UNITED STATES MARINE CORPS
THE BASIC SCHOOL
MARINE CORPS TRAINING COMMAND
CAMP BARRETT, VIRGINIA 22134-5019

PRINCIPLES OF FIRE SUPPORT B2C2437 STUDENT HANDOUT

Principles of Fire Support

Introduction

The purpose of this instruction is to provide you with a basic understanding of the different fire support assets (air, artillery, mortars, and naval surface fire support) available to support the Marine Air-Ground Task Force (MAGTF), as well as the capabilities and limitations of these weapons systems.

Importance

Fire support as defined in Joint Publication 1-02 is the application of fires that directly support land, maritime, amphibious, and special operations forces to engage the enemy forces, combat formations, and facilities in pursuit of tactical and operational objectives.

In This Lesson

We will discuss the capabilities and limitations of the fire support assets available to you in the Marine Corps. They include: 60mm Mortars, 81mm Mortars, 120mm Mortars, 155mm Artillery, HIMARS, Naval Surface Fire Support, and Aviation assets.

This lesson covers the following topics:

Principles of Fire Support (Continued)

Learning Objectives

Terminal Learning Objectives

0302-FSPT-1300 Given a scheme of maneuver, fire support available, and commander's intent, develop a fire support plan to support the ground scheme of maneuver in accordance with the commander's intent.

0302-FSPT-1302 Given a radio, call signs, frequencies, available supporting arms, equipment, a scheme of maneuver, and a commander's intent, employ supporting arms to achieve desired effect(s) on target that support(s) the ground scheme of maneuver.

Enabling Learning Objectives

0302-FSPT-1300a Without the aid of reference, identify fire support asset capabilities without error.

0302-FSPT-1302a Given a radio, call signs, frequencies, available supporting arms, a target, a scheme of maneuver, and a commander's intent, determine fire support available to achieve desired effect(s) on target.

0302-FSPT-1302b Given a radio, call signs, frequencies, a target, a scheme of maneuver, planned supporting arms, and a commander's intent, position observer(s) to observe the target in support of the scheme of maneuver.

0302-FSPT-1302c Given a radio, call signs, frequencies, available supporting arms, equipment, a scheme of maneuver, and a commander's intent, integrate supporting arms to achieve a combined arms effect.

0302-FSPT-1302d Without the aid references, describe command relationships without omission.

0302-FSPT-1302e Without the aid of reference, describe the three types of terminal control used to employ close air support aircraft without omission.

0302-FSPT-1302f Without the aid of reference, describe conditions required to clear an aircraft to release ordnance without omission.

0302-FSPT-1302g Without the aid of reference, describe the capabilities of mortars without omission.

0302-FSPT-1302h Without the aid of reference, describe the structure of the 60mm mortar section in the weapons platoon without omission.

0302-FSPT-1302i Without the aid of reference, describe the structure of the 81mm mortar platoon in the weapons company without omission.

0302-FSPT-1302j Without the aid of reference, describe the capabilities of the Shoulder Mounted Anti-Armor Weapon (SMAW) without omission.

0302-FSPT-1302k Without the aid of reference, describe the structure of the assault section in the weapons platoon without omission.

0302-FSPT-1302l Without the aid of reference, describe the capabilities of anti-armor weapons without omission.

0302-FSPT-1302m Without the aid of reference, describe the structure of the anti-armor platoon in the weapons company without omission.

M224 60mm Mortars

The M224 60mm mortar is a smooth bore, muzzle loaded, high angle of fire weapon (see diagram below). Three M224 mortars make up a mortar section, which is organic only to an infantry rifle company. It can be fired from either a drop fire mode (conventional method) or trigger fire mode (conventional or hand-held method). A lightweight auxiliary base plate is used when firing the mortar in the hand-held mode. It can be fired in a direct lay mode or through the use of a fire direction center (FDC).

M224 60mm Mortars (Continued)

60mm Mortar Section

Organization	Weight
• One section o Section leader – Sergeant 0341 • Three squads each with o One M224 o Three Marines – Squad leader/Gunner – Corporal 0341 – Assistant gunner – Lance Corporal 0341 – Ammunition man – Private First Class/Private 0341	

Item	Weight in Pounds
Cannon M225	14.4
Bipod M170	15.2
Sight M64	2.5
Base plate M7	14.4
**Base plate M8	3.6
Conventional mode	46.5
**Handheld mode	18.0
Max Range	3,500m
ECR	30m

M252 81mm Mortars

The M252 81mm medium extended range mortar (see diagram below) is a crew-served, smooth bore, muzzle loaded, high angle of fire weapon system. It is designed to be fired in the indirect fire mode, cannot be fired handheld, and normally utilizes a FDC. The M252 is highly accurate up to ranges of 4500m to 5700m depending on the munition. A blast attenuation device (BAD) is attached to the muzzle of the cannon assembly to reduce the blast effects on the mortar crew. The M252 is ideally suited to support light infantry forces.

