle, mankind developed other aerospace vehicles that became known as "transorbital aircraft". These were used to build the first space station and the Lunar colonies. Later, more advanced versions would operate regularly between space going vessels, which would remain in orbit, and ground based landing sites. These "landing craft" were the precursors to the standard ship's shuttle found aboard every starship today. With the development of impulse engines and repulsor technologies, true aerospace vehicles were born, able to operate in and around a planetary atmosphere with grace and power. The age of true Aerospace flight had begun.

Development of the SFMC Aerospace Branch

World War One

During World War One, no one was really sure how aircraft could be used effectively. The obvious use was for observation, but lacking radio technology the observer had a difficult time communicating what he saw to his superiors on the ground. These aircraft were unarmed and barely capable of maintaining flight. Legend has it that one day a British observation airplane on patrol was fired upon by a German observation plane nearby. The German pilot was armed with a pistol, and didn't even achieve a hit. Unharmed but shocked, the British pilot returned the next day armed with a rifle and returned the favor, and the era of armed air to air combat began. Later, someone had the bright idea of bombing targets from above. Unfortunately these aircraft were not capable of carrying heavy bomb loads, and the pilot had to throw small bombs from the cockpit by hand, which made the aircraft all but useless in this role.

World War Two

In World War II the concept of strategic bombing came to the forefront. In latter stages of the war, skies filled with planes like these B-17 Flying Fortresses were a common sight.

World War Two saw the development of a new mission for the aircraft that of ground support. Planes were still used extensively for observation, but now took a more direct role in the conflict below. Fixed wing aircraft were made of lightweight metals and had much more powerful engines and lifting surfaces, allowing them to carry heavier guns and large amounts of ordnance, from rockets to bombs. By strafing and bombing the enemy from above, aircraft were able to bypass many forms of fortification and achieve results that more conventional forces could not. Of course, to prevent the enemy from doing this, more advanced antiaircraft weapons were developed, including aircraft whose sole purpose was to hunt other aircraft.

The concept of strategic bombing came to the forefront in World War II. In latter stages of the war, skies filled with planes like these B-17 Flying Fortresses were a common sight. Later, the invention of jet engines and advanced electronics would move air-to-air combat to a new level, as guided missiles and electronic warfare became common threats.

World War Three

By the time World War Three broke out, jet aircraft were the standard of all air forces in the world, although some propeller driven aircraft were still in use for specialized roles like search and rescue. The primary use for aircraft had by then become one of three specialized categories, which form the basis for the current SFMC Aerospace branch. These categories were Fighters, Bombers, and Support Aircraft.

Fighters had the duties of air superiority, or destroying enemy aircraft. Bombers conducted ground support missions, primarily through low-level penetration raids. These bombers carried either precision-guided munitions (known as "smart bombs") or tactical nuclear weapons. Support Aircraft duties included observation, transportation of cargo, in-flight refueling and rescue.

Colonial Marines

Ground Attack craft like this AH-45 Cheyenne dropship were considered cost effective by MegaCorps, so they formed the backbone of the Colonial Marines aerospace program.

After the devastation of the Eugenics Wars and World War Three, the MegaCorporations began colonizing other planets. They formed the Colonial Marines to protect the terraformers and colonists as they developed planets into self sustaining Colony Worlds. The Aerospace branch of the Colonial Marines consisted primarily of transports and light ground attack craft. Each MegaCorporation had its own versions of these basic craft, each different from the others. In the profit-oriented culture of the MegaCorporations, these types of vehicles were cost effective, as they could be used for noncombat missions like reconnaissance and cargo hauling. Air Defense fighters were considered useless, as no one had encountered any hostile spacegoing races. Once the Romulans attacked in 2156 and started the Four Year War, this attitude changed, but not fast enough to get fighters to the Colony Worlds in time. World after world fell to Romulan forces. Differences in repair parts, pilot training and armament made the Aerospace forces completely ineffective. More Romulan ships were destroyed by ramming attacks than any other tactic.

UNPF Marines

Once the UNPF was created, two important things happened for the Aerospace branch. First, all but three designs for Aerospace craft were eliminated, greatly simplifying the logistical situation as well as pilot training. Second, techniques for launching Aerospace fighters from starships were developed. A primitive but effective tactic of hard docking fighters to purpose built dispersed structures allowed these "junk yards" to launch all their fighters at once. Later, as launch bays and launch tubes (employing the "track and rack" system) became more reliable, more and more starships carried fighters for self-defense and scouting. These two developments were critical to success at the Battle of Cheron, where nearly all of the Romulan Fleet was destroyed in four hours.

Admiral Napier, despite the political consequences, refused to send any of the newly built Aerospace fighters to the Colony Worlds. She assembled every possible starship capable of carrying fighters, no matter how few, and assigned it to the fleet headed for Cheron. Intelligence had determined that the Romulans would strike at Cheron next. Through a series of risky Intelligence ploys, the Romulans were allowed to discover that Earth intended to fight a major battle at Cheron, but not the exact details of the force Napier had assembled. The Romulans, seeing a chance to cripple Earth's fleet, sent every available ship to Cheron, along with a huge force of Romulan troops for the follow up invasion of Earth. As the two fleets formed up for battle, Napier realized that the Earth forces were badly outnumbered and the possibility for defeat was very high. Knowing this would leave Earth defenseless against invasion, Napier ordered the fighters to make a high-speed attack on the troop carriers behind the main Romulan line-of-battle. Six hundred fighters charged the enemy cruisers and battleships, taking tremendous losses as they tore into the Romulan line. Romulan gunners were unprepared for the speed and ferocity of a fighter attack. Napier was startled to see Romulan ships firing point blank into other Romulan vessels as their weapons tried to track the fighters at close range. The Romulan formation broke up as ships maneuvered for position, some ramming others. As the fighters broke through the Romulan line and attacked the helpless transports, Napier realized the opportunity she had been given and ordered the fleet to engage. The Romulan fleet was totally destroyed, many ships never realizing they have been engaged by the capital vessels of the Human fleet. However, victory came at a high price: only 14 Aerospace pilots came home from the Battle of Cheron.

The STARFLEET Marine Corps

When the SFMC was finally created from the surviving units of the UNPF Marines, the Aerospace Branch was in better shape than the ground forces. Pilot training focused on the two primary combat missions of aerospace superiority and ground support. The SFMC formally adopted the naval nomenclature of "Fighter" and "Attack" for its fighters and bombers, and established an institution dedicated to training its pilots for combat. When the Klingon-Federation War broke out in 2195, the Aerospace Branch was the only part of the Corps that was having success against the Klingons. The Klingon High Command had not created any form of Aerospace branch within their own ground forces, preferring to use starships for orbital bombardment. Whenever the Klingons were found without heavy starship support, Federation Aerospace fighters exacted a heavy toll for the High Command's lack of vision.

Traditions

Branch Motto: "Fortuna Favet Fortibus"
Literally translated, this means "Fortune Favors the Bold". It refers back to the Battle of Cheron, and the common belief among pilots that speed and daring will carry you farther in battle than anything else.

Branch Slogan: "High Guard"
This slogan refers to the Aerospace pilots chosen field of battle, in atmosphere or close orbit. If there is a high ground in 24th century combat, then it is space, and the Aerospace Branch guards that high ground.

Branch Device: The AeroStar

The long-tipped star has been a venerable Starfleet tradition for centuries. Reputed to have been a representation of Zephram Cochrane's original warp theory power distribution diagram, it has represented everything from individual ships' command departments to the fleet itself. Throughout this time it sat humbly on the combadges of the SFMC Aerospace Branch. No one makes a big fuss about the fact that SFMC Aero used the star even before the fleet began plastering it all over the place, for they had adopted it as the symbol of warp power and space flight for the corps since the SFMC was formed in 2161. When asked about it, most Aerospace members simply smile.

Delta Wings

Aviator wings are probably one of the oldest traditions in the history of aerospace flight. These wings have taken many incarnations throughout the years, and their current form reflects both the modern nature of the service and its long history. Marine Aviators (and they are traditionally called this regardless of whether they fly primarily in atmosphere or space) currently wear wings that resemble the historical wings of their ancestors, but with a modern touch: Centered on the golden wings is a miniature combadge, which reflects the contemporary service in the SFMC.

Aerospace Craft Insignia

SFMC aerospace branch aircraft and spacecraft craft have this insignia (also known as a roundel) to identify their branch of service. The insignia is displayed on the sides of the fuselage and, when present, on the upper and lower surfaces of the wings.

Rivalry between Ground Crews and Pilots

Since the first biplane fighter pilot yelled "Contact!" to some private to crank his engine on a field in World War One, ground crews and pilots have had a special relationship. Without one the other is useless. The ground crew can work and repair as long as it wishes, but if no one takes the craft into action then their efforts are useless. The most skilled aerospace pilot can do little damage to the enemy when his craft is stretched out in five hundred pieces across the flight deck, waiting to be serviced.

When considering these facts one would assume that ground crew members and pilots would enjoy a friendly, family atmosphere. One would be mistaken. Pilots have a tendency to view ground crews as ground personnel. Ground crews operate in the same theater as the normal "Groundhogs" or ground based branches that pilots do enjoy a friendly rivalry with. Pilots are for the most part officers, whereas with the exception of their administrators ground crews are nearly all enlisted men. This is yet another unwritten rivalry.

When ground crews do engage in combat, it is in ground combat style, and usually in defense of their installation. When ground combat ensues the first duty of a pilot is to get his craft up and away from danger and capable of entering the battle from the air. These differences in personnel, contributing traditions, and combat experience make for a relationship of mutual respect laced with friendly annoyance. This relationship is unique to the Aerospace branch and is best illustrated by the traditions and rituals of the branch, some of which date back to that private winding up that pilot's biplane way back in World War One.

Singing on Work Details

Most aerospace service crews have a "work jingle". This is a simplistic, and if possible, annoying little tune that the entire crew can sing, whistle, or hum as it works. The "jingle" is usually a popular tune made famous by holiday usage or advertising. Data tapes at the SFMC Historical Archives located on Alpha Centauri show late 20th century military service crews singing tunes such as "I Wish I Was an Oscar Meyer Wiener" and "Getting to Know You". Similar units in World War II actually printed sheet music with their unit emblem printed on the cover. SFMC aerospace service crews have been known to be fond of "Moon over Rigel 7", "Feeling Fine with Yoyodyne" made popular by their commercials, and "Be Kind to your Pointy Eared Friend". These "jingles" accomplish two goals—they help pass the time, and they annoy the waiting pilots.

Moving Day

New arrivals to service crews are treated to a unique form of initiation by their pilots. As a ranking officer, the pilot will order a newly assigned relief group to move his craft from one end of the installation to the other. Be it a hanger bay on board ship or an entire ground based airfield! The new replacements are given the entire day and are forbade any mechanical assistance; the craft must be moved by their own power. Since most replacement groups number about 15 to 20 personnel, this task is not impossible, but is still difficult. This tradition has resulted in many interesting and amusing stories.

Christening a Pilot and his Fighter

In combat situations a long-standing tradition of the aerospace branch is the ritual of "Saucing the newbie". Before their first combat mission, newly assigned pilots are escorted to the front of their craft by the senior pilot in the unit. They are met there by the senior NCO of the service crew and a bottle of an alcoholic beverage. The senior pilot then proceeds to give a speech on the possible ways the new pilot could die in the upcoming combat. The veteran may be as elaborate as they wish and some of these speeches have been known to go on for over an hour.

Upon the conclusion of this speech the senior NCO says "With the men's compliments, sir. If you're going to get incinerated, might as well do it with style!" then he pours the entire bottle of alcohol over the new pilot and then busts the bottle on the nose of the craft. Should the pilot return safely he is to then burn this flight suit as a symbol of his birth of fire.

Rivalry between Pilots

Pilots have hundreds of practical jokes they play on each other. The most regular being stealing each other's clothing (usually undergarments) and waving them at each other during noncombat missions. These jokes keep their relationships fresh and help ease the tension of being in constant danger when on duty. Pilots of all types, but especially fighter and attack pilots, have a tendency to operate every vehicle they come into contact with as fast as possible—regardless of whether it is an aerospace craft or some form of personal transportation.

Fighter Jocks, Mailmen and Trash Haulers

Fighter pilots consider themselves the best of the Aerospace pilots. For this reason they sometimes refer to Attack pilots as Mailmen (they deliver packages) and Support pilots as Trash Haulers (they carry cargo). Attack and Support pilots consider Fighter pilots to be flashy, macho and egotistical (obviously brain damaged from flying around all day at high altitude). For this reason, they are referred to as Fighter Jocks. Whether this refers to their 'macho' attitude, or a piece of pilot support clothing, has been the subject of many a bar brawl. Attack and Support pilots both reflect their attitude toward Fighter Jocks with this centuries old joke: "The difference between God and a fighter pilot is that God knows he's not a fighter pilot."

However, despite these little attitudes, Aerospace pilots of all types stick together when dealing with other branches (whom they refer to collectively as Groundhogs).

Salutes

When operating from a ground installation, a pilot will exchange a salute with his crew chief when he is ready to begin taxiing. This is both a sign of respect on behalf the ground crew (crews always salute their pilots as they fly into battle, regardless of whether or not they can see them directly) and it is a signal that the pilot is ready to assume total responsibility for the craft and that the crew's job is done for now. On a carrier, the pilot salutes the launch officer in a similar manner when he is ready to launch his craft. This both signals the pilot's readiness to the launch officer, and fulfills a centuries-old Marine tradition of saluting whenever one departs a vessel.

Callsigns

Traditionally, Marine Aviators each receive a callsign at some point in flight school. It may come from an instructor or a classmate. It may be officially bestowed on the student in an informal "ceremony", or it may simply be a nickname that "catches on" during training.

One common element to most callsigns, though, is that the pilot very rarely has any say in what it will be...and it will be his throughout his career whether he likes it or not. Some are plays on the pilot's name ("Heater" for Bob Heatley, or "Soup" for Trisha Campbell), some describe a physical characteristic—or lack thereof ("Stretch" for a tall pilot or "Tiny" for a large one), and some have long, convoluted and fascinating stories behind them. These callsigns, as well as the aviator's rank and full name, are typically stenciled on his aircraft under the canopy by his crew position. The name and rank of the ground crew chief for the aircraft is usually stenciled on the forward landing gear door or some other equivalent position depending on the craft.

"Air"

The roots of aviation on every Federation member world are deeply planted in atmospheric flight. Because of this long tradition, you will find that the Branch commonly refers to things in terms of "air" whether actual air is involved or not. For instance, a Marine Air Wing may be composed solely of craft that operate exclusively in space. Another good example: although the technically accurate description of the vehicles in the Branch's inventory is "aerospace craft," you will commonly hear them referred to as "aircraft."

Part 4 - Organization

The Aerospace Branch is one of the largest and most powerful Branches in the Corps. Only the Infantry has more sway in policy and warfighting doctrine. This has led to an organization steeped in tradition and rules...and a corresponding number of exceptions at the seeming whim of branch administrators. So, with the caveat that any particular organization or job within the branch may look nothing like the "book strength" description, here are the average organizational parameters for the branch.

Unit Organization

Marine Aerospace units are organized along traditional lines, following the 20th century standard of "pairs" in tactical situations. This creates a very simple, but effective method of organization. The table below shows useful comparisons between Aerospace Units and more familiar Infantry Units. While there is no "official" correlation between the branches (for example, a squadron is not exactly the same as a company), these comparisons may be helpful for the new Marine.

Aerospace Branch Unit Equivalents

Aerospace Branch	Infantry Units
Team	Squad
Flight	Platoon
Squadron	Company
Marine Air Group	Battalion
Marine Air Wing	Brigade
Marine Air Force	Division

Team

The basic maneuver element of the branch is the "team." It is composed of two craft that operate in tandem, with the junior pilot usually serving as the "wingman" of the senior who is designated "lead". In combat, the two aerospace craft cover each other defensively and operate together offensively to destroy enemy targets. The team is the smallest element normally dispatched for an aerospace intercept mission or scouting mission.

Flight

A flight is a group of two teams, totaling four aerospace craft. The flight is the smallest element normally dispatched for a patrol or attack mission. A flight is also the smallest element that may be detached from its parent unit in order to perform duties with composite units or with other branches, though normally squadron-sized units are chosen for such roles.

Squadron

The squadron is the smallest organizational unit in the Branch, meaning it is the smallest self-contained unit (when the squadron deploys, all of its vehicles and support personnel travel with it). It is composed of 3 to 5 flights, plus assorted support personnel. This means that squadrons may reasonably vary from 12 to 20 craft, though most average 16. Most squadrons are homogenous, which means they have a specific function or type of duty and the associated vehicles to perform it (i.e., Tactical Attack Squadron, Heavy Transport Squadron, etc.). Less common, but still quite widespread is the composite squadron, which carries a mixture of different types of flights.

Most Marine Strike groups (MSGs) in the Aerospace Branch are squadron-sized, but some may be larger. The MSG is a purpose-formed unit which may be as simple as pulling one squadron from a MAG and assigning it independent duty, or as complicated as forming a custom-made MAW for a particular mission profile.

Squadron Designators

Squadrons are designated by the standard set by the Old Earth United States Navy, which in a three letter prefix followed by the squadrons number. For example VMA-78. The three letter prefix actually describes the type of unit. "V" has historically represented fixed wing aircraft, "M" stands for Marine, and "A" stands for attack. Other types of squadrons include: Fighter (VMF), Fighter/Attack (VMFA), Electronic Warfare (VME), SpecOps (VMM), Support (VMS), Training (VMI), Test/Special Duty (VMX).

Marine Air Group

A Marine Air Group (MAG) should not be confused with a Marine Strike Group. While some aerospace MSGs are MAGs, most are of squadron size. The MAG is composed of 3 to 6 squadrons. These squadrons may be assigned scattered throughout a sector or on different carriers, or the MAG may deploy and fight as a cohesive unit, based on mission requirements and MAG composition.

An Air Group is normally the largest unit able to be deployed on a carrier. When both naval and marine aerospace forces are combined on a carrier, then the unit is simply known as an Air Group and the senior aviator is designated Commander, Air Group or simply "CAG". If the group is exclusively marine craft, it may properly be referred to as a Marine Air Group, although its commander will still be referred to simply as CAG.

Marine Air Wing

The Marine Air Wing (MAW) is the largest element of aerospace craft currently employed by the STARFLEET Marine Corps. It is made up of 2 to 3 MAGs or 6 to 18 squadrons. On average, most wings total 140 to 150 aerospace craft. Wings vary widely in organizational composition: they may have no subordinate MAGs and simply have squadrons assigned directly to them, or they may encompass 2 or 3 established MAGs. More often, they have at least one MAG with additional squadrons attached directly to the wing based on mission requirements and resource availability. There are a few supercarriers in the fleet, which are capable of embarking entire MAWs, but if a MAW is deployed en masse it is usually to a planetary installation.

Marine Air Force

While it has not been used in recent history, there is a provision within Aerospace Branch organization to form an even larger unit in time of war. Known as a Marine Air Force (MAF), the unit is roughly equivalent to a Marine Division of ground forces and would generally include a force totaling some 4 to 6 MAWs. The 16th Marine Air Force and the 23rd Marine Air Force were both formed during the Klingon War, each reaching a maximum strength during the height of hostilities of nearly 900 craft and over 8,000 personnel. After the war, both were quickly dismantled, and no MAF has existed since.

Fields of Service

The Aerospace Branch is divided into three related areas, called Fields of Service. These fields of service are based on mission and equipment used.

Air Combat Command

This is the Field of Service that concerns the craft primarily designed for use in planetary atmospheres. These craft generally have lifting and control surfaces to enhance their performance in atmosphere and reduce their power consumption for items such as antigravs and thrusters. Having wings, ACC craft are by far the most distinctive in the Corps. All these craft are capable of spaceflight, but are much more at home in the air (even when the "air" isn't necessarily a nitrogen/oxygen mix). The ACC generally oversees all combat operations within a planetary atmosphere. To this end, they possess not only the direct combat assets such as fighters and bombers, but also tactical support assets such as electronic warfare craft and a limited amount of tactical airlift capability.

Space Combat Command

This field of service concerns the warp-capable aerospace craft of the SFMC, and their primary mission of deep space or orbital escort, interdiction, and attack. Pilots in this field train extensively for patrolling in space, convoy escort duties and anti-starship assault. While these craft could certainly operate in most atmospheres and some have wings, they are not nearly as at home as they are in a zero atmosphere/zero gravity environment.

This is an important but increasingly small arm of the Branch, since most of the spaceborne combat duties in the Federation now fall to Starfleet. For several decades, the fleet had all but ignored small craft combat in space, and so the Corps developed a large and varied aerospace arm to fill this niche. However, the fleet has recently been growing its own aerospace branch to such an extent that many Marine SCC units were either transferred en masse to the fleet or reassigned to the ACC with new craft.

Aerospace Mobility Command

The AMC's primary mission is rapid, Federation-wide mobility and sustainment for the SFMC. They provide tactical and strategic airlift and aerial refueling for the Corps, and many special duty, operational support, and aeromedical evacuation missions are also assigned to the AMC. It is the AMC that has primary responsibility for amphibious landing operations as well, providing drop ships, assault shuttles, and other landing craft. The command also plays a crucial role in providing humanitarian support, transporting critically needed supplies for planets suffering natural or man-made disasters, famine, etc.

One of the smaller, but more infamous, sections of the AMC is the Corps' Special Air Operations Wing (SpecAirOps). This wing supplies specially modified and crewed support, transport, and medivac craft to SpecOps teams. These craft belong to and are crewed by the Aerospace Branch, but work so extensively with the Special Operations Branch that it may literally be months between times when a SpecAirOps flight physically checks in with its squadron or MAG.

MOS Descriptions

Most Aerospace Branch MOSs are assigned/achieved independently of a particular airframe. This has always been true of ground crews, but was not always true of aircrew MOSs. However, an effort to streamline personnel systems within the Corps over the last year or so has led to a simplification of the Aerospace MOS system, and to the scheme currently used. For more information about Aerospace MOS, please refer to the SFMC MOS Manual.

Inside a Marine Strike Group (Aerospace)

The MSG is a flexible package that varies in size and composition from post to post. As in other branches, there is really no 'standard' MSG. Most instructive for the new recruit (and probably simplest for them as well) would be a look at an MSG that is a single squadron in strength, like the Second Marine Air Wing's premier attack squadron.

The Blue Blazers

The 78th MSG fl ies a Close Air Support (CAS) mission using the A-18 Firebolt as their primary aircraft. Their job in CAS is to attack enemy forces, which are engaged with, or are about to engage, friendly forces. This calls for precision attack, applying firepower precisely where it is needed and in closely prescribed amounts.

The 78th Marine Strike Group (Aerospace) is built almost entirely around Marine Attack Squadron 78 (VMA-78). VMA-78 is one of the first Marine squadrons to receive the A-18, and the first to deploy on a Qapla' class cruiser (the USS Khai Tam, NCC-81000). When it originally deployed to the Khai Tam , the squadron consisted of four flights of four Firebolts each. Flights are lettered by standard phonetic alphabet: Alpha, Bravo, Charlie, Delta.

Shortly after deploying, the squadron was ordered to detach delta flight so that it could supply an organic CAS capability to the 667th powered infantry aboard USS Yamato. When this happened, the 78th was allowed to add a fifth flight, echo, which consisted of a single E-39 Explorer and its crew. The Explorer Coordinates A-18 engagements and provides forward traffic control.

With an entire flight of A-18s detached, some have questioned adding the burden of the Explorer. The E-39 is a valuable combat asset with little self-defense capability and so must be protected in battle. However, in its role on the Khai Tam, the 78th's action is usually confined to small-scale planetary action for which a three flight squadron is more than adequate, and adding the E-39 allows the 78th to "fight smarter" and therefore increase its effectiveness.

Aerospace squadrons are typically top-heavy with officers since pilots are usually all commissioned officers to begin with. Therefore, most every pilot takes on a role in administration and operation of the squadron in addition to his normal job of flying. That is one reason few non-flight officer MOS's exist in the branch.

Table of Organization & Equipment
Marine Attack Squadron 78 (VMA-78)

Assigned: USS Khai Tam, NCC-81000
Higher HQ: 2nd Marine Aerospace Wing (2MAW), Starbase 25

AIRCRAFT: 16 ea A-78 Dragon, 1 ea E-5B Paladin

PERSONNEL (35 Officers, 71 NCO/Enlisted, 106 Total Assigned):

Sqdn. CO (COL or LTC): 1 [A-78 pilot]
Sqdn. XO (LTC or MAJ): 1 [A-78 pilot]
A-78 Pilots (CPT or 1LT): 14
A-78 WSRDs (1LT or 2LT): 16

E-5B Pilots (CPT or 1LT): 2
Aerospace Intercept Officer (CPT or 1LT): 1
Aerospace Traffic Controllers (SGT): 3
E-5B Crew Chief (SSGT): 1
In-flight Refueling Technician (CPL): 1
E-5B Weapons Systems Operator (CPL): 1

Maintenance Chiefs (SSG): 5
Maintenance Technicians (enl): 35
Ordnance Technicians (enl): 20
Aerospace Logisticians (enl): 5

Detached Aircraft: 4ea A-78 Dragon

Detached Personnel (Delta Flight):

Flight CO (CPT): 1 [A-78 pilot]
Flight XO (1LT): 1 [A-78 pilot]
A-78 Pilots (1LT): 2
A-78 WSRDs (1LT or 2LT): 4

Maintenance Chiefs (SSG): 1
Maintenance Technicians (enl): 7
Ordnance Technicians (enl): 4
Aerospace Logisticians (enl): 1

The main table above indicates the total number of aircraft and personnel assigned to VMA-78, including Delta Flight. The sub-table in the lower right shows the numbers strictly for the detached Delta Flight in order to give the reader an idea of what resources a single flight may possess.

In keeping with this philosophy of dual-roles for aviators, the 78th makes assignments for their pilots that are very similar to those you would find in any Marine Corps Aerospace Squadron:

- The squadron CO is the senior aviator and is Alpha Flight Leader.
- The squadron XO is the next senior aviator, leads Bravo Flight, and serves as Squadron S-1 (Personnel).
- Charlie Flight Leader serves as S-3 (Training and Operations).
- Echo Flight Leader (E-39 pilot) serves as S-2 (Intelligence).
- Alpha Two (second team leader in alpha flight) serves as S-4 (Logistics).
- Bravo Two serves as S-5 (Public Affairs)

Other jobs such as Safety Officer, Air Group Liaison, Morale & Welfare Officer, etc. are doled out to the remaining pilots as their workload and aptitudes dictate.

Part 5 - Equipment

While the aerospace Branch is rife with complex and fascinating equipment, of greatest interest to the new recruit is no doubt the large variety of aerospace craft in the Marine Corps inventory, so that is where our discussion will begin. First we will discuss the most common craft in the inventory, and then talk about key systems and weapons they have in common. After the discussion of aerospace craft will be brief listings regarding personal protective gear and other flight crew accessories. The dizzying array of ground support equipment will be covered in later training. For more information about Aerospace Equipment, please refer to the SFMC Arms & Equipment Manual.

Aerospace Craft Designation

Marine planes are of two main categories: "aircraft" and "spacecraft." BOTH are technically aerospace craft. That is to say, any craft in the SFMC inventory is capable, to some extent, of operation in space and operation in atmosphere. The main difference, then, is where the craft primarily operates. Generally, spacecraft operate primarily in space, while aircraft operate primarily in atmosphere. In terms of gross oversimplification: aircraft have wings, spacecraft don't. Of course, a "true" aircraft operates only on the principles of aerodynamic flight, and therefore only inside an atmosphere. However, in the context of Marine aviation, it is understood that the term aircraft applies to transatmospheric craft as well.

The purpose of an aerospace craft designation in letters and numbers is simply to identify the craft and its primary mission. At the root of it all is a simple letter/number combination. A-18, for example, indicates a Firebolt attack aircraft. The A stands for attack and the 18 is the design number. Spacecraft generally have odd numbers; aircraft generally have even numbers. Some aerospace craft have dual roles, for example a fighter-attack strike craft like the F/A-55 Le-Matya.

Basic Mission and Type Symbols

Below is a list of the basic letter designators for Marine craft:

- A – Attack
- E – Electronic Warfare/Early Warning
- F – Fighter
- I – Instructor/Training
- S – Support/Amphibious Operation
- T – Transport/Cargo
- U – Utility
- X – Research/Experimental

Series Symbol

Follow-on changes to the A-18 would call for a series symbol, indicating an improvement on, or change to, the same design. A-18A or A-18C, for example.

Modified Mission Symbol

When the basic mission of an aerospace craft has been considerably modified for other than the original or intended purpose, a modified mission symbol is added. For example, an A-18A modified to be principally a reconnaissance aircraft would become an RA-18A.

Modified Mission symbols are:

- A – Attack
- E -– Special Electronics
- H -– SAR/Medivac
- K – Tanker
- M -– Special Operations
- Q -– Drone/Remotely Piloted Vehicle
- R – Reconnaissance
- V – Staff
- X -– Experimental/Long Term Test
- Y – Prototype

Personal Protective Gear

Aerospace personnel generally fight from their vehicles, and so do not require a great range of protective garment options. Loadmasters, crew chiefs, and other flight crew that may have to deplane in a landing zone have the option of wearing the standard Infantry garments for hazardous environments. Many crew members of Drop Ships and Medivac craft wear the MIPPA personal armor system, or at least parts of it, over their flight suit as an added precaution. Details on these garments and accessories can be found in the Arms and Equipment Guide.

Field Gear/Personal Weapons

By and large, aircrews are not expected to fight outside their craft, and are issued and trained in a limited amount of personal or man-portable weaponry. For more information about Aerospace Equipment, please refer to the SFMC Arms & Equipment Manual.

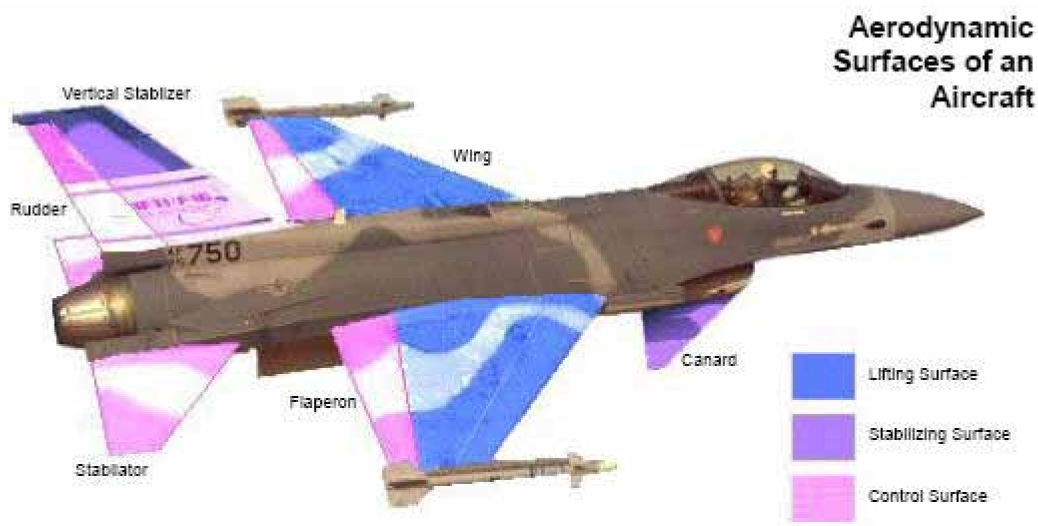
Part 6 – Flight Training

SFMC Flight School is an in-depth course that lasts nearly a year. Obviously, in the space available here we can no more than gloss over the tactics and training employed by the Aerospace Branch. However, even this brief introduction should give you a good idea of the complexity of aerospace operations.

Airframes, Propulsion and Other Systems

Below are some design standards that are common to all styles of modern aerospace craft.

Maneuvering



The illustration above is of a late 20th century aircraft and shows a good selection of aerodynamic surfaces. Few aircraft today would have this many surfaces simultaneously. In fact, many aircraft today have no empennage (tail assembly) to speak of. Good examples of modern tailless aircraft include the A-78 Dragon, E-2 Crusader, and T-6 Atlas.