M252 81 mm Mortars (Continued)

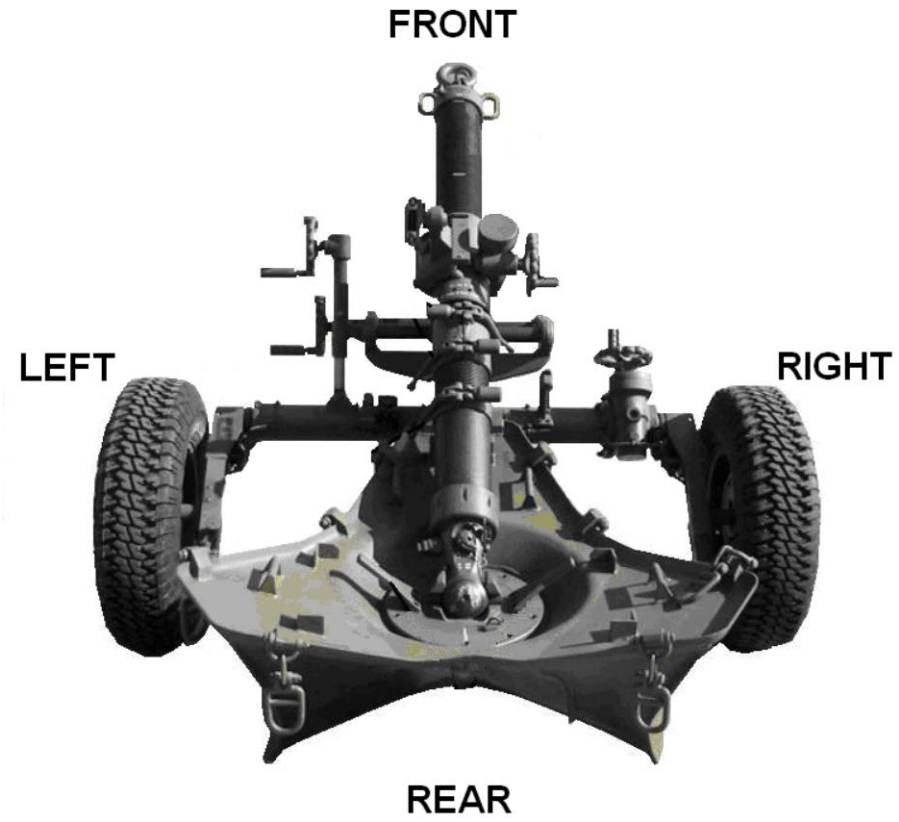
81mm Platoon Organization

Organization	Weight
• Platoon HQ o Platoon commander – First Lieutenant 0302 o Platoon Sergeant – Gunnery sergeant 0848/0369 o Ammo technician – Lance Corporal 2311 o Ammo man/driver – Private First Class 0341 • Two sections (four squads per section) o Section leader – Staff Sergeant 0369 o Two ammo men – Lance Corporals 0341 o Plotter – Sergeant 0341 o Plotter/recorder – Corporal 0341 o Recorder/driver – Lance Corporal 0341 o Two forward observers – Corporals 0341 • Eight squads each with o One M252 o Six Marines – Squad Leader – Sergeant 0341 – Gunner – Corporal 0341 – Assistant gunner – Lance Corporal 0341 – Three ammo men – Privates 0341	

Item	Weight in Pounds
Cannon M252	35
Mount M177	27
Base plate M3A1	25.5
Sight M64A1	2.25
Total weight	89
Max Range	5,700m
ECR	35m

M327 120mm Mortars (EFSS)

M327 mortar equipped units will provide all-weather, ground-based, close supporting, accurate, immediately responsive, and lethal indirect fires in support of the Marine Air-Ground Task Force (MAGTF). The M327 mortar is capable of successfully engaging a spectrum of potential point and area targets, including motorized, light armored, and dismounted personnel targets, command and control systems, and indirect fire systems. M327 mortar fires will disrupt, degrade, or destroy as much of the threat force capabilities as possible prior to the initiation of the direct fire engagement and provide accurate, lethal, close-in fires throughout the duration of the engagement. As a critical element of the ground fires triad, the M327 mortar will afford the MAGTF commander increased flexibility in tailoring his fire support systems to support the scheme of maneuver. M327 mortar equipped units are well suited for missions requiring speed, tactical agility, and vertical transportability.