Aerodynamic Lifting Surfaces

Spacecraft rely on inertia-balancing and antigrav systems to provide necessary lift when flying in atmosphere. This is fine for coming and going through an atmosphere, but if you plan to stay for a while in the air, these systems chew power and do not supply great quantities of maneuverability. Therefore, aircraft use aerodynamic lifting surfaces for better agility and power management. It is the presence of wings more than any other single design element that distinguishes aircraft from all other military auxiliary craft.

In addition to wings, depending on aircraft design, other fixed aerodynamic surfaces may be present to aid in trim and handling. These include horizontal stabilizers, canards, and vertical stabilizers. The use of sophisticated flight management software in many aircraft has eliminated some or all of these stabilizing surfaces in several SFMC designs.

The illustration above is of a late 20th century aircraft and shows a good selection of aerodynamic surfaces. Few aircraft today would have this many surfaces simultaneously. In fact, many aircraft today have no empennage (tail assembly) to speak of. Good examples of modern tailless aircraft include the F-82 Phantasm

Aerodynamic Control Surfaces
Aircraft will generally make use of aerodynamic control surfaces for maneuvering for the same reasons they use wings instead of antigravs for lift: better maneuverability in the air and more efficient power utilization. These surfaces usually include ailerons to control roll, flaps to aid with lift, elevators to control pitch, and rudders to control yaw. Aircraft can also use combination surfaces depending on design. These include flaperons (performs the function of both flaps and ailerons) and stabilators (performs the function of both elevators and horizontal stabilizers).

Thrust Control
Standard shuttle-style reaction control thrusters are used for maneuvering in space or in low or zero atmospheric planetary operations. These thrusters supply most fine attitude control and maneuvering capability.

In craft with impulse systems, vectored thrust can be used to greatly enhance maneuverability. These systems work in one of two ways: 1) either the exhaust nozzle is physically turned to funnel exhaust gasses in a particular direction; or 2) the exhaust stream can be turned using magnetic fields if the exhaust products have sufficient charge.

Most missiles in the SFMC inventory use vectored thrust for maneuvering; or alternatively use distributed thrust, which accomplishes the same goal by forcing exhaust out more than one nozzle in an intentionally imbalanced manner.

Propulsion
Spacecraft Propulsion
Faster-than-light (FTL) propulsion for certain Marine spacecraft is from a small warp core similar in design to those used in standard Starfleet warp-capable shuttles and runabouts. Sublight propulsion is usually accomplished by smaller versions of standard impulse reaction drives~~,~~ or fusion systems like those used for main propulsion on transatmospheric craft.

Aircraft Propulsion
Aircraft rarely if ever require FTL transit capability, and most often require small, powerful propulsion systems which make them quick and maneuverable over the battlefield. Therefore, a series of very different power plants has evolved for Marine aircraft.

For a long time, some designers favored air-breathing engines for atmospheric flight, but these have severe limitations. The most crucial is that they are useless in atmospheres containing less than 15% oxygen and so are limited strictly to operations on Class M worlds. Old air-breathing craft did have thruster systems for space flight, but they were small systems not capable of sustained operations in atmosphere. This, coupled with the large amounts of fuel necessary, eventually made air-breathing engines obsolete in the Marine inventory.

Much more common in today’s aircraft are micro-fusion propulsion systems, which quite closely resemble the reaction control thrusters of starships. These systems provide a good thrust-to-weight ratio and are very fuel efficient, meaning that relatively small amounts of reactant (fuel) are required. Even the smallest fusion drives take up a lot of space and require a lot of maintenance, however, so they are not appropriate for all applications.

In aircraft that do not use fusion power, the most common propulsion system is a unique impulse reaction drive that uses phased energy rectification to superheat fuel. The fuel quickly changes state from a liquid to a rapidly expanding gas, propelling the craft at high speeds without actually "burning" the fuel, which means that oxidizer or air are not required. This "phaser" propulsion system is powered by large energy cells known as "charge packs," and these systems are generally referred to simply as charge pack systems.

Impulse Drive

The impulse drive is a propulsion system used for sublight speeds. In Federation spacecraft, the impulse drive consists of one or more fusion reactors, an accelerator-generator, a driver coil assembly and a vectored thrust nozzle to direct the plasma exhaust.

This plasma can be employed for propulsion or diverted through the Electro Plasma System (EPS) to the power transfer grid via EPS conduits so as to supply other systems. The accelerated plasma is passed through the driver coils, thereby generating a subspace field which improves the propulsive effect.

Inertial dampers are used to compensate for acceleration and are set so the propellant used for impulse drive retains its inertia upon being vented from the craft. Energy conservation is generally achieved by the use of magnetohydrodynamic thrusters, which are used in conjunction with the craft's warp drive's alteration of the craft's relativistic mass, to achieve mid-to-high sub-light speeds.

Warp Drive

Warp drive is the technology that allows space travel at faster-than-light speeds. This is accomplished by generating warp fields that form a subspace bubble around the spacecraft. This bubble distorts the local space-time continuum and moves the craft at speeds faster than the speed of light.

Federation warp engines are fuelled by the reaction of matter (deuterium) and antimatter (antideuterium), which is mediated via an assembly of dilithium crystals in the warp core. These are non-reactive with antimatter when subjected to high-frequency electromagnetic fields and allow the production of a high energy plasma, which is channelled by plasma conduits through the warp EPS. The electro-plasma is subsequently directed by plasma injectors into a series of verterium cortenide warp field coils, which are located in warp nacelles and generate the warp field.

The first Terran warp drive was developed by Zefram Cochrane, whose first successful flight with a warp-powered vessel occurred in April, 2063. However it was not until the 2140's that a warp engine was developed that could exceed warp factor 2. By the year 2152, warp technology was advanced enough to allow a vessel to travel at warp 5. In the 24th Century, Federation craft could travel at speeds just under warp 10.

Fuels

In warp, fusion, and charge pack systems, the principal fuel is deuterium, usually stored in slush form. Reaction control systems (thrusters) that are used for maneuvering in space usually use monomethyl hydrazine. Both fuels can be transferred by tanker craft. Tankers can also supply electrical power to charge pack systems, and atmospheric gases to life support systems.

Airframe and Other Systems
Anyone even passingly familiar with starship construction would recognize the materials used in aerospace craft construction, so little time will be spent on materials. Instead we will concentrate on the use of IDS and SIF systems, and the unique MAST system used on newer SFMC craft.

Inertial Dampening Fields
Also known as IDFs, these are found on all SFMC aerospace craft. More powerful versions are found on warp-capable spacecraft, since these vehicles operate at significantly higher accelerations. The primary job of the IDF is to compensate for acceleration forces (also known as “g-forces” since they are measured in “gravities” with 1g being equivalent to the acceleration due to gravity on a typical class M world). It does this by providing a balanced force field thrust in the direction opposite to the acceleration, thus canceling the potentially lethal effects of acceleration on crew and airframe.

Structural Integrity Fields
SIFs bolster the physical strength of the airframe via the judicious use of force fields. All SFMC aerospace craft have SIF generators installed to compensate for the stresses the airframes are subjected to in combat. Frequently, the generator is connected to the IDS generator and the two work in concert.

MAST
Modern space flight and, to a lesser extent, modern atmospheric flight would not be possible without IDFs and SIFs. But this strength does not come without cost. IDF/SIF generators cause significant power drains in small engines or charge packs. This had been a growing problem in the effort to make smaller craft with concurrently small engines and power reserves. It therefore behooves aircraft designers to develop aircraft that can take as much stress as possible without the aid of SIF/IDFs in order to minimize power loss.

One problem with this philosophy, however, is aircrew survivability. As long as 400 years ago, aircraft strength and maneuverability parameters began to surpass those of their pilots. Even on 20th-century Earth, fighters were being produced that could attain g-forces their pilots could not survive. This problem was solved with IDFs, but again at a high cost in power. A compromise was struck between power drain and crew survivability with the MAST system.

With the Maximum Aircrew Stress Transfer (MAST) system, each aircrew member is monitored by a medical scanner in the base of his helmet. This sensor monitors blood-oxygen levels in the brain as well as other critical health data. When g-forces act on the aircrew, the scanner can determine whether or not the g-forces exceed safe tolerances for the crew members. As soon as minimum safe thresholds are neared, the scanner signals the flight control computer.

In the case of positive g’s (see discussion on g-forces elsewhere in this text), a force field is activated in the lower portion of the seat that squeezes blood from the crew members’ lower extremities in order to increase the blood supply to the brain. If the force field has reached its safe maximum and the crew member is still experiencing problems, the computer then kicks in the IDF. It carefully controls the IDF usage to keep g-levels just within acceptable maximums. In the case of negative g’s, the IDF compensation immediately kicks in. In this way power drainage is kept to a minimum while aircrew survivability is assured.

Weapons Bays

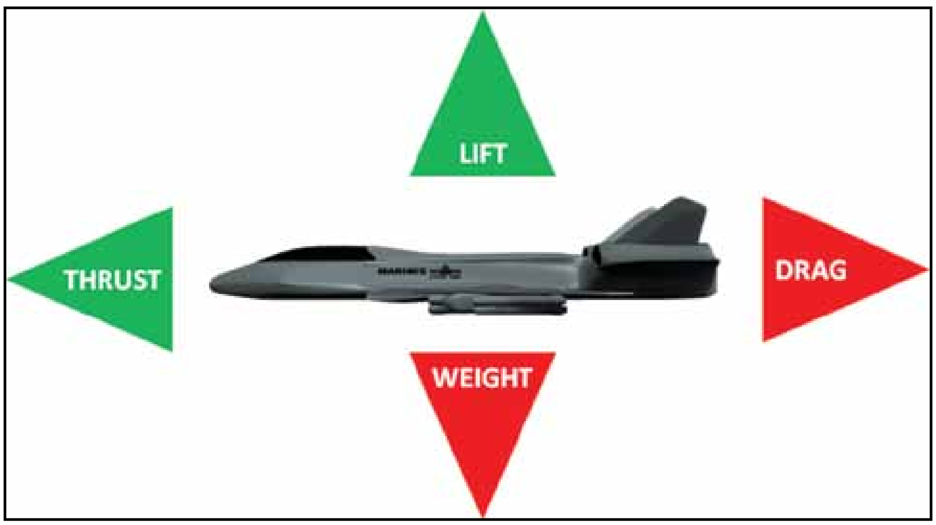
While many aerospace craft have the ability to be fitted with external ordnance or stores on under wing or wingtip pylons, this is not usually desirable. External stores contribute greatly to drag and, more importantly, sensor signature. External stores also require massive amounts of energy shielding on atmospheric entry to avoid thermal effects from atmospheric friction. Therefore, most craft are fitted with at least one internal weapons bay, which may hold anything from air-to-air missiles (for an interceptor) to large bombs or torpedoes (for attack craft).

Ground School

When you enter the Aerospace Branch, you attend a basic branch orientation course, known simply as Ground School, which is conducted at Marine Corps Aerospace Training Center Twenty-nine Palms on Earth. Twenty-nine Palms is a historic Marine Corps base, which at one time served the United States Marine Corps. Today the base is much, much larger, encompassing much of central Southern California including the old US Air Force facility known as Edwards Air Force Base. Twentynine Palms is one of the largest Marine Corps bases in the Federation.

No matter what your eventual MOS, having all personnel attend the same ground school gives them a common frame of reference for aerodynamic principles and aerospace operations. After ground school, MOS-specific training (including Flight School) is attended based on your individual career choices. Below are some of the basic subjects covered at Ground School.

The Aerodynamic Flight Model



One of the first areas to be covered in Ground School is why aircraft fly. Basic flight theories and models are discussed to give a feeling for how aircraft work, after which courses in Marine Aviation and Air Ops will give the context for these initial principles.

Aerospace craft are equipped with antigravity generators so in many cases lift created by airflow over a wing surface is no longer needed to maintain flight. However, many craft in the SFMC still make use of aerodynamic lift to replace or augment antigravs when operating in atmospheres. Therefore, understanding the principles of aerodynamic flight will help you understand some of the design characteristics found in many of the SFMC's aerospace craft.
A craft in flight is the center of a continuous battle of forces. The conflict of these forces is the key to all maneuvers performed. There is nothing mysterious about the forces in question. They are defined and well documented. The direction in which each acts can be calculated, and the aircraft is designed to take advantage of each. These four forces are known as lift, weight, thrust, and drag.

Lift
Lift is the force that acts in an upward direction to support the craft in the air. It counteracts the effects of weight, and is generated by airflow over a lifting surface, such as an aircraft wing. The amount of lift produced by a wing is dependent on several things: the angle of attack (the angle at which the wing meets the air), the high-lift devices on the wing (flap, slat, and slot), the density of the air, and the area and speed of the wing. All of these forces work together to keep the craft airborne. The wing keeps the airplane aloft by pushing the air surrounding the plane in a downward direction. Angle of attack and speed are particularly interconnected; the more speed you have, the less angle of attack you need, while the less speed you have, the more angle is needed. The angle can be changed by changing the plane's attitude. Up to a certain point, increasing the angle of attack increases the lift force produced by the wing. An increase in lift means the plane can climb faster or fly slower.

Weight
Weight is the force of gravity acting downward on the craft and everything in the craft, including the crew, cargo and fuel. Lift must be greater than or equal to weight if flight is to be sustained.

Thrust
Thrust is the force developed by the craft's engines, and it acts in the direction of motion. Thrust must be greater than or equal to the effects of drag for flight to begin or be sustained. Thrust can be calculated mathematically if enough other information is known, such as flow and exact velocity of the gas propellant.

Drag
Drag is the force that tends to push against the craft. Drag is caused by the disruption of the airflow around the nacelles, the fuselage, and all protruding objects on the craft. An aerodynamic shape reduces drag. This is why the tactical aerospace craft employed by the SFMC retain much of the aerodynamic styling of older aircraft. Motion will become zero if the drag on the craft becomes greater than the thrust being applied by the aerospace craft's engines.

There are two main types of drag: friction drag and form drag. Friction drag occurs in the thin air layer next to the surface of an object. This layer of air is called the boundary layer. This type of drag occurs because one of layer of a fluid slides over another layer; the air through which the craft is traveling sliding over the boundary layer air. The molecules of air in the boundary layer move in two different ways; orderly motion of the molecules is known as laminar flow and irregular motion is called turbulent flow. Form drag occurs when the airflow past an object breaks away from the object, thus taking energy from the object and slowing it down. On aircraft, wings, engines, landing gear, and any other non-streamlined part of the craft cause form drag. Engineers work to reduce form drag by streamlining as much of the craft as possible. They can also add devices to decrease the amount of air breaking away from the wing.

There are two other types of drag that can be important. Induced drag is also called drag due to lift. The difference in pressure above and below a wing causes air along the bottom to flow outward, while air along the top flows inward. This in turn causes a vortex behind each wing, holding the plane back, and potentially posing a safety threat to airplanes following close behind. Wave drag occurs only on craft that are traveling at transonic and supersonic speeds. It is caused by the formation of shockwaves around the aircraft. Wave drag creates a different set of problems for engineers and their efforts to make craft stable at supersonic speeds (Mach 1 or higher) and hypersonic speeds (Mach 5 or higher).

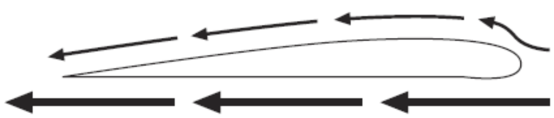
Newton's Laws of Motion

Inertia
According to Newton's First Law of Motion (the law of inertia), an object at rest will remain at rest and an object in motion will remain in motion at the same speed and in the same direction, until an outside force acts on them. For a craft to taxi, hover or fly, a force must be applied to it. Once the craft is moving, another force must act on it to bring it to a stop. This willingness of an object to remain at rest or continue in motion is referred to as inertia, and is most notable in space (where there is little atmosphere or gravity to create drag or weight).

F=ma
The Second Law of Motion states that if an object moving with uniform speed is acted upon by an external force, the change of velocity (acceleration) will be directly proportional to the amount of force and inversely proportional to the mass of the object being moved.
Simply put, this means that an object being pushed by 10 pounds of force will travel faster than it would have if it were pushed with 5 pounds of force. A heavier object will accelerate more slowly than a lighter object when an equal force is applied.

Action and Reaction
The third law of motion (the action-reaction law) says that for every action, there is an equal and opposite reaction. This law can be demonstrated with a balloon. If you inflate a balloon with air and release it without securing the neck, as the air is expelled the balloon will move in the opposite direction of the air rushing out. This explains how propulsion is achieved; the acceleration to the rear of matter (in this case, air) provides a thrust that propels the object forward.

Bernoulli's Principle



Air traveling over a wing must travel faster at a lower pressure than the air under it, essentially creating a partial vacuum above the wing and pulling it up, creating lift.

This principle states that when a fluid flowing through a tube reaches a constriction or narrowing of the tube, the speed of the fluid passing through the constriction is increased and the pressure of the fluid is decreased. It is the shape of the aircraft wing and the motion of air over it that creates lift.

Air flowing across the flat bottom of a wing has a higher pressure because it travels a shorter distance. Air flowing across the curved top of a wing must travel farther (and therefore faster), decreasing pressure above the wing and creating lift.

Air traveling over a wing must travel faster at a lower pressure than the air under it, essentially creating a partial vacuum above the wing and pulling it up, creating lift.

Getting Your Bearings

Now that you have an understanding of why a plane flies, you can move on to how a plane is flown. Even if you are not going on to become a pilot, it will help you to know these basics of aircraft operation.

Bearing

In the 3D world of space flight, the three axes of a ship are combined to create two particular planes. The longitudinal axis – fore to aft – is the X-axis and the lateral axis – left to right – is the Y-axis. These combine to create XY plane or azimuth. Combine the X-axis with the Z-axis – up and down – creates the XZ plane or elevation. These are used in determining an object's bearing, or direction from your vehicle at a specific point in time.

An object with a bearing of 025 mark 035 can be found 25° to starboard and 35° above the craft's XY plane. In other words, up and to the right. To roll the ship 45° to port would move the position of the object. It's bearing would become changed. What was 35° above is now 10° below the XY plane. What was 25° to starboard is still 25° to starboard. Now the object will be slightly below and still to the right of the craft at a bearing of 025 mark –minus 10.

When specific position is not known or necessary, colloquial shorthand is often used which refers to direction in terms of an analog chronometer. The object at 025 mark 035 is said to be at a craft's "one o'clock high". An object below you at a bearing of 270 is at your "nine o'clock low." This is where the common phrase "check your six" derives, since the "six o'clock" position is directly behind you.

Heading

Heading is the course your vehicle is on at any given point in time, and is calculated in a similar fashion to bearing. The difference is that your heading is calculated from some common reference point such as the planetary magnetic pole or the planetary system's primary star. In some cases, standard galactic navigational references will be programmed into your flight computer, and you will use the same methods that large starships use.

Which reference point is used will be determined by the type of vehicle you are in and the tactical mission. Obviously, a pilot flying a low level atmospheric bombing mission isn't going to need galactic reference points! It is important to understand the difference between heading and bearing. Heading is what direction an object is traveling and bearing is where that object is in relation to you.

Satellite Navigation

Satellite navigation is used on many planets. Radio signals are transmitted from satellites in planetary orbit, and are received by equipment on the craft. Signals from at least three satellites are used to calculate the craft's location. Satellite navigation is the more advanced system and is preferred by the Federation, when it is possible for the planet to use that system. However, on non-Federation worlds, the old-fashioned systems of air navigation must often be used, and are therefore still taught to all SFMC pilots.

Air Navigation

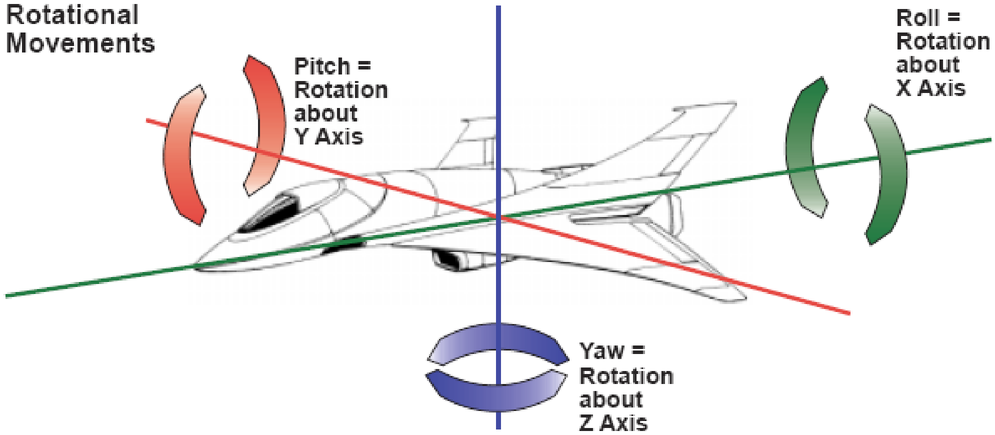
Air navigation is used by aircraft operating within a planet's atmosphere, and is generally employed when satellite navigation is not possible. This system is the means by which pilots determine their plane's location in the air and direct its route of flight. Pilots use charts, compasses, radio systems, and computerized instruments to navigate accurately.

The most common method of air navigation is called pilotage or piloting. The key to this method is following a series of landmarks on the ground in order to keep on course. Before take-off, the pilot plots his course on an aeronautical chart (a map showing the location of landmarks that can be used for course purposes, such as bridges, highways, railroad tracks, rivers, and towns). This chart also shows routes for aircraft, landing fields, and radio stations that broadcast air navigation signals. As the pilot flies over each landmark, he checks it off the chart; if he does not pass over a planned landmark, he must adjust his path in order to resume the proper course.

A more difficult situation occurs when there are few or no visible landmarks. The navigation system called dead reckoning must be used over such areas as forests, deserts, large bodies of water, or heavy clouds. Pilots must use an accurate clock, compass, and calculator, in addition to their charts, in order to determine time, speed, and distance. The pilot must plan his route in great detail in advance, taking care to determine how long it should take to reach the destination while flying at a constant speed (the course is adjusted for the wind). While in-flight, the pilot watches the compass to keep the plane headed correctly. Difficulty can arise because changing winds may drive a plane slightly off course.

Navigation across planetary oceans requires the use of special systems. Three commonly used systems are inertial guidance, loran (long range navigation), and satellite navigation. Inertial guidance systems do not rely on any information from outside the vehicle; the computer and other on-board devices provide the guidance information. The devices measure changes in the craft's speed and direction, and use that information to calculate the craft's position and guide it on course.

Rotational Movement



Translational movement is movement in a straight line. A ship moving straight ahead is translating along its X-axis and is said to have a positive X translation. Since thrusters can push a spacecraft in a straight line in any direction, translational movement is particularly important in spaceflight. Rotational movement is movement around an axis and is particularly important in atmospheric flight. Every vehicle has three rotational axes that are 90° from each other and named by their direction: longitudinal (X), lateral (Y), and vertical (Z).

Pitch

The lateral axis is the pivot point about which a craft pitches. Pitch can best be described as the up and down motion of the nose of the craft. Pitch is primarily controlled by symmetrical application (both up or both down) elevators, stabilators, or flaperons. It can also be accomplished with vectored thrust.

Roll

The longitudinal axis is the pivot point about which a craft rolls. The movement associated with the roll is best described as the movement of the wing tips, one up and one down. Roll is primarily controlled by differential application (one up, one down) of ailerons or flaperons.

Yaw

The vertical axis is the pivot point about which a craft yaws. Yaw can be best described as the change in craft heading to left or right along the primary direction of the craft. On craft that have them, yaw is controlled by the rudder. On tailless craft, yaw can be controlled by differential or vectored thrust, but is usually accomplished in combination with roll in a bank.

Center of Gravity

During flight, the craft's center of gravity changes many times. This can be caused by flight maneuvers, reduction of fuel, expenditure of ordnance, or other factors. Pilots use trim tabs, located on the elevators, ailerons, and rudder to keep the craft balanced.

Jet Engines

There are four basic types of jet engines: turbojet, turboprop, turbofan, and ramjet. The chief difference is in the portion of their total thrust that is produced directly from jet propulsion. Another difference is in the way they compress the air as it enters the intake ducts.

Three of the types–turbojets, turboprops, and turbofans–use a turbine as their main component. The turbine is the machine that converts the energy of a fluid stream into mechanical energy of rotation. It is a rotor device with fan-like blades. The working fluid that is used to drive a turbine can be either a gas or a liquid. The working fluid is pumped through the turbine and creates reaction, thus resulting in thrust.

The turbojet was the first type of engine used to power an airplane, and all other jet engines are variations of this. Turbojet engines send the air through a compressor that squeezes the air and forces it into the combustion chamber. In the chamber, it is mixed with fuel and ignited, forming burning gases. The gases are sent through the turbine, causing it to spin. The turbine is connected by a shaft to the compressor, thus the spinning of the turbine keeps the compressor operating. Then, the afterburner supplies the hot exhaust gases with extra fuel, which increases the speed of the jet exhaust. In the 20th and 21st centuries, this engine was most used by the military for fighter aircraft.

Turboprop engines are actually turbojet engines that also have a propeller. The turbojet engine is used to turn the propeller, which supplies most of the engine's driving power. The propeller rotates when burning gases from the combustion chambers turn the power turbine. This turbine is connected to a shaft that drives the propeller. When the hot gases escape the engine, they provide additional thrust. Turboprop engines do not, however, use afterburners.

Turbofan engines differ from turbojet engines because they have a huge propeller-like fan at the air inlet. Most of the air drawn through the fan passes around the rest of the engine, creating thrust. The rest of the air entering the enclosed engine, which operates like a turbojet, creates more thrust. The other main difference is that in addition to the compressor and combustion chamber, the turbofan has two turbines. One is used to drive the compressor. The other, the fan turbine, turns the fan. Since thrust is produced by two different methods, a turbofan can create more thrust at low speeds. In the 20th and 21st centuries, it was the most common type of jet engine, used by most commercial airliners.

Ramjet engines cannot be operated independently; they can only operate after they have been brought to supersonic speed by a rocket or another engine. Air rushes into the engine through air inlets, and slows down as it approaches the combustion chamber. Compression is caused by more air entering behind it at high pressure, thus mechanical compression is not needed. In the chamber, it is mixed with fuel and burned. The pressure produced by the burning fuel and air sends hot exhaust gases out the jet nozzle and drives the engine forward. Ramjets operate best at high, steady speeds. For this reason, in the 20th and 21st centuries, they were primarily used to propel guided missiles.

Another important type of engine is the rocket engine. The main difference between a rocket engine and a jet engine is that the rocket engine stores within itself all the substances necessary for operation. It carries it's own matter and energy sources, thus eliminating the need for any outside substance. The stored energy source is exploded in a chamber, and the explosion is used to eject the stored matter at high velocity, thus causing propulsion. Because no external substances are required for propulsion, this type of engine is suitable for use in space. Rocket engines were used to first propel humans from Earth into space in the late 20th century.

Flight School

If you are going on to become a pilot or flight officer (systems officer, air intercept officer, etc.), you will go from Ground School to Flight School. Basic Flight School also takes place primarily at Twenty-nine Palms. Flight in exotic atmospheres and gravities are practiced at Marine Corps Aerospace Ranges on Venus, Mars, and among the moons and rings of Saturn. An intensive course of space flying is also conducted at the Marine Corps Aerospace Range in Sol's asteroid belt. The course and content of flight school may vary for aircraft type and crew position; however, some basic principals are covered with all students. A very brief overview follows.

Basics of Flight

In addition to the basics of aerodynamics and controls taught in ground school, the following flight basics are covered in early flight school.

Airfield Takeoffs

At facilities equipped with runways, you should use a rolling takeoff or landing rather than a vertical takeoff or landing (VTOL) on antigravs for two reasons: first, to conserve energy (antigravs require a lot of it), and second, to keep yourself in practice for occasions when you can't perform an antigrav VTOL.

After taxiing to the end of the runaway and receiving Air Traffic Control (ATC) clearance for takeoff, begin your takeoff roll with full power forward thrust (known as military power). In the takeoff roll, you will encounter three critical speeds or velocities. The first, V1, is the point after which you are no longer able to safely stop on what is remaining of the runway—you are committed to takeoff once you exceed V1. Next is the speed at which you can safely lift the nose landing gear, which is called "rotating" the aircraft. When rotating, do not lift the nose too high, or you can drag the tail of the plane on the ground, causing damage to the aircraft. After rotation speed is the speed at which the aircraft has sufficient velocity to leave the ground, often called unstick speed.

Another key velocity at takeoff is V2, which is the takeoff safety speed, the speed at which the craft can still be flown after takeoff with an engine failure. Some fighters and attack planes have only one engine, and discussions of V2 with pilots of these craft can lead to hard feelings.

As the lift is generated under the wings, the craft will begin to rise from the strip. Pull back gently on the stick once this begins and continue your ascent at a moderate angle (usually around 10 degrees). Climb too steeply and the craft will stall—that is to say the wing's angle to the air (known as angle of attack) will be so steep that air cannot flow properly around the wing in order to provide lift and the craft will drop from the sky. Be careful, also, that your ascent angle is not too shallow or you risk hitting any nearby structures.

Shuttlebay or Flight Deck Launches

After getting clearance from Primary Flight Control (known as PriFlight), activate your antigravs enough to raise the craft 1 to 2 meters from the deck and then maneuver the craft to the bay doors. After clearing the doors, increase thrust and maneuver to the port or starboard side of the ship, as pre-designated by ship protocols. Do not engage your main engines until you are clear of the bay's forcefield, or you endanger deck crews and other craft working and waiting inside the bay. Once you are clear of the vessel and released for maneuvering by PriFlight, engage your engines and move away. Contact Carrier Air Traffic Control (CATC) for vectors (course instructions) out of the launch area.

Tube or Rail Launches
Some carriers use launch rails or tubes to give aircraft a high initial velocity to clear the carrier quickly and aid in getting craft away as fast as possible (a carrier is at its most vulnerable when launching or recovering craft). These launches are some of the wildest rides Marine Aviators will take: craft can go from zero to 300 kph in less than three seconds and 50 meters.

Ground crew will assist you in taxiing to the head of the launch tube/rail. There you will be instructed to stop while the launch mechanism engages your craft. Once engaged, the launch officer will give you the signal of two fingers of one hand (full power) against the flat palm of the other (under tension). Cinch down your safety harness, salute the deck officer to show you are ready, and put your head back against the seat. The launch officer will return your salute and crouch down and touch the deck, indicating to the tube/rail operator (known as a shooter) you are ready to be launched.

Up to this point, the carrier Air Officer (known as the Air Boss) or the shooter have been able to abort the launch process with the push of a button. But once the operator pulls the launch "trigger", the process is automatic. You are accelerated at high speed and thrown clear of the carrier. Remember to keep your head pressed firmly against the back of your seat, as rapid acceleration sometimes overcomes the inertial dampers' ability to completely neutralize the forces at work. Keep the stick straight until clear of the tube outer hatch. Once clear of the launch zone, PriFlight will give you your initial departure vector and instruct you to contact CATC for further instructions.

Basic Atmospheric Maneuvers

Climbing
To start a climb, increase thrust. Because the difference in the speed (and therefore pressure) of air traveling over the wing and under it increases as aircraft speed increases, lift will increase with speed and you will begin gaining altitude gradually. To climb rapidly, increase your thrust, and pull back on the stick. Don't bring the nose up too far or your craft will stall. To achieve the best climb rate, use full thrust with the nose of your craft at no more than 30 degrees (larger transports may need even shallower angles).

Decent/Diving
To descend without gaining speed, decrease your thrust. The reduced thrust will allow gravity to pull your craft towards the surface. You will gradually lose speed this way, or even maintain a speed if your descent is gradual enough. You can also descend rapidly and gain speed by entering a dive. Maintain full thrust and pull up as you near the surface. Be careful not to dive too steeply—the resulting high speed may leave you with insufficient maneuvering room to pull up at the end of the dive.