M327 120 mm Mortars (Continued)

Item	Weight in Pounds
Cannon M327	295
Undercarriage	734
Base plate	502
Mortar Stool	70
Total weight	1,601
Max Range	8,135m
ECR	45m

Mortar Capabilities and Limitations

Mortar Capabilities	
Capability	**Description**
High volume of fire	The maximum (30 rds/min) and sustained (20) rds/min for 60mm; 15 rds/min for 81mm) rates of fire allow both mortar systems to provide a considerable amount of ammunition in support of maneuver forces.
Highly responsive asset	The location of the mortar systems closer to the supporting units equates to faster response time.
Light, mobile, and flexible	Both mortar systems are light enough to be hand carried, if necessary, and can be employed in a variety of positions on the ground.
Fires from and into defilade	Mortars can be positioned on the ground to take advantage of protection by terrain; for example, behind a hill mass or in a dry riverbed. Conversely, mortars' inherent high angle fire capability allows them to engage targets located in defilade positions.
CO's "hip pocket artillery"	The 60mm and 81mm mortar are organic assets within the Marine rifle battalion thus increasing their knowledge of the maneuver unit's experience and capabilities due to habitual working relationships.

Mortar Limitations	
Limitation	**Description**
Long time of flight	The high angle nature of fire for the mortar contributes to their longer time of flight for the round to reach the target area. This also makes the mortar system more susceptible to direction-finding radar.
Ammunition consumption	Due to the maximum and sustained rates of fire, mortars expend more ammunition. A smaller effective casualty radius requires both systems to use a greater number of rounds to accomplish the same mission as compared to other fire support systems.
Multiple displacements	The shorter range of both mortar systems require the tubes to move closer to the engagement areas whenever maneuver units reach beyond the range of their mortars. During their movement, mortars have a limited capability to employ their systems to supporting units.

Mortar Capabilities and Limitations (Continued)

Conclusion. The mortars are a crew-served weapon system, which can be found in Marine infantry companies and battalions, except for the 120mm mortar system that belongs to the artillery community. It is a muzzle-loaded, smooth-bored, all weather capable weapon system that Marines can carry and disassemble. In the weapons platoon of an infantry rifle company are three 60mm mortar systems. In the weapons company of the infantry battalion are eight 81mm mortar systems. A Light Armored Reconnaissance (LAR) Battalion also possesses eight 81mm Mortar systems. Mortars are capable of firing a wide variety of ammunition. Due to their increased responsiveness and the fact that they belong to the maneuver commander, mortars are often referred to as the “CO’s hip pocket artillery.”

Marine Corps Artillery

Generating combat power in support of maneuver at the decisive time and place achieves victory on the battlefield.

Mission. The mission of Marine artillery is to:

- Integrate and deliver lethal and non-lethal fires to enable joint and maneuver commanders to dominate their operational environment across the spectrum of operations.

Artillery conducts three key tasks to accomplish their mission.

- The primary task: to provide close and continuous fire support to the maneuver units. Fire support is provided day or night and in all weather conditions.
- Artillery gives depth to the battlefield. Weapons with ranges of 20+ kilometers have the ability to:
    - Attack reserves and assembly areas.
    - Interdict supply lines.
    - Disrupt the enemy's command and control facilities.
- Deliver counter fire within the range of our weapon systems to ensure freedom of movement for ground forces.

Artillery Weapons Systems

M777A2 155mm Towed Howitzer.

Characteristic	Data
Weight of weapon	Roughly 10,000 pounds
Range	18,100 meters
	30,100 meters with rocket assisted projectile (RAP)
Maximum rate of fire	5 rounds per minute
Sustained rate of fire	2 rounds per minute
Ammunition available	Standard 155mm ammunition

Artillery Weapons Systems (Continued)

HIMARS

Characteristic	Data
Weight of weapon	32520 pounds
Range	30,000 meters
Maximum rate of fire	N/A
Sustained rate of fire	N/A
Ammunition available	M31 (HE) & M48 (ATACMS)

Artillery HIMARS Ammunition

Shell	Description
M31	• 200 lb HE warhead (PD or Delay fuze capable) • GPS aided • Range: 15-70 km • Accuracy: 3m from target
M48 ATACMS	• 500 lb unitary warhead • Range: 70 – 300 km • Accuracy: 8m from target

Artillery Organization

The three active duty artillery regiments and one artillery regiment in the reserve structure are the:

- 10th Marines within the 2nd Marine Division. **Fully fielded with 120mm
- 11th Marines within the 1st Marine Division.**(1) HIMARS BN
- 12th Marines within the 3rd Marine Division.
- 14th Marines (the reserve artillery regiment), an element of the 4th Marine Division (the Reserve Division). **(1) HIMARS BN

The 10th and 11th Marines each have four battalions and a headquarters battery. The 12th Marines has one artillery battalion and a headquarters battery.