Turning
Bank your craft by moving your stick in the direction of the turn and then pull back slightly. This will cause the craft to roll and to turn (the two combined are a bank). The more you bank, the greater the turn rate. However as you turn, you generally lose speed and altitude. Watch these factors to maintain a well-coordinated turn.

Holding and Approach Patterns
Throughout your flight, ATC may direct you into a holding pattern. This is usually a circular or rectangular pattern (with rounded corners) used to space out air traffic

that is getting heavy and too close to one another. A very typical area for a hold is near the destination airfield when there are many planes landing and taking off. Holding aircraft in such a pattern is also known as marshalling.

As you near the end of your flight, you will generally be vectored into an approach or landing pattern that differs at each landing facility and even throughout the day based on weather, traffic, etc. The purpose of the approach pattern is to allow the aircraft to gradually descend and slow down in preparation for landing, and to do it all in a highly controlled airspace to avoid collisions. Once aircraft leave the pattern and head for the runway, they are said to be on final approach, and the very last leg just before touchdown is called short final.

One of Earth's first VTOL jets, the AV-8B Super Harrier, demonstrates the concept of the landing spot. The United States Marine Aircraft is making for a "Spot 9" on board an amphibious assault ship.

Airfield Landings
In the case of craft using VTOL capabilities, the final approach leg will be aligned to a particular marked area in the landing zone (called a spot or pad). Landing involves simply a slow descent to the pad.

In the case of a rolling landing (which should be used whenever runways are available—see takeoffs), it is a matter of a slow decent to the runway threshold, flaring the wings as air speed drops, and allowing the craft to stall and drop the last meter or so to the pavement. Landing glideslope is even more precise than the ascent angle. Try to keep your glideslope around 3 degrees in order to descend in an orderly fashion without stalling.

Carrier Landings
Carriers employ a Landing Signal Officer or LSO to guide approaching craft to a safe landing. Once carrier air traffic control (CATC) has released you from the holding pattern and cleared you for final, you should signal the LSO when you have the landing target (called a meatball by pilots) in sight. Then carefully follow his instructions. For most carrier approaches, the short final is handled by tractor beam and the pilot is simply along for the ride down to the deck.

Wave Off
If there are any problems on the short final, the pilot may initiate or be instructed to perform a wave off. This is sometimes also called a missed approach or go-around. To perform a wave off, apply military power and pull up. Be very careful of your pitch angle here because you are starting out at a low speed and will stall easily. Once clear of the runway or carrier landing zone, contact Approach ATC for vectors back into the landing pattern.

Kicking it Up a Notch

Instrument Flying
When first learning atmospheric flight, you will be under VFR - Visual Flight Rules. The weather will be clear and calm, and you will rely on your eyes for most of your navigation and maneuvering data. And that will probably be the last time you fly mainly VFR in your career.

Much more common to the modern combat pilot is IFR or Instrument Flight

Rules. IFR flights are carried out in conditions where visual cues may be absent, misinterpreted, or deceptive. The most common reason for flying IFR is weather or darkness. Without any horizon for reference (as at night with no moons), the plane's own motion gives you a false sense of down and your senses can no longer be trusted. Instruments must be relied on to determine the plane's position, heading, attitude, etc.

Several flight instruments are standard in the cockpit of an airplane. These include a compass, vertical-speed indicator, altimeter, horizon indicator, air-speed indicator, clock, turn-and-bank indicator, and gyrocompass. Most of these instruments date back to the 20th and 21st centuries. While the look and feel of the instruments may have changed, the need for them has not when performing atmospheric flight. One of the most important instruments is the altimeter. There are two kinds, barometric and radio (or radar). A barometric altimeter displays air pressure, whereas a radio altimeter displays the distance between the aircraft and the ground by bouncing radio waves off the surface of the planet.

Also important is the air-speed indicator. This instrument tells the pilot the Indicated Air Speed (IAS) by measuring the difference between the static air pressure outside the craft and the pressure the craft hits as it flies through a mass of air. However, IAS is not the same as the actual speed at which the craft is moving, the True Air Speed (TAS). The air-speed indicator is affected by changes in temperature and air pressure at different altitudes, thus causing the IAS and TAS to be different. TAS is the speed of the plane in relation to the air through which it is moving, while Ground Speed (GS) is the speed of the plane in relation to the planet. A pilot calculates TAS by comparing the IAS and the outside air temperature. Since air is usually colder at higher altitudes, TAS tends to increase over indicated air speed about 2 percent for every 1,000 feet (300 meters) of altitude. For example, if a plane is flying at 10,000 feet and its IAS is 100 mph, the craft's TAS will probably be about 120 mph. A pilot can use TAS to calculate GS if he knows the direction and speed of the wind. In the above example, with a TAS of 120 mph, if the craft is flying into a 30-mph headwind, the GS will be about 90 mph.

Another good historical example from the 20th century: The Unites States Navy's Blue Angles fly a very tight diamond formation, travelling at almost 400 miles per hour with a mere 1.5 feet between one plane's wingtip and another's canopy.

Formation Flying

Another key skill for Marine Aviators is the ability to fly in formation. A tight formation has several advantages, not the least of which is that two or more planes in tight formation may appear to be only one on long-range sensors. Formations you will learn include echelons (right or left) where planes line up in a diagonal line from the leader; diamond, where a flight of four planes flies in a diamond shape with the leader a bit higher at the front point and the trailing "slot pilot" a bit lower at the rear; and wedge or arrowhead. Many formations are learned, but these are the basics. Emphasis is on your ability to maintain position in the formation and to maneuver with the group en masse.

Advanced Atmospheric Maneuvers

Break

A break is a very tight turn at a high angle of bank. Simply bank hard to one side. Once the craft has rolled 45-70 degrees, apply slight nose up to sharpen the turn. If you should start to lose altitude, increase nose up or reduce your bank angle to raise your nose. A break is useful when you want to quickly change direction. It can be used when you see bandits that you wish to attack, or as an evasive maneuver.

Barrel Roll

When performing a barrel roll, your craft will cut a corkscrew path. To execute a barrel roll, bank sharply in one direction while applying slight nose up. To maintain rotation about the roll axis, Maintain this bank as your craft inverts (at the top of the roll). A barrel roll can be used as a defensive maneuver when the enemy is on your tail. A perfect barrel roll is possible without a loss of altitude, but it is very difficult.

Loop

A Loop is a full 360° rotation in pitch. Gain plenty of speed before beginning a loop (a loop is often preceeded by a dive). Increase thrust to full and apply hard nose up. The craft should be upside down at the top of the loop. Maintain hard nose up and complete the loop, flying level at the end of the maneuver. The craft should be traveling at its initial heading but at a lower altitude.

Immelmann

An Immelmann is a climbing half loop combined with a 180-degree roll. The result is a reversed direction at a higher altitude. At the beginning of this maneuver, your craft should be flying level at high speed. Begin by increasing your thrust and applying hard nose up thrust. As your craft reaches the top of the half loop, it will be inverted. Roll left or right in order to roll your craft till it is upright. Upon the completion of an Immelmann, your craft should be at a higher altitude and traveling in the opposite direction from your initial heading. The Immelmann can be a useful pursuit maneuver when you pass beneath an enemy traveling in the opposite direction. The Immelmann trades speed for altitude.

Split-S

Almost the opposite of an Immelmann, the Split-S combines a half roll with nose up thrust to perform a half loop. First, roll your craft 180 degrees so that the craft is inverted. Then stop the roll and apply hard nose up thrust to execute a half loop, returning the craft to level flight. This maneuver reverses the craft’s direction while losing altitude. Although it can be used to engage an enemy flying beneath you in the opposite direction, the Split-S will greatly increase your speed. The Split-S trades altitude for speed.

Wing Over

In a Wing Over, your craft behaves like a marble rolled up a ramp; gravity draws it back down to the bottom. Begin a steep climb. As the craft nears a stall, use full thrust to yaw the craft either left or right until its nose is pointing down in the opposite direction of the climb. This is a tricky maneuver, but it is useful after a diving attack, allowing a quick return for a second pass.

Scissors

The Scissors maneuver is composed of a series of extreme banks from side to side. You can perform the scissors maneuver by alternating hard rights and lefts. When a target is scissoring, an attacker can’t maintain a steady target lock; and, if the scissoring craft is more maneuverable than a rear attacker, the scissors can slow the target down and force the attacker to pass him.

Skid
A skid appears as a lateral slide with a gradual loss of altitude. While dipping one side, apply opposite thrust to prevent yaw. (Your heading shouldn't change significantly). The craft will "skid" in the direction of the dipped side as altitude is lost. A skid can be used to lose altitude without incurring a large increase in speed or a drastic change in heading.

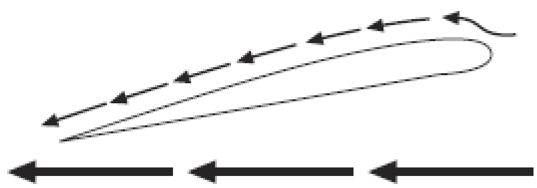
Chandelle
A Chandelle is a slow-climbing turn through 180 degrees. Beginning from level flight, bank to the left or right and gently apply nose up to increase elevation. Don't bank too steeply or you will perform a break turn (and lose altitude). Maintain this rising turn until you have turned 180 degrees. When you have completed this maneuver, you have reversed direction and gained altitude.

Hazards

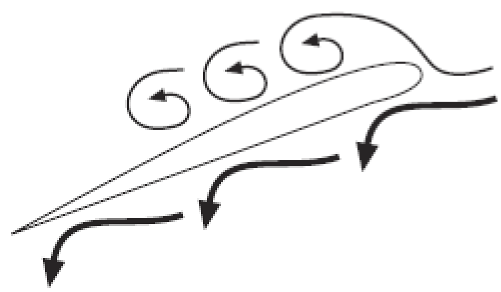
There are many dangers inherent to aerospace flight, some of which are universal and some apply only in an atmosphere. Some of these may require the pilot to eject or "punch out", while others can be successfully corrected by pilots when they occur. For more information on ejection systems, please refer to the Arms and Equipment Manual.

Stalls

Normally, the shape of the wing makes the distance over the top longer. Air must travel faster across the top, creating lower air pressure and thus lift.



If the wing meets the air at a steeper angle of attack, the distance over the top is made even longer. The air travels faster and lift is increased.



If the wing meets the air at too steep an angle, the air burbles. This causes a decrease in lift. The plane stalls and loses altitude rapidly. Most Marine aircraft equipped with a "stickshaker" that vibrates the joystick when the craft is nearing an aerodynamic stall.

A stall is caused when you increase the angle of attack on the wing, usually by pulling up sharply on the nose of the aircraft. Airflow strikes the bottom of the wing and is disrupted too much to generate lift, causing the aircraft to fall. The pilot must force the nose back down, then attempt to level the flight to begin developing lift under the wings again. All of this takes time, which is why low altitude stalls usually result in a crash.

Spins

A spin is an aggravated stall that occurs when one side of the aircraft stalls before the other. Normally this happens when a craft is maneuvering near the critical angle of attack and then stalls, as in a steeply banked turn. The stalled side will lose lift and drop, while the lift and drag on the other side will induce the craft to rotate. The result is a corkscrew descent, which may turn into a "flat spin" where neither wing is able to generate any lift and the control surfaces are unable to influence the craft's attitude. Once a flat spin occurs, it usually results in a crash, as the pilot is unable to get the nose down and regain lift. Pilots are trained to take immediate action in the case of a spin in order to prevent a flat spin. Most Marine Aerospace Craft are also equipped with spin-recovery systems to aid the pilot in getting the craft back under control.

Normally, the shape of the wing makes the distance over the top longer. Air must travel faster across the top, creating lower air pressure and thus lift. If the wing meets the air at a steeper angle of attack, the distance over the top is made even longer. The air travels faster and lift is increased.

If the wing meets the air at too steep an angle, the air burbles, creating turbulence. This causes a decrease in lift. The plane stalls and loses altitude rapidly. Most Marine aircraft equipped with a "stickshaker" that vibrates the joystick when the craft is nearing an aerodynamic stall.

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

FOD
Foreign Object Damage, or FOD, refers to an object striking and damaging the aircraft. This is usually along the leading edge of a lifting or control surface. This destroys the aircraft's ability to generate lift, resulting in a crash if antigravs cannot be engaged in time. Other times it may mean an object striking the canopy, blinding the pilot by shattering the windscreen or penetrating to injure him. Aircraft are particularly vulnerable to this during takeoff/landing, when speed and lift must be carefully controlled. Ground fire, birds, and debris (including tools left in or around the aircraft by careless technicians) can all cause FOD.

Airframe Failure
High stress maneuvers can cause an aircraft to stretch, distort or simply come apart under the strain. Obviously, this leads to bad things.

Blackouts, Redouts, and Grayouts
High speed dives force blood towards the top of the pilot's body, causing his vision to "red out" as he is forced into unconsciousness by blood pressure. The opposite occurs during high-speed climbs, like the pull out at the bottom of a steep dive. Blood is forced towards the pilot's feet, causing him to "black out" from loss of blood pressure to the brain. High speed turns and rotational movements can cause a similar effect, known as a "gray out", where the pilot doesn't lose consciousness but is dazed and incapable of taking effective action to regain control of the aircraft, sometimes for several minutes. This is less of a problem with modern inertial dampening fields, but in high speed aerospace maneuvering~~,~~ the effects of inertia and gravity can still be felt. Twentieth century pilots wore flight suits that inflated and deflated to limit the blood flow to and from the upper and lower portions of the pilot's body~~,~~; the modern MAST system uses a force field in the seat to accomplish the same thing.

Accident Causes

While the Corps has an outstanding safety record, accidents still happen. Flying is potentially dangerous, even in peacetime. However, studying the causes of accidents in flight school allows pilots to be prepared to face them in the real world. The basic causes of aircraft accidents can be broken down into five general categories: Battle Damage, Crew Factors, Weather, Collision, and Maintenance Deficiency/Mechanical Failure.

An A-18 wing with a direct hit all the way through. Incredibly this Harrier made it back to its base. The damage had cut the power supply to the port antigravs, so the pilot was forced to make a rolling landing. Fortunately, the landing gear was not affected.

Battle Damage

Battle damage causes the majority of aerospace craft damage and losses during combat operations. The engineering of SFMC craft and the training of their crews focus heavily on avoiding and preventing this damage, as well as responding to it. SFMC aerospace craft can really "take a beating", but there comes a point when damage is simply beyond the airframe's ability to cope. This is when the ejection pod becomes paramount in importance.

Crew Factors

Once known to Terrans as "human factors", crew factors account for an average of 70% of aircraft losses in peacetime. "Crew" refers not only to the plane's aircrew, but also to ground crew, ATCs, chain-of-command, and anyone else with influence over the final outcome of the craft's flight. Most accidents and damage resulting from crew factors can be broken down into the following types.

Cascade Errors

The lion's share of crew factor accidents result from a chain of events involving more than one mistake/error/bad decision. The "culminating error" that immediately precedes an accident is often where the public points the blame but a good accident investigation considers all the events leading up to the culminating error as well.

Pilot Judgment Errors

Errors made by the aircrew in either normal operation or in responding to an emergency are not typically errors in airmanship. Much more likely are errors involving decisions rather than the actual handling of the aircraft. Many factors can affect a pilot's decision-making, especially the stress of combat or of responding to an emergency situation.

Distractions

There may literally be dozens of things all simultaneously vying for the pilot's attention. In this environment it is actually surprising that distractions don't contribute to more accidents than they do.

Cockpit Discipline

Errors in cockpit discipline result from a breakdown in procedures and practices, complacency, boredom, frustration, etc. In Marine Corps aviation, these are the least frequent errors thanks to the rigorous training aircrews undergo, and the high degree of standardization between aircraft.

Weather
Meteorological conditions on planets with atmospheres present the second greatest danger to pilot's in peacetime. Turbulence, wind shear, icing, thunderstorms, microbursts, and other conditions challenge pilot and autopilot alike. The best defense is training and the most accurate forecasting possible.

Collision
Thanks to modern collision avoidance systems like CATS (the Collision Avoidance and Traffic System), midair collisions are relatively rare with modern aerospace craft. Highly qualified ATCs and associated equipment help tremendously. However, problems do still occur. The majority of midairs happen around air bases and carriers where there are a large number of craft taking off and landing in a small area. Another common source of "midairs" (even though there is no air around) are collisions during docking in space. These are typically low-speed collision but serious consequences can easily result from these accidents.

Another type of collision, with the ground, has also been reduced greatly with the help of terrain avoidance systems like TAS/GPW (Terrain Avoidance System/ Ground Proximity Warning). Still, "controlled flight into terrain" (CFIT) incidents are still possible when the craft's speed is such that it cannot adequately respond to TAS warnings before collision. Also, collisions may happen in combat or training scenarios when CATS and TAS are switched off due to operational considerations.

Maintenance Deficiency/Mechanical Failure
Thanks to the SFMC's rigid maintenance programs and the exhaustive training and certification required of Marine ground crews, few accidents or incidents can be attributed to maintenance deficiency these days. Mechanical failures, however, still play a role in aircraft accidents. Thanks to sophisticated computer diagnostics, though, their role has been drastically reduced. Despite what the general public sees in the media, mechanical failure today causes less than 2% of all aircraft accidents (and maintenance deficiencies less than 1%).

The SFMC Aerospace Combat College (Black Flag)

"In 2198, when we fought the early Klingon Aerospace Corps, we had a kill ratio of nearly thirteen to one. That is to say that we shot down thirteen Klingon pilots for every one of ours we lost. By the time we fought the Cardassians in 2350, that ratio had fallen to only three to one. Our pilots had lost their dogfighting skills, relying more and more on missiles and other 'smart weapons'.

To address the problem, and to make our pilots the best in the Galaxy, the STARFLEET Marine Corps established this Aerospace Combat College. Black Flag, as it is commonly called, exists for one purpose: To teach you how to engage other aerospace craft and win. You men and women are the best the Aerospace branch has to offer, but we will make you better.

For the next five weeks, you will fly against expert pilots. Veterans. Aces. Each with thousands of hours of flight time, each with at least five real world kills. All of them flying equipment that closely matches threat vehicles you will meet in the real world. You will die many times here, in practice, so that you won't have to in the real world. Welcome to Black Flag."

--Colonel Martin F. Shaeffer, callsign "Assassin"

Advanced Combat tactics and techniques are taught to fighter and attack pilots at the Black Flag facility, which resides in a secluded and remote area of Twenty-nine Palms. Originally formed to teach Aerospace Combat Maneuvering to fighter pilots, Black Flag now also teaches advanced tactics to attack pilots through its "Black Flag-Strike" program.

Aerospace Combat Maneuvering

The actual sequence of high or low speed sublight maneuvering in fighter combat is referred to as Aerospace Combat Maneuvering, or ACM. In ACM, you will conduct 95% of your maneuvers at sublight speeds (in space) and subsonic speeds (in an atmosphere). This is because the ability to turn inside your opponent's maneuver and bring your weapons to bear is the most important facet of a dogfight, and high speed equals a larger turning radius. Remember, speed is for getting to and from the fight, maneuverability is for winning it.

Critical Concepts

The Wingman

Defensively speaking, in combat~~,~~ two heads are better than one. A wingman is there to keep the enemy off your tail and to help you spot things you might otherwise miss in the confusion of combat. Likewise, you are there to protect your wingman~~,~~ and help him spot things he might miss. Never, ever, leave your wingman in combat. The odds of surviving a dogfight alone~~,~~ against two or more enemy opponents is very low. Having a wingman raises those odds by more than double.

The "Loose Deuce"

Normal procedure for a combat air patrol (CAP) is to operate in two teams of two craft each, or a "pair of pairs". The two teams fly the patrol separated by several kilometers between themselves (just at the limit of visual range). The lead flight is slightly ahead of the trailing flight~~,~~ by a distance of a half-mile or so. This is known as the "Loose Deuce" because it allows the maximum amount of maneuvering space between the teams if they have to engage an opponent while keeping each other in supporting range of the other team.

SAM Dancing
The Surface-to-Air Missile (SAM) is the most common defense available to enemy ground forces, since it is cheap, easily produced, and fairly lethal to aerospace craft. Direct fire energy and projectile weapons also pose a threat, but the SAM is far more often seen. There are two methods of dealing with a SAM.

First, given enough time and a SAM that is approaching from the front angle of view, you can engage it with your direct fire weapons. Modern targeting systems and rapid fire weapon systems make this possible, although more advance SAMs will attempt to evade your fire as they close the range. Second, if the SAM is launched at you from below or behind your aerospace craft, wait until it is almost to you, then break hard right or left away from it while activating your countermeasures. Aerospace craft are almost always more maneuverable than a SAM and, combined with chaff or flares, this move will break the lock on your vehicle, causing the SAM to miss. Timing is critical to effectively execute this maneuver, as too early will give the SAM time to adjust its trajectory and too late will mean a hit.

Erratic Maneuvering (EM)
Rapid and random changes of attitude, heading, and speed make it hard for enemy gunners to predict where a fighter will be at any given moment, and therefore make it difficult to bring weapons to bear effectively. EM is most often used while approaching or leaving a target, while the fighter's weapons are unable to engage the enemy (out of range, out of ammo, etc.). This is because EM makes it impossible for a fighter to bring its own weapons to bear effectively against the enemy. Erratic maneuvering is also known as "jinking" in some circles.

Historical ACM Engagement
In the early twentieth century air-to-air combat consisted of getting close enough to shoot at the enemy with machine-guns mounted in the nose or wings of your aircraft. Because of the limitations of the ammunition available at the time, you had to get very close to your opponent in order to hit him, sometimes as close as a few hundred feet!

By the end of World War Two, cannon had replaced most machine-guns, increasing the effective range of attack to almost a thousand yards. Primitive rockets and missiles were developed and soon became advanced enough to replace aircraft guns as the primary method of engagement. Guns never quite became obsolete, as they were reliable and deadly at close range—and you almost always ran out of missiles before you ran out of ammo for your cannon.

Modern ACM Engagement
A typical modern aerospace engagement can be broken into five phases, each with a definite purpose and method. Here we'll walk you through a typical engagement, phase by phase, and cover some of the important problems and concepts of each one.

- **Acquisition/Identification of targets -** Acquisition and identification of targets is the first step of an engagement. The rules of engagement for SFMC pilots prohibit firing long-range weapons on unidentified targets. The unidentified sensor target that is approaching your flight could be anything from a genuine threat to a curious local citizen. It is even possible that the other aerospace craft hasn't detected you yet since most civilian sensors are less capable than our military ones. You have to know what you are shooting at before you launch an attack. However, it isn't as easy as it sounds. There are three major things that complicate the identification process.

- **Shadowing -** Sometimes a single sensor signal is actually two or more craft flying very close together. This makes it difficult for an observer to distinguish the separate signals, making it appear as if only a single vehicle is approaching. Once the signal gets closer, it suddenly breaks apart to reveal separate threats. This technique is known as shadowing, and is also used to conceal smaller vehicles alongside a larger one, as in certain pirate raids against convoys.

- **IFF Problems -** While IFF (Identification, Friend or Foe) transponders make identification in combat a great deal simpler, they also have their limitations. Most importantly, IFF transponders can be reprogrammed by individuals with the time and equipment. Multiple code IFF units can be built, allowing the user to select any of a number of "false IDs" to be sent out. Which means the IFF signal you are receiving could be the daily mail shuttle arriving or an Orion Commerce Raider moving into weapons range.

- **Background clutter -** In certain terrain, especially in a planetary atmosphere, sensors may have difficulty in correctly or effectively identifying targets. This is especially true at low altitudes and around concentrations of certain kinds of ores. High-density asteroid fields, areas of strong energy fields, and even intensive energy weapons fire can seriously reduce a sensor's ability to detect targets.

- **Seeking Weapons Volley, Long Range -** Once you identify a threat and you are authorized to engage it, do so at the longest possible range. With modern systems, this can include targets that are beyond visual range (typically greater than about 40 km). This usually means using seeking weapons such as missiles or torpedoes. Enemy craft will also seek to engage you at the maximum possible range, using whatever form of seeking weapon they are equipped with. Modern self-guided weapons come in a variety of styles and characteristics. Longer-range missiles (such as the AA-L-691 Indra) will be launched first, followed by those with shorter range (such as the AA-R-829 Lei Gong). Missiles are very cost effective, as an inexpensive missile is quite capable of destroying a valuable pilot and his aerospace craft. They also deliver the same amount of damage when they hit, unlike energy weapons, which are affected by range and medium. However, missiles can also be shot down or affected by countermeasures.

- **Energy Weapons Volley, Medium Range** - Once you close the range enough that your direct fire energy weapons can effectively bear, engage the enemy immediately. Energy weapons are superior to seeking weapons in that they have zero flight time. They damage the target as soon as you trigger them, assuming your aim is good. There are three disadvantages associated with all energy weapons. The first is that if you have a limited endurance vehicle (such as an aerospace craft using a charge pack), they will deplete your energy reserves a little each time you fire. This fact discourages pilots from indiscriminately "hosing the sky" with their beam weapons. Secondly, all energy weapons are "range of effect" weapons, which means they do less damage the farther away the emitter is from the target. Finally is the "tracer effect" of the beam lancing across the sky, which calls everyone's attention to the source of the beam……you.

- **Close Combat Maneuvering -** Once you have reached visual range, it gets fast and brutal as vehicles maneuver to bring weapons to bear on each other. Close combat maneuvering is characterized by low speeds (subsonic in the atmosphere and sublight in space), constant maneuvering (especially turning) and point-blank weapons fire. Pilots call this "dog fighting" and it is where pilot skill has the most affect on survival. Long considered obsolete, projectile weapons have returned to common use among Tactical aerospace craft, and usually take center stage in CCM. In fact, the distances usually involved in CCM are commonly referred to as "gun range." The M-437 Light Cannon is accurate, reliable, requires a minimum of energy to operate, and delivers a powerful punch. They can carry a lot of ammunition as well, which gives the craft more endurance in a fight.

- **Disengagement -** At some point in a dogfight, you are going to want to leave. This is called disengagement and may occur because you have been attacked by overwhelming forces, your craft is low on fuel or ammo, or simply because you have more important business elsewhere.

  The first thing you have to do is clear any pursuit on your tail, using whatever maneuvers will accomplish that. Second, you have to be able to travel faster than anyone who would wish to pursue you. If you can't outrun the enemy, you are not going to be able to disengage—unless you destroy the enemy (and then he certainly can't outrun you, now can he?). Even if you can outrun them, you may not be able to outrun their seeking weapons. Be prepared to employ countermeasures as you extend the range between yourself and the enemy since they often cannot resist a "parting shot" at your vehicle.

ACM & Strike Tactics

Most tactics in aerospace combat are fairly obvious; it is just a question of choosing the correct maneuver for any given point in the engagement. Some of the more important tactics are listed below.

The Yo-Yo

Named after a simple child's toy, the Yo-Yo is an attack pattern commonly used by interceptors against an unknown target. The attacker flight angles their path directly at the enemy, passing through their formation from lower to higher altitude. As soon as the attacking flight clears the enemy formation, they execute an Immelman turn and pass back through the enemy on a course approximately 180 degrees from their original. Done properly, this gives the attacking flight one excellent weapons pass, followed quickly by another (usually guns only) pass through a disorganized and scattering enemy formation.

The Iron Cross

Four aerospace craft working in tandem perform this maneuver, usually as a ground attack mission. Two aerospace craft can do it, but it is risky, as neither has a wingman to help if unexpected enemy aerospace fighters are encountered. Approaching the target area, but before they enter enemy scanning range (or maximum range of enemy weapons believed to be in the area) the team splits into two separate groups. One approaches at low altitude from one direction, while the second group approaches from a direction 90 degrees perpendicular to the first. Their attack runs are timed so that the second group passes over the target 15 to 30 seconds after the first group.

This accomplishes three things. First, the target area is hit from multiple directions, making it difficult to determine where the attackers are coming from (and which way they are going when they leave). Second, the explosions from the first pass will be subsiding so they do not damage the second flight, and may allow the second flight to select targets that survived the first strike. Third, defenders that survive the first attack and remove themselves from cover to fight fires, assess damage, man defensive weapons, etc. are caught in the open by the second wave of ordnance. This is particularly useful in the suppression of air defenses. Weapon emplacements and SAM launchers that survive the first attack and then expose themselves as they fire on the departing flight are destroyed by the second flight's attack.

Improvised Tactics

In desperate situations, desperate solutions are sometimes necessary. The SFMC does not endorse these high-risk maneuvers but they have worked on occasion in the past so we have included them here.

Threading the Needle

In any kind of congested terrain, such as asteroid belts or extremely low altitude atmospheric flight, there are lots of things that can damage or destroy an aerospace craft. Leading an attacker through a high speed, high-risk chase through such obstacles can result in the poorer pilot crashing. It definitely takes skill, nerve, and desperation to attempt such a maneuver at maximum speed.

Brake Check

More effective against traditional atmospheric craft, this maneuver can also be employed against lower quality pilots and equipment. Simply put, the defender uses his thrusters, antigravs, or maneuver drive and inertial dampers to drastically decrease speed. This causes the unwary or inexperienced pilot to overshoot, placing them in the defender's weapons arc for a quick shot. Unfortunately, against a skilled pilot or one with better equipment, this maneuver fails, leaving you helpless in the attacker's weapons arc, and at low speed. This just about guarantees your destruction.

Carrier Air Operations

A brief overview of the complexity and coordination involved in Carrier Air Ops always proves interesting to new Branch members, so here we will cover the basics steps of launch and recovery operations.

The Air Boss

The Carrier Air Officer is known as the Air Boss and has ultimate responsibility for all aircraft, launch, and recovery operations on board. He occupies a cramped, crowded station in a raised platform on the flight deck (known as Primary Flight Control, or PriFlight) from where he may survey flight operations. He and his assistant ("Lil' Boss") are always veteran Naval or Marine Aviators.

Launch Operations

Launch operations get aircraft off the carrier and into space as rapidly as possible. Three lights on the PriFlight tower signal to the flight deck when launch operations begin. An amber light illuminates one minute prior to the first launch. Great emphasis is placed on lighting the amber exactly on schedule. A red light replaces amber at the 15-seconds-to-go mark. At precisely the appointed time, the green light illuminates and the first plane is launched.

FOD walk down
Prior to any air ops, the Boss will call "All hands on the flight deck, heave to for FOD walk down." All the deck crews form a line across the shuttle bay or across each launch tube, and walk from one end to the other, constantly scanning the deck for any loose material that might be kicked up by antigravs or thrusters, potentially causing damage to aircraft, deck equipment, or personnel.

Start 'Em Up
Prior to the FOD walk down, the aircraft have been arranged on deck so as to permit them to taxi to their assigned launch tube or bay door in the proper order. This task is accomplished by the Aircraft Handler (sometimes referred to as the "Mangler"), who runs several computer simulations to show the best order and positioning of aircraft to accomplish the day's air objectives. Once the walk down is complete, the Air Boss calls for a clear deck and gives the signal to start engines. Non-essential crew clear the flight deck, and plane captains set cockpit switches and warm up engines for their pilots. Soon the deck is engulfed in the sound of whining antigravs, warming fusion systems, and humming charge packs. Speech soon becomes impractical. All communications are conducted via helmet communicators and hand signals.

Pilots climb into their aircraft and shake hands with their plane captain. The plane captain takes up position at the nose of the aircraft and, using hand signals, takes the pilot through a preflight check of all control surfaces, running lights, and sensor systems. Pilot and plane captain work together to assure the craft is flight worthy. When preflight is completed, the plane captain signals the chock and chain man to release the wheels and symbolically hands the plane over to the aircraft director in that deck area who will direct the pilot to taxi to his launch position using hand signals.

The Dance on the Deck
On ships without launch tubes or rails, aircraft launching is fairly straightforward (see "Flight School"). However, there is a complex choreography to the deck crew's launch preparations known as "the dance on the deck" when launch tubes or rails are used (the launch mechanisms in both are the same, the difference being that tubes are compartmented from each other with bulkheads, while rails are aligned in the open on the flight deck). Preparatory to launch, the aircraft must taxi to its assigned launch position. The launch area aircraft director (known as a "yellow hat") will guide the plane to the waiting spot, which is just behind the blast deflector at the head of the launch tube. Once he directs the plane to stop there, he turns to the launch officer, salutes, and ends his salute by pointing at the launch officer, meaning, "you now have responsibility for this aircraft." Once the launch officer acknowledges the salute, the yellow hat then walks back to the taxi area to take responsibility for moving the next plane.