Artillery Battalion. The battalion, the basic tactical unit for the artillery, contains: One headquarters battery and three firing batteries (six howitzers in each battery; 18 howitzers in the battalion).

Headquarters Battery. The headquarters battery provides the equipment and personnel to assist the battalion commander in controlling and supporting the battalion.

Firing Battery. Three firing batteries in each artillery battalion each

- Is commanded by a Captain (0802).
- Has six howitzer sections (with one howitzer in each section).
- Has one FDC that
  - Exercises technical and tactical fire control for the battery.
  - Communicates with higher headquarters and the supported unit.
- Has a battery headquarters element which contains these sections
  - Communication.
  - Motor transport.
  - Medical.
  - Liaison. The liaison officer (LNO) is an 0802 Lieutenant. The section provides artillery liaison personnel to operate (with equipment) with the Fire Support Coordination Center (FSCC) of the supported unit.
  - Forward observer (FO) teams. Company fire support teams of the supported maneuver battalion. Each FO team consists of:
    - An FO (0802 lieutenant)
    - A scout observer (0861)
    - One or two radio operators (0621)

Artillery Organization (Continued)

- **Firing Team**. Regardless of the organization and equipment, the mission of any indirect fire unit remains the same: "to put steel on target as quickly as possible." Accomplishing this goal requires a three-part team (whether the team is artillery, mortars, naval surface fire support, or any other indirect firing organization):

    - The observer —"eyes"
    - The FDC — "brain"
    - The howitzer section — "muscle"

  The Observer — "Eyes." The FO teams and the liaison section provide the link between the maneuver unit and the supporting artillery. The FO will locate and identify targets for the battery or battalion to engage. The liaison officer will assist the infantry battalion FSC in coordination and planning of artillery support. The FOs and LNO "see" the battlefield and feed information to the FDC.

  The FDC — "Brain." The FDC is the brain of the battery. The information gained by the "eyes" is fed here. The fire direction officer (FDO) is responsible for the FDC. Upon hearing the call for fire, the FDO issues a fire order to the FDC. The FDC takes the rough information obtained from the "eyes" and calculates firing data for the howitzer. Data is then sent to the gun line.

  The Howitzer section — "Muscle." The gun line is the muscle. The howitzer section applies the data to the gun and delivers "steel" to the target. The section chief (0811 Staff Sergeant), responsible for the howitzer section, ensures that the correct fuze, fuze setting, round, charge, deflection, and quadrant are fired.

Artillery Organization (Continued)

Artillery Capabilities and Limitation.
The tables below describe the capabilities and limitations of artillery.

Capability	Description
Maneuvering fires	• Can shift fire from one target to another without displacing (physically moving) • This responsiveness allows close integration with maneuvers
Massing fires	• Despite extensive dispersion between batteries and battalions, different units can simultaneously engage one target or a group of targets (two or more targets fired simultaneously) • Whenever possible, artillery battalion will mass its batteries to have greater effect o 18 rounds landing at the same time causes greater damage and more casualties than 18 rounds landing six at a time, 20 seconds apart
Surprise fires	• Fires delivered without adjustment, thereby allowing for greater effect • To be effective, an accurate target location must be given or known
All weather capability	• Artillery is not limited by visibility or weather conditions • Is an all weather, 24-hour supporting arm
Fires from and into defilade	• Artillery can be positioned on the ground to take advantage of protection provided by terrain, for example o Behind a hill mass o In riverbed • Conversely, by using high angle fire, artillery is able to engage targets located in a defilade position
Rapid displacement	Artillery is able to move rapidly from one position to another

Limitation	Description
Reduced effectiveness	• A battery cannot shoot while displacing unless it conducts a “hip shoot” (the hasty, unplanned occupation of a firing position) • Battery is most vulnerable when on the move
Poor terrain	Broken or rough terrain • Limits mobility • Slows the displacement of batteries • May limit dispersion between howitzers
Close combat	Battery’s support is degraded when defending its own position

Artillery Organization (Continued)