As the plane waits to move up to the head of the tube, two white-shirted safety "checkers" (complete with checkered helmets) will inspect the plane one last time for any potential "safeties"—issues that affect the safety of the plane or launch operation. As the plane moves up to the launch spot, the checkers walk with it, sometimes crouching under wings or stabilators, looking for leaks, control movement, structural deficiencies, etc.

Once they give the thumbs-up, a "hookup man" in a blue shirt with a yellow helmet runs forward, hunched over, and kneels beside the nose. He looks over to the launch tube control panel where the "shooter" sits. The shooter will raise one finger over his head to show "ready on the tube". He will then look at the launch officer (who normally has responsibility for a pair of tubes, so it is vital to gain his attention before proceeding) who will raise the finger on the same side of him as the tube to show "I'm ready too."

The hookup man then engages the tube launch mechanism by entering a code on a panel near the craft's nosewheel door. This sets up a dedicated data link between THIS plane and THIS launcher. Once completed, the hookup man will hold his hands over his head with fingers interlocked to signal the plane is engaged with the tube. The shooter will answer by holding both his hands high in the air to show he is clear of the control panel and will remain so until the hookup man and checkers are clear. The hookup man makes a whirling motion with his hand and points forward (ready to go) as he runs clear of the craft.

Once all deck personnel are clear of the aircraft, the shooter will raise the blast deflector behind the plane and engage the holdback field. If the landing gear is down, it is now retracted as a force field slightly lifts and suspends the plane at the mouth of what is essentially a magnetic launcher similar to a photon torpedo launcher. The shooter whirls his hand and points to the launch officer who is in a protected enclosure in view of the pilot.

Once at the proper launch height (normally not more than a meter), the launch officer will begin to wave/rotate two fingers in the air, which tells the pilot to bring his engines up to military power. This is the reason for the blast defector, which traps the exhaust and spares the deck crews from the force and heat of the engines. When full power is reached, the launch officer will hold his two fingers against the palm of the other hand to indicate full power under tension (the holdback force field keeps the plane from moving even at military power).

Seeing the signal of the launch officer, the pilot salutes to show he is ready to leave the ship. The launch officer returns the salute and crouches down and taps the deck. The shooter checks one more time behind the plane, then down the launch tube to make sure the launch area is clear. It is only then that the shooter reaches for the launch trigger that simultaneously releases the lifting field and starts the launching superconductors which essentially throw the plane out the outer hatch.

Even as the plane is still speeding down the launch tube, the blast deflector starts to drop and the launch officer begins to direct the next plane up to the launch area, the checkers walking hunched down along its sides, ready to start the dance all over again.

Launch Order and Rate

The launch process, which may involve as few as two or as many as 50 going off as many as ten launch tubes, is carefully planned in advance and unfolds rapidly. To avoid dispersing craft too much, a carrier must remain on a relatively slow and steady course during launch and recovery, making it very vulnerable. Therefore, the faster the planes can be launched, the better. Large "supercarriers" can launch their entire air wing in only a few minutes.

Typically, the first aircraft to launch will be an MT-39 Valkyrie II to serve as search and rescue craft should any other craft get in trouble during the launch process. The MT-39 will take up a station-keeping position near the carrier. Next up is sometimes an E-39 Explorer to scout out ahead of the rest of the air group to sense targets and threats for them. Fighter escorts follow to protect the E-39. The rest of the launch order is dependent on the mission.

Launch Alerts
Sometimes, aircraft will be placed on special standby modes called "alerts" based on anticipated air action. A "ready alert" is usually a two-plane interceptor team that sits on the launch tubes with crews at the controls for the duration of the alert. When not conducting other air ops, at least two fighters are on ready alert at all times. Pairs of fighters usually take one-hour shifts at the head of the launch tubes with their crews just sitting in the cockpit waiting. Should defense of the carrier become suddenly necessary, the craft can be launched in seconds.

Other alerts are characterized by the amount of preparation needed. Typical alerts are a "15 minute alert" and a "30 minute alert", which means the craft assigned to the alert force, and their crews, must be ready to launch in the specified time. This usually means crews sitting or even sleeping on or under their aircraft while they wait.

Landing Signal Officer
PriFlight and launch officers control launches, but recoveries hinge on the LSO, or Landing Signal Officer. The LSO is an experienced aviator, usually from the landing aircraft's own squadron. He observes the approach of the craft on the master recovery LCARS display at the LSO station near the shuttle bay. From here he can direct pilots accurately with suggestions on course changes and approach methods. Good communication skills are critical for an LSO. A good LSO anticipates problems and offers solutions probably at the same time the pilot thinks of them. Seeing a trend toward a rapid approach, a good LSO might say, "Don't get fast," or, "Ease power." A bad LSO might say, "You're too fast." The pilot feels insulted and an adversarial relationship is initiated.

Recovery Operations
At the other end of air ops are craft landing back aboard the carrier, known as recovery. Depending on the facilities of the carrier, craft may be launched and recovered simultaneously.

Final Approach
The eye of the LSO is uncanny. From his little box next to the shuttle bay, he can look through his porthole and see, even at extremes of visual range, whether or not the pilot is lined up properly to take the landing tractor beam. He guides the pilot in with instructions to make sure he is lined up on the "meatball", the visual landing target that, if followed by the pilot, will guide him into the "funnel". The funnel is the imaginary cone representing the limits of operation of the landing tractor beam.

If the pilot is inside the funnel once he gets within tractor range, he has made a "trap". He can shut down his engines and the beam will pull his craft into the shuttle bay. If he is outside the funnel, he has made a "bolter" and must go around for another try. If his approach is unsafe, the tractor beam is not working properly, or the deck is not ready to receive another aircraft (called a "foul deck"), the LSO hits a "pickle switch" that he holds in his hand. This turns the meatball flashing red, indicating a wave off to the approaching pilot.

Landing Grades
Each landing is graded by the LSO based on the quality of the approach and the distance from the operational center of the tractor beam the plane is when the beam engages. A smooth approach at proper speed that is right down the center of the funnel is graded simply as "OK." An unsafe approach with gross deviations gets a "C".

Deployment

Deployment of Pilots

Once Ground and Flight Schools are over, pilots will be assigned to a squadron for deployment. New pilots are generally distributed evenly throughout active squadrons so that no one squadron has too many new pilots. While deployed, pilots are constantly evaluated, trained and retrained. In addition to their flying duties, pilots also are assigned secondary squadron jobs such as safety officer, logistics officer, etc. There are few officers in the branch who are not pilots, so secondary duties come with the job.

Black Flag Selection

When fighter or attack pilots reach a level of professional proficiency, they can be recommended for Black Flag. Black Flag graduates are expected to return to their squadrons to share what they have learned, and thus pass on the advanced training to other pilots who do not merit Black Flag.

Black Arrow Selection

Fighter or attack pilots that have excelled in airmanship and teamwork may be selected for the SFMC's Flight Demonstration Team, the Black Arrows. The Arrows operate two squadrons—one that makes appearances within the Federation on member worlds, and one that travels to foreign systems as ambassadors of good will. Each squadron flies a total of ten craft (eight of which are flown at any particular show). A tour in the Black Arrows is typically two years, which consists of one year as the domestic team, then one year as the international team (the squadrons interchange en masse). Former Black Arrows return to squadron duty, again to pass on their specialized training and experience.

Squadron Deployment

Marine Squadrons can be land based or ship-based, and it is normal for squadrons to be rotated through these two duties on a regular basis. Squadrons are deployed and redeployed en masse to maintain operational integrity. While it is quite normal for pilots and crews to change squadrons after one or two years, it is also not uncommon for a pilot to stay with a squadron for much longer. A few pilots have served their entire career with one squadron.

Carrier Deployment

Most ship-based Marine aviation is carrier-based. When assigning SFMC aerospace units to STARFLEET vessels, the Federation has followed the following distribution pattern. All vessels that are capable of carrying aerospace craft are divided into four broad categories. These categories are derived from a number of factors like the vessel's primary mission, launch and recovery facilities, storage space, and crew capacity. These categories are known as True Carrier, Casual Carrier, Auxiliary Carrier, and Station.

- **True Carriers -** True Carriers are vessels designed to carry and deploy large numbers of small craft, either as fighters or transports. Good examples of this type of vessel include the Frederickstad, Gabriel, Archangel, and Alaska classes. True Carriers are generally assigned from 1 to 3 wings of aerospace craft. Included in this category are "amphibious assault" ships, which carries both drop ships and escorting craft. Examples of this type of ship include the Normandy class. True carriers are the most likely to employ launch tubes or rails.

- **Casual Carriers -** Casual Carriers are vessels that have extensive cargo or shuttle space, which may be easily converted into launch and recovery areas for aerospace craft. Good examples of this type of vessel include the Galaxy, Galaxy II, Entente, and Qapla' classes. Casual carriers are generally assigned from 1 to 3 MAGs of aerospace craft.

- **Auxiliary Carriers -** Auxiliary Carriers are vessels that are not primarily intended to act as Carriers, which may have all or some of their complement of small craft replaced with aerospace craft. These tend to be mission specific replacements, although there are several vessels that have put their fighters to good use and chose to retain them. Some examples of vessels that fall into this class are the Nebula, Ambassador, and Oscar classes. Auxiliary Carriers are generally assigned one or two squadrons of aerospace craft.

- **Stations -** Starbases and stations have aerospace craft assigned to them based upon their location, size and general mission. An Ournal class space dock, for example, is one of STARFLEET's largest stations and may have a dozen Wings assigned to it, particularly if it is positioned in some place of military or strategic value. Pioneer class space docks, which are two-thirds the size of the Ournal, will have a much smaller number of aerospace craft assigned, perhaps as few as two Wings. This is primarily because the space available for pilots to live aboard the space dock is much less than other station types.

Planetary Deployment
The number of craft assigned to a planet will vary widely. The defensive needs of each planet, its population size, the number of facilities of strategic value and the overall STARFLEET presence will affect the deployment of units greatly. As a general rule, there will be at least one Squadron assigned to every planet, above and beyond any planetary defense forces that may be available. This unit often has the dual task of defending the planet against invaders and training local planetary defense pilots as well.

Permanent SFMC Aerospace facilities on planets fall into four broad categories, which include Marine Corps Aerospace Training Center (MCATC), Marine Corps Air Station (MCAS), Marine Corps Airfield (MCA), and Marine Corps Aerospace Range (MCAR).

- **MCATC's -** MCATC's are the largest planetary aerospace facilities and include both training and regular wings. Each of the three commands has their headquarters at a different MCATC. Ground School, Basic Flight School, and Black Flag, as well as the Aerospace Branch's arm of the Training and Doctrine Command, are headquartered at MCATC Twenty-nine Palms on Earth. The Air Combat Command and the ACC Advanced Flight School are headquartered at MCATC Choc'Tau on Andor. The Space Combat Command and SCC Advanced Flight School are headquartered at MCATC Canberria on New Valley Forge IV. The Aerospace Mobility Command and AMC Advanced Flight School are headquartered at MCATC Tsing-Ta on Vulcan.

- **MCAS's -** Permanent planetary aerospace bases with no training wings are usually categorized as Marine Corps Air Stations. Since these are planetary bases, usually on Class M worlds, the use of the more traditional "Air" is used. The vast majority of SFMC planetary aerospace facilities fall into this category.

- **MCA's -** Small permanent planetary aerospace facilities, or temporary ones of any size, are referred to as Marine Corps Airfields. MCAs have ground support facilities and ATC on site.

- **MCAR's -** Marine Corps Aerospace Ranges are temporary or permanent facilities dedicated to training exercises, but without permanent ground support or ATC. For instance, MCAR Venus stakes out an Australia-sized airspace straddling Venus' equator, but there are only four runways there used for touch-and-gos (practice landings and takeoffs), no hangars or support equipment, and ATC is handled by Earth's Antarctica Traffic Control.

Appendix A - Glossary

Here is a list of common terms, abbreviations and acronyms that appear in this manual. There may be some references to terms that are common to the SFMC but are not listed in this glossary. Those terms should be listed in the Marine Force Manual or in other relevant Branch Guidebooks.

Ablative - Any material that heats up when energy is applied to it, then burns away, taking part of the energy applied to it away as it does so.

Aerospace - A planet's atmosphere and the space outside of it, considered as one continuous field. Also, things that are designed for flight in aerospace.

AG - -Abbreviation for Antigravity or Antigrav.

Airfield - A planetary installation whose primary purpose is the launch and recovery of aerospace vehicles.

Airstrip - A planetary takeoff and landing point for aerospace craft, especially tactical aerospace craft.

Antiaircraft - Any ground based weapon system that is used to shoot down aerospace vehicles. This is most often missiles and directed energy weapons, but can refer to any weapon system that is capable of reaching and then damaging aerospace vehicles.

Antigrav - Short form of Antigravity.

Antigravity - Method of lift that uses an antigraviton generator to counteract the local gravitational field. Antigravity units are common in the 24th century, and form the basis for most forms of transportation within an atmosphere. They are sometimes unreliable in areas of high radiation.

Antipersonnel - Anything designed to negatively affect personnel, whether to hinder their movement or physically harm them.

Antivehicular - Anything designed to negatively affect vehicles, whether to hinder their movement or physically damage them.

AP - Abbreviation for Armor Piercing or Antipersonnel, depending on the context in which it is used.

Armor - Any physical substance used to shield or protect an individual or object.

Attack - Type of aerospace craft used by the SFMC. Fighters are designed to engage other fighters, while attack craft are designed to engage ground targets and starships. Attack craft carry heavier weapons and are less maneuverable than fighters. Can be considered the 24th century equivalent to "Bombers" or Close Air Support craft.

AV - Abbreviation for Antivehicular.

Azimuth - An angular measurement, used to locate a star or other object. Something that is bearing 90 degrees from yourself can be said to have an azimuth of 90 degrees.

Ballistic - A weapon that relies on some form of physical projectile to damage the target, either through kinetic energy (like a bullet) or through the use of explosive warheads (like grenades and missiles).

Ballistics - A field of physical science that deals with the behavior, performance and effectiveness of projectiles.

Bandit - Slang for known enemy aircraft.

Bank - Basic maneuver used to turn your aerospace craft to one side or the other.

Barrel Roll - Advanced maneuver where your aerospace craft rotates along its centerline, without changing heading.

Beam Phaser - A phaser that fires a continuous energy beam, rather than short rapid pulses.

Bearing - A measurement of an object's relative direction from your craft.

Bernoulli's Principle - This principle states that when a fluid flowing through a tube reaches a constriction or narrowing of the tube, the speed of the fluid passing through the constriction is increased and the pressure of the fluid is decreased.

Black Box - Slang for the Flight Data Recorder unit mounted in all SFMC aerospace craft.

Blackout - Condition of unconsciousness resulting from loss of blood flow to the brain.

Bogey - Slang for unidentified object.

Bouncing - Making a high speed, minimum clearance pass by a vessel (or group of vessels) that had not been previously aware of your presence.

Branch - A group of related jobs within the STARFLEET Marine Corps, like Combat Engineer, Aerospace or Infantry. There are eight branches of duty within the SFMC.

Branch Insignia - The official logo of the branch of service within the SFMC. The official version for Aerospace is a Delta Shield with the Flight Arrow centered in a red background. The unofficial (but very common) version is a smaller set of gold or silver wings attached on either side of a lapel-pin sized red Delta Shield.

Branch Motto - A phrase or saying that sums up an organization's motivation, history or purpose. Usually in some foreign language, and formally phrased. "Fortuna Favet Fortibus" is the Aerospace branch motto. Literally translated, this means "Fortune Favors the Bold". It refers back to the Battle of Cheron, and the common belief among pilots that speed and daring will carry you farther in battle than anything else.