Limitation (Continued)	Description (Continued)
Air attack	• Artillery is extremely vulnerable to air attack while displacing • Movement or dust clouds are easily detected from the air
Ammunition/logistics burden	Artillery units must have uninterrupted supply of ammunition to provide continuous fire support • One MTVR, 7-ton truck (with M105 trailer) can carry 120 complete 155mm rounds (projectile, powder, and fuze) • A battalion can fire the equivalent of one truckload of ammunition every minute
Inability to support the initial phase of an amphibious operation	• Artillery will be on ship or en route to the beach during the initial phase of the amphibious assault • Naval gunfire and air must provide initial support
Communication	• To provide support, effective communication must be maintained • Communication is often the Achilles heel of any operation due to the o Dispersion between units o Terrain o Weather o Enemy interference
Counter battery radar	If the enemy possesses counter battery radar, they can • Track the projectiles • Determine their origin • Return fire

Conclusion. Marine artillery provides all-weather fire support to maneuver commanders and is capable of firing in the direct and indirect fire modes. Supporting units can depend on the M198 155mm towed howitzer to provide the added weight to any operation. The organization of Marine artillery provides the MAGTF commanders with flexibility. Three firing batteries plus one headquarters battery in the artillery offer constant support, firing a multitude of ammunition ranging from HE to the Copperhead laser guided projectile. The FO (eyes), FDC (brains), and gun line (muscle) all furnish maneuver units' lethality up to 30,100 meters.

Ammunition

Projectiles	60mm	81mm	120mm	155mm	EFFECTS
HE (High Explosive)	X	X	X	X	Filled with Composition B and TNT. Designed to destroy or inflict casualties on personnel or light skinned vehicles
WP (White Phosphorus)	X	X	X	X	Designed for screening, obscuring, incendiary (refueling stations), and signaling/marking. HE/WP is optimal if there are vehicles refueling (HE for the vehicles and WP for the fuel).
RP (Red Phosphorus)		X		X	Same as WP except it produces gray smoke that billows faster and provides a more widespread smoke screen
Illumination	X (40 sec)	X (60 sec)	X (120 sec)	X (120 sec)	Illuminates battlefield and used for signaling/marking
IR Illumination	X	X	X	X	Illuminates battlefield and seen through night vision
M825 Smoke (WP)				X	Provides 5 to 15 minutes of smoke. Uses 116 felt wedges impregnated with WP for rapid dissemination. Designed for screening / obscuring (optimal) but not for marking
HE / Rocket Assisted Projectile (RAP)				X	A rocket motor allows the HE projectile to carry up to 30,100 KM.
Improvised conventional munition (ICM)				X	Base ejecting type projectile that contains 88 dual purpose armor defeating and antipersonnel grenades. **ICM can produce duds. Used against heavy armored vehicles.

Ammunition (continued)

Fuzes	60mm	81mm	120mm	155mm	EFFECTS
Point Detonating (PD) or Quick (Q)	X	X	X	X	Functions on impact. HE/Q and/or PD is effective against personnel and light skinned vehicles.
Delay (D)	X	X	X	X	Causes the projectile to detonate .05 secs after impact (5m-15m). Opttimally used with HE, and HE/D is used mostly against enemies with overhead cover. Also used in heavily wooded areas, and times where you want to minimize shrapnel on the battlefield (friendly troops in the maneuver).
Proximity (Prox) / Near Surface Burst (NSB)	X	X			Radio activated and functions when it receives the reflection of a self-transmitted radio signal. Height of burst 0-3 ft (NSB) or 3-13 ft (Prox). HE / Prox and/or NSB is optimal against personnel in the open without overhead cover.
Variable Time (VT)				X	Radio activated and functions when it receives the reflection of a self-transmitted radio signal. VT has a 7m height of burst and HE/VT is optimal against personnel in the open w/out overhead cover.
Time			X	X	Used with WP, Illum, and HE

Naval Surface Fire Support

Three Missions of Naval Surface Fire Support (NSFS). NSFS ships exist to support the assault of an objective by destroying or neutralizing:

- Shore installations that oppose the approach of ships and aircraft (Normally an advance force will split from the main amphibious task force (ATF) body to accomplish tasks in advance of the main force arrival. This advance force normally will include NSFS ships.)
- Defenses that oppose the:
    - Actual landing of the landing force
    - And to provide support for the advance of the landing force ashore

Ships Capable of Providing NSFS. A number of types and classes of ships can fire in support of land operations. Each of these classes of ship will have its own peculiarities and characteristics based on its:

- Configuration
- Primary mission
- Weapons systems

The types of ships that provide NSFS are

- Destroyers (DD)
- Guided missile destroyers (DDG)
- Guided missile cruisers (CG)

Although there are many classes of ships, there are only a few types of gun mounts and computer systems, each of which implies certain capabilities.

Guided Missile Cruisers. The Ticonderoga class guided missile cruisers perform primarily in a battle force role. These ships are

- Multi-mission surface combatants.
- Capable of supporting carrier battle groups, amphibious forces, or operating independently.
- Armed with two 5”/54 gun mounts to support the landing force.

Destroyers. These NSFS platforms are capable of supporting

- Carrier battle groups.
- Surface action groups.
- Amphibious groups.
- Replenishment groups.

The Arleigh Burke class destroyer has one 5”/54 gun mount; the Spruance class has two 5”/54 gun mounts.

Naval Surface Fire Support (Continued)

MK-45 5"/54. The MK-45 is a 54-caliber, lightweight gun that provides surface combatants accurate naval gunfire against

- Fast, highly maneuverable surface targets
- Air threats
- Shore targets during amphibious operations

The MK-45 is controlled by the MK 86 gun fire control system that allows the ship to engage targets while moving. The capabilities of the MK-45 are listed in the table below.

Capability	Measurement
Minimum range	910 meters
Maximum range	23,000 meters
Maximum rate of fire	40 rounds/minute
Sustained rate of fire	20 rounds/minute

NSFS Capabilities. To ensure that NSFS ships can provide effective support to a landing force, a planner must have a good foundation in the characteristics of NSFS. The capabilities and limitations should be considered both when planning and adjusting NSFS. These capabilities and limitations are actually a set of related characteristics that can be liabilities in one situation and enhancements in another.

- **Mobility**. Ships can maneuver in the water to position themselves to best support the landing force. Many limitations that will be discussed later can be overcome by planning to take advantage of the ship's mobility. Ships are also able to maneuver to defend themselves against attack.

- **Accuracy**. The gunfire control systems (GFCS) available can place accurate fires on a target from a ship underway, allowing the simultaneous engagement of two targets.

- **Variety of Ammunition**. The types of projectiles and fuzes available are very similar to those found in the firing battery. The projectiles include
  - HE.
  - WP.
  - Illumination.
- **High Initial Velocity**. NSFS is particularly suited for destroying hardened and fortified targets where penetration is necessary before damage can occur. If the target presents a vertical surface to the gun-target line (GTL), this characteristic is enhanced. The muzzle velocity of Naval guns firing full charge is 2650 feet per second (f/s). An M16A2 assault rifle is3250 f/s.
  An artillery piece firing an intermediate charge is about 1200 f/s.
  The ballistic characteristics of NSFS more closely resemble those of an assault rifle than a howitzer.

Naval Surface Fire Support (Continued)

NSFS Capabilities. (Continued)

- **Narrow, Accurate Deflection Pattern**. The high muzzle velocity causes a very accurate deviation dispersion pattern along the GTL, which allows very close placement of fires to maneuver units when the GTL parallels their positions.

- **High Rate of Fire.** The rapid rates of fire for each gun mount are made possible by power hoisting and loading equipment. When engaging personnel-type targets, where reaction time degrades ammunition effectiveness (because personnel seek protection), this high rate of fire is significant for maximizing effects on target.

NSFS Limitations. Many of the NSFS limitations are simply the same characteristics that are capabilities, but studied from a different perspective. Careful, detailed planning can reduce or eliminate the impact of these limitations on combat operations.

- **Effects of Hydrography**. Shoals, minefields, and reefs limit the maneuverability of the ship. Shallow waters may force the ship to stand farther from the beach than would be optimal. The ability to position ships for most effective support is reduced if the areas in which the ships can maneuver are restricted.

- **Fixing Ship's Position**. To provide accurate initial salvos, the ship must determine its location. Both radar and visual means are used to triangulate the ship's position at various times and establish a "track." If the beach is relatively featureless, the ship will have difficulty locating itself precisely enough to provide good fire support. Then AN/UPN-32 and AN/PPN-19 radar beacons can be used to give the ship a fixed reference point.

- **Effects of Weather and Visibility.** NSFS must be observed for maximum effectiveness. If weather conditions are such that spotters are unable to observe the impact of rounds or the targets, most of the rounds fired may have no damaging effect on their intended targets. Additionally, if the ship is relying on visual navigational aids and the weather interferes with visibility, the ship will encounter difficulty fixing its position. A radar beacon can be used to provide a reference point to minimize this problem. Ships cannot provide effective support in excessively stormy weather. Rolls in excess of 15 degrees stress the gun mount stabilizers beyond their design parameters.

- **Changing GTL**. When the ship is maneuvering, the GTL will slowly change. This change may become an important consideration when friendly forces begin to fall along the GTL. A long-range dispersion pattern on the GTL could become a hazard to troops.