Branch Slogan - A word or phrase that reflects the morale, esprit de corps, and motivation of an organization. The Aerospace branch slogan is "High Guard" and refers to the Aerospace pilots chosen field of battle, in atmosphere or close orbit. If there is a high ground in 24th century combat, then it is space, and the Aerospace Branch guards that high ground.

Break - A very tight turn with a high angle of bank. Often used as a last instant evasive maneuver to break tracking of a homing missile.

Camouflage - Any material or technique used to hide an object or individual from detection. This can range from simple paint applied in different colors that help a vehicle blend into the foliage around it to sophisticated electronic scanner scrambling devices.

Capital Vessel - Term used to indicate a warship equipped with heavy weaponry that makes it capable of fighting alone against other warships. Capital vessels usually form the center of a battle group, and are often surrounded by escort vessels. Cruisers, battleships, and dreadnoughts are capital vessels. Most carriers are not, as they lack the heavy weaponry that would allow them to fight alone against other capital vessels.

Cardassians - Alien race seen regularly on Star Trek: Deep Space Nine. They are hostile to the Federation and make formidable ground troops.

Carding - Slang for getting a visual identification of a bogey.

Carrier - Any vessel designed or equipped for the launch and recovery of small craft, especially strategic or tactical aerospace craft.

Centrifugal Force - Not really a force, this is the effect of inertia on an object that is traveling in a circle. Inertia tries to maintain the objects original heading (tangent to the circle) while the object changes course. This gives the feeling of being pressed outward as the object travels in a circle. A good example is a bucket of water twirled around your head on a length of rope. Centrifugal force is what keeps the water in the bottom of the bucket, instead of sloshing out onto your head.

Chaff - Traditional term for material used to confuse radar homing missiles. Originally it meant metal foils strips, cut to the same length as the known enemy radar wavelengths. When dispensed, it formed a cloud of reflective material, suddenly giving the missile hundreds of targets. Modern chaff used by the SFMC consists of small particles of various alloys, some charged and some not. These particles radiate in the same range of frequencies as most known enemy sensors packages, with results similar to traditional chaff. The effectiveness of all chaff relies on knowing what kind of enemy sensors are being used to detect the target. Chaff is ineffective against heat seeking missiles, for example.

Chandelle - A basic maneuver, consisting of a slow climbing turn through 180 degrees.

Charge Pack - A much larger and more rugged version of a standard power cell. These are used to power vehicles and are rechargeable from fusion plants (or in some cases, solar cells).

Check Six - Slang for “Check behind you, in your six o’clock position”. This is where enemy fighters try to be before blasting you with weapons.

Cheron, Battle of - Decisive battle of the Romulan War, where the Romulan Fleet was destroyed by a Federation fleet near the planet of Cheron. This was the last major battle of the Romulan War, as it crippled the Romulan Empire’s offensive strength.

Climb - Basic maneuver indicating a gain in altitude.

Colonial Marines - One of several historical Marine organizations that evolved into the present day SFMC.

Combined Arms - Military term for operations that involve units from more than one branch (Aerospace and Armor, Mecha and Infantry, etc.)

Defensive Operations - Operations whose purpose is to defend against an enemy offensive operation.

Deflector Shield - Standard defense field for starships, based on the ability to alter gravitational effects across a plane perpendicular to the incoming threat.

Descent - A basic maneuver, indicating a loss of altitude.

Direct Fire - A method of weapon employment where line of sight must exist between the firing weapon and its target.

Dive - A basic maneuver consisting of a rapid loss of altitude and a nose-down attitude.

Drag - One of the four forces that affect aerodynamic flight.

Duranium - Extremely hard metal alloy used extensively in starship construction.

ECM - Abbreviation for Electronic Countermeasures.

Electronic Countermeasures - Technique for countering enemy sensing and targeting attempts, through jamming, misinformation, and/or distortion of their sensor signals.

Elevator - One of the control surfaces on a traditional aerodynamic vehicle. Controlled by the pilot, and mounted on the trailing edges of the horizontal stabilizers, the elevator causes the aircraft to pitch up or down.

Eugenics Wars - Devastating wars that took place in Earth's history, as genetically engineered humans (who believed themselves superior to non-engineered humans) tried to conquer the world. Some were led by Khan Noonian Singh (the same fellow you saw in the movie Star Trek II: The Wrath of Khan).

Exoatmospheric Operations - Operations that take place outside of a planetary atmosphere.

Exotic Atmosphere - Any nonstandard atmosphere that is composed of toxic, corrosive or high-pressure gases.

Federation - Shortened form of United Federation of Planets.

Fighter – A type of aerospace craft used by the SFMC. Fighters are designed to engage other fighters, while attack craft are designed to engage ground targets and starships. Attack craft carry heavier weapons and are less maneuverable than fighters.

Fighter Jock - Slang for fighter pilot.

Fistrium - A refractive metal that standard sensors cannot penetrate.

Flare - An incendiary device used to distract or decoy heat-seeking missiles. The flare burns at a temperature hotter than the exhaust of the target vehicle, attracting the heat-seeking missile away from its original target.

Flechette - Small dart or needle sized projectiles, usually fired in a large group as an antipersonnel weapon. Flechettes are usually ineffective against armored vehicles and buildings. Flechette is pronounced "Flah-SHAY", and the plural is pronounced "Flah-SHAZE".

Flight Suit - The basic combat uniform of all Aerospace pilots.

Force Field - A defensive technology, consisting of an energized field that protects a target by deflecting, diverting or absorbing a certain amount of energy per millisecond. For simplification, these force fields are rated in strength from Zero to Ten.

Friction - The resistance to motion of two moving objects or surfaces that touch.

Furball - Slang for complex and confusing dogfight, usually involving many aerospace craft from both sides.

Fusion Plant - A small fusion based power-generating unit. Not nearly as powerful as a matter-antimatter reaction, but still quite powerful.

Grayout - A condition related to blackouts and redouts, where the pilot does not loose consciousness, but is incapacitated for some period of time, ranging from a few moments to a few minutes. Most often occurs during and after high-speed turns and acceleration or deceleration.

Groundhog - Nickname given to ground force units by Aerospace personnel. Also nickname given to ground crews by their pilots.

Hardened - Term used to describe a building or fortification that has been constructed to resist damage from enemy weapons. This can be done by improving the design, using stronger materials, etc.

Hardpoint - Point on a vehicle or fortification where weapon or auxiliary systems are mounted.

Heading - Direction that an object is moving in. In most cases, this refers to your aerospace craft.

Hover - A state of flight, where all four forces (Lift, Weight, Drag and Thrust) are in perfect balance. The vehicle hangs suspended in midair, without any forward motion.

Inertia - Term for the tendency of a moving object to continue moving in the same direction at the same speed and a stationary object to remain stationary.

Infantry - Basic military unit and the cornerstone of the SFMC organization. A separate branch of duty within the SFMC, as well.

Kelbonite - A refractive metal that standard sensors cannot penetrate.

Kg - Abbreviation for kilogram.

Kilogram - Standard measurement for weight used in the metric system. One kilogram is 1000 grams, or about 2.2 pounds.

Kilometer - Standard measurement for distance used in the metric system. A kilometer is 1000 meters, or about 0.6 miles.

Kitty Hawk - Location on Earth where man's first aerodynamic flight was recorded.

Km - Abbreviation for kilometer, a thousand meters.

Kph - Abbreviation for kilometers-per-hour, a measure of velocity.

Landing - Basic maneuver, consisting of reducing the aerospace craft's forward motion and relative speed to zero as it returns to the ground or a carrier.

Lateral Axis - An imaginary line~~,~~ drawn through the aerospace craft from wingtip to wingtip.

Launch Tube - A method for rapidly launching small craft from a larger vessel. Usually located along the centerline of a starship~~,~~ or at an angle to it on either side (if installed in pairs). Small craft launched in this manner are usually recovered via shuttle bays.

Lift - One of the four forces that affect an aerodynamic flight.

Longitudinal Axis - An imaginary line drawn through an aerospace craft~~,~~ from nose to tail along the centerline of the vehicle.

M - Abbreviation for meter.

M/AM - Abbreviation for Matter/Antimatter.

Magnetic Accelerator - Device that propels metallic objects at very high speeds using magnetic fields.
Variations of this are used as rail guns, etc.

Mailman - Slang for Attack pilot.

Marine Occupational Specialty - The specific "job" or function to which the individual Marine is trained to do. Groups of related MOSs are called Branches. For more information about MOS, please refer to the SFMC MOS Manual.

MegaCorporations - Huge industrial conglomerates of the 21st century responsible for much of Earth's early colonization efforts and rebuilding of civilization after the devastating Eugenics Wars. Funded the Colonial Marines.

Meter - Measure of distance, the standard on which the metric system is based. One meter equals 39 inches, or one yard plus three inches.

Microgravity - Correct term for areas of extremely low gravity. (There are no naturally occurring areas of "zero-gravity" since everything exerts some pull on everything else.)

Mission - Term used to describe the current duty or expected function of an aerospace pilot and his or her craft.

Mm - Abbreviation for millimeter, one thousandth of a meter.

MOS - Abbreviation for Marine Occupational Specialty.

Mph - Abbreviation for miles-per-hour.

Nitrium - Extremely tough metallic alloy used to line power conduits, M/AM reaction chambers, and other high-energy storage areas.

Offensive Operations - Operations whose purpose is to damage or destroy an enemy's forces, and/or gain control of territory or material.

Orbital Bombardment - Term used to describe one or more starships firing weapons or dropping ordnance on a planetary surface. Unless the planetary defenders have weapons capable of reaching into orbit and damaging a starship, they are pretty much helpless. Orbital bombardment is not very precise, but can effectively destroy the surface of a planet in days or even hours.

Phaser - Acronym for Phased Energy Rectification-

Phaser Array - The entire weapon system, including focusing lenses and targeting systems, used to fire a vehicle or installation mounted phaser.

Phaser Battery - Term used to describe a multiple-emitter phaser array, synchronized to fire on the same target at one time. Usually refers to planetary emplaced phaser arrays.

Pitch - A measurement of movement in an aerospace craft, best illustrated by the movement of nose or tail in an up or down direction.

Planetary Defense Site - Weapon installation designed to engage orbital targets, like starships. Usually
underground, well hardened, and with multiple independent power supplies.

Plastalloy - A very strong but lightweight metallic plastic. It is non-magnetic and does not rust.

Polystylete - Cloth like material used to construct flight suits. When exposed to non-oxygen atmospheres, such as the vacuum of space, it becomes a rigid and nonporous material.

Power Cell - An advanced form of battery, used to power small electronic devices and weapons.

Powered Infantry - The standard Heavy Infantry forces of the STARFLEET Marine Corps. They wear powered armor suits that make them stronger and harder to kill than light infantry as well as mounting heavier weapons.

Pulse Phaser - A phaser that fires rapid bursts of energy at a target, increasing its chances of a hit at the cost of some of its destructive power.

Recon - Slang for reconnaissance.

Reconnaissance - The process of scouting for information on an area, especially as relating to enemy presence.

Redout - Condition of unconsciousness resulting from an excess of blood flow to the brain.

Reflective - Any material that reflects light or other directed energy back at the source. A mirror is reflective.

Refractive - Any material that refracts light or other directed energy way from itself, usually in multiple directions or wavelengths. A prism is refractive.

Rodinium - One of the hardest metals known to Federation science. Outposts along the Romulan Neutral Zone were constructed of cast Rodinium.

Roll - A measurement of movement in an aerospace craft, best illustrated by the movement of the wings rotating around the longitudinal axis of the vehicle~~,~~ without changing its heading.

Romulans - Alien race that was regularly seen on Star Trek. Hostile at times to the Federation but now under friendly terms. They use cloaked ships and disrupters as standard technology. For more information about the Romulans, please refer to the SFMC Xeno Studies - Romulan Manual.

Screens - Slang for force fields.

Sectis, Sectis III - The first planetary system invaded by the Romulans during the Romulan War~~,~~ and the first place the SFMC suffered casualties in that war.

Sensor Signature - The signal or emissions that personnel or vehicles give off, which can be detected by enemy sensing devices. This can be heat, electromagnetic, acoustic, or some other form of energy.

SFMC - Acronym for STARFLEET Marine Corps.

Shuttle Bay - Area aboard a starship or space station that is used for launch and recovery of small craft, especially shuttles.

Spaced Ceramic Composites - Type of armor designed to reduce the effectiveness of high-energy weapon impacts and incendiary weapons. Consists of specially blended ceramic composites~~,~~ formed into two or more layers of honeycombed plating. The spaces in the honeycomb pattern help dissipate and reduce electrical and thermal concentrations. Found in most armored vehicles and some aerospace Attack craft.

Square Pegging It - Slang used by ground crews to indicate improvising a solution.

Stall - Condition resulting from increasing a wing's angle of attack until airflow (and therefore lift) is disrupted, causing the aircraft to fall.

Standardization - A method of increasing an organization's efficiency by standardizing equipment, uniforms, and policies. This prevents confusion, eases the logistical burden for replacement parts, and limits incorrect identification of personnel.

Survival Vest Pack - Standard piece of survival equipment issued to all SFMC pilots, it comes with a life support generator, rations, and other useful items.

Third World War - Last of Earth's global conflicts, taking place during the mid 21st Century. More than 37 million people were killed.

Thrust - One of the four forces that affect aerodynamic flight.

TRACOM - Acronym for STARFLEET Marine Corps Training and Doctrine Command.

Transports - Aerospace craft used to carry troops and materials.

Trash Hauler - Slang for support pilots, especially transport pilots.

Tribble Factor - Slang for varying degrees of tension experienced in a dogfight. (As in, how do tribbles hang onto walls and things, without any hands?)

Tricorder - Standard hand held sensor unit, used by the Federation.

UFP - Abbreviation for United Federation of Planets.

United Nations - An organization of nation-states on Earth, created during the 20th century. Its focus was on international peace and cooperation.

United Nations Peace Force - Military forces of the United Nations, charged with peacekeeping duties and defense of Earth against aggressors.

UNPF - Abbreviation for United Nations Peace Force.

UNPF Marines - A historical Marine organization, one of the predecessors of the STARFLEET Marine Corps.

Vertical Axis - An imaginary line drawn through an aerospace craft, passing vertically through the center of the vehicle.

VTOL - Acronym for Vertical Takeoff and Landing.

Weight - One of the four forces that affect aerodynamic flight.

Wing - The basic lifting surface of an aerodynamic vehicle. The bottom surface of the wing is flat, while the upper surface is curved. Airflow across the top surface is faster, and at less pressure, which generates lift.

World War One - First of Earth's global conflicts, in which Germany tried to conquer Europe and eventually drew most other nations into the fight.

World War Two - Second of Earth's global conflicts, pitting the Allies against the Axis powers.

World War Three - Last of Earth's global conflicts, taking place during the mid 21st Century. More than 37 million people were killed.

Yaw - A measurement of movement in an aerospace craft, best illustrated by the movement of nose or tail to either the left or the right along the lateral axis of the vehicle.

Zero-g - Slang for areas of very low gravity.

About the SFMC Academy

The Starfleet Marine Corps Academy was established by Commander Starfleet in 2164 when it was determined that Starfleet Academy could no longer adequately meet the needs of both services. The historical home of the United States' Navy and Marine Corps academies, Annapolis, was selected as the new home of the SFMCA. The head of the Academy, known as DCO-Academy, TRACOM, is still headquartered at the main campus in Annapolis. The motto of the SFMCA is "Facta Non Verba" or, in Federation Standard, "Deeds not Words." This is reflected in the more informal academy slogan, "We lead by example... whether we mean to or not." The DCO-Academy, TRACOM reports to the Commanding Officer of the Training Command (COTRACOM) who, in addition to the SFMCA, oversees branch schools, enlisted personnel training, advanced technical schools, and periodic skill re-fresher courses. Most of these courses are held either at one of the SFMCA facilities, or at one of the many training facilities in the New Valley Forge system which is home to TRACOM. These facilities, together with an Oberth-class spacedock serving as TRACOM headquarters, comprise Station Valley Forge. Today, the SFMCA consists of 5 campuses, 8 training worlds, and 42 ranges and field courses throughout the UFP. Together with Station Valley Forge, the SFMCA comprises one of the largest and most advanced military training organizations in the known universe.