Naval Surface Fire Support (Continued)

NSFS Limitations. Changing GTL (Continued)

During the Okinawa campaign in World War II, the Marines were quite successful in overcoming this problem with careful planning. NSFS plans were made such that a series of fire support areas (FSAs) were assigned and placed in an on-call status. As the troops ashore maneuvered to a position where the GTL endangered the forces, the ships were ordered to the next assigned FSA, maintaining a parallel GTL-friendly front line relationship.

- **Long Range Pattern**. Naval guns produce most of their error as a range dispersion pattern oriented along the GTL. When firing with full charge on flat ground, NSFS will be rather difficult to adjust onto point targets because of the large range dispersion. Firing reduced charge can minimize the range dispersion, at the cost of some accuracy in deflection. Adjusting with several salvos per adjustment can assist in the adjustment phase to place a mean point of impact onto the target.

- **Flat Trajectory**. While the high velocity is desirable for giving NSFS its penetrating qualities, the high velocity also creates the flat trajectory that can make the engagement of some targets in defilade impossible. Unlike artillery, naval guns cannot “cut” the charge. Only two powder increments are available: full and reduced charge. When using the reduced charge, the angle of fall is increased, allowing fires to reach some defilade positions, but the range of the weapon is greatly decreased.

- **Magazine Capacity is Limited.** When the ships are shot dry, a re-supply must be arranged. Careful planning can minimize the impact of ships’ non-availability for tactical missions.

For example, a general support (GS) ship could be assigned to an interim DS role while the DS ship is off station. Ships should undergo replenishment before a major attack. Planners should be aware that a certain percentage of ammunition would be reserved for defense of the ship.

When compared to artillery, the limitation of ammunition availability is minor. A typical NSFS ship will carry about 600 5”rounds per mount. If proper planning has been accomplished, re-supply ships will be available. A support ship can steam out, link up with the re-supply vessel, re-supply, and be back on station within 4 to 6 hours.

Naval Surface Fire Support (Continued)

- **Communications.** Communications is the major limitation of NSFS. Radio is the only means of communication, and the nets are subject to interference both man-generated and atmospheric. Without communications, the only NSFS will be of the preplanned, scheduled variety. Using alternate frequencies or relaying calls for fire via alternate nets can minimize communication problems.

Conclusion. Naval surface fire support provides maneuver commanders a responsive asset during amphibious landings and continuing operations ashore. The 5”-54 gun system offers flexibility to commanders by providing fires at ranges up to 23,000 meters using an assortment of ammunition. Successful integration of naval surface fires with maneuver units involves planning early and continuously. Maneuver commanders who employ naval surface fire support provide a unique added dimension to their operations.

Marine Aviation Ordnance

Aircraft carry four general categories of ordnance:

- Bombs
- Missiles
- Rockets
- Guns

Aircraft can employ a vast array of weapons (ordnance designed to kill or destroy). We are only going to cover those most likely to be employed by Marine Corps aircraft in a Close Air Support (CAS) type of environment. As such, weapons used to shoot down other aircraft, penetrate through tens of feet of hardened concrete or mountain side, or those that split or merge atoms are not going to be covered here.

The type weapon or system used will depend on the

- Mission
- Method of delivery
- Desired results

Marine Aviation Ordnance (Continued)

To exploit the full capabilities of any weapon or system, we must understand some basic nomenclature and what options are available. In general, weapons kill and destroy in the following three ways:

- Heat (Flame and/or temperature)
- Blast (Concussion)
- Fragmentation (Projectile)

General Purpose, High Explosive Bombs.

- MK-80 Series Bombs. The MK-80 series of bombs is the most widely used weapon in the inventory and is in the “dumb bomb” category. Dumb bombs are not precision guided munitions and are only influenced by gravity and wind once the ordinance is released. About 45 to 50 percent of bomb weight is explosive. General-purpose (GP) bombs use all three weapon-kill mechanisms. The blast and heat effects are greater than any other conventional ordnance weapons. Consideration must be given to the size of the fragmentation envelope for enemy and friendly ground and air assets.

Mk-80 Series Bomb
The series consists of the

- Mk-82 = 500lb bomb
- Mk-83 = 1000lb bomb
- Mk-84 = 2000lb bomb

Marine Aviation Ordnance (Continued)

Fuzing. Fuzing has a significant impact on the weapons effect. Fuzes control the

- Arming delay (time from release to armed)
- Functioning delay (time of detonation with respect to impact).

The types of fuzes for MK-80 series bombs are

- Mechanical, which are very reliable
- Electrical, which offer a wide variety of features and pilot selectable options

Generally, all other weapons types have only one fuse available.

The three functioning modes are:

- Delay. Increases the penetration effects. The longer the delay, the greater the penetration. Use on targets that require penetration. The delay on electrical fuzes is pilot selectable in flight. Electrical fuzes can use a hardened steel nose plug to allow greater hard target penetration.

- Instantaneous. Amplify heat and fragmentation. Use on targets that have no major protection. Electrical fuzes offer a much quicker response time in this mode. This produces a distinct tactical advantage when maximum fragmentation and minimum cratering are required.

- Proximity. VT amplifies fragmentation. VT fuzes produce an air burst. VT elements are only available on electrical fuzes.

Laser-Guided Bombs (LGBs). LGBs combine GP and penetration warheads with guidance packages and control fin assemblies to provide a free-fall weapon capable of limited maneuverability after release from the delivering platform. The guidance package consists of a laser spot seeker that identifies laser energy and uses it to guide to the point of impact. Small canards located immediately behind the seeker head are moved in response to guidance inputs to keep the laser energy centered in the seeker field of view. It is important to understand that laser-guided bombs are designed to minimize minor deviations in the planned delivery. Delivering platforms are still required to meet precise release parameters to ensure that the weapon's seeker is able to initially acquire the laser energy reflected from the target.

Marine Aviation Ordnance (Continued)

Guided Bomb Units (GBUs). GBUs are guidance kits attached to the bomb body of MK-82, 83, or 84 bombs, which allow the bomb body to be "guided" to the target. This guidance can come in several different forms:

- Mk-82 + LASER GUIDANCE PACKAGE = GBU-12
- Mk-83 + LASER GUIDANCE PACKAGE = GBU-16
- Mk-84 + LASER GUIDANCE PACKAGE = GBU-10

LGB Employment Considerations. The most important planning factor for LGB employment is the need to reflect laser energy off the intended target. A laser spot can be provided

- By the delivering platform (self-lazing)
- From an accompanying aircraft (buddy lazing)
- By a ground-based laser system

Careful consideration must be given to the effects of weather, terrain, and laser line-of-sight to ensure that obstacles do not come between the laser source and the target.

An LGB has no ability to differentiate between the laser source and the reflected energy from the target, so it is critical to consider the location of a ground-based laser team in relation to the weapon delivery axis.

LGB Advantages and Disadvantages

- The primary advantage of LGBs is the accuracy with which they can be employed. With LGBs, fewer weapons and aircraft are required to achieve the desired level of damage.
- Disadvantages include the need for laser designation of the target and degradation by weather or other obscurants.

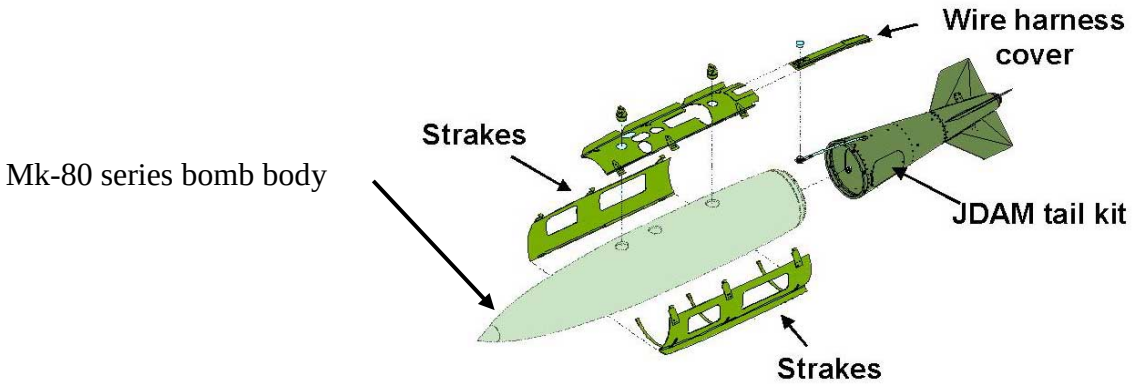
Joint Direct Attack Munitions (JDAM). JDAM is really more of a guidance package than an individual weapon. By placing the JDAM inertial navigation system (INS)/Global Positioning System (GPS) guidance assembly on a conventional Mk-82/83/84 bomb, the resulting weapon can provide precision guidance like an LGB but does not require a laser designator. Since each JDAM can be programmed with separate target coordinates, multiple targets can be hit on a single pass. By strapping a GPS kit onto a GP bomb body, the number of bombs needed to destroy or neutralize a target is reduced. This group of weapons includes the

- Mk-82 + GPS GUIDANCE PACKAGE = GBU-38
- Mk-83 + GPS GUIDANCE PACKAGE = GBU-32
- Mk-84 + GPS GUIDANCE PACKAGE = GBU-31

Marine Aviation Ordnance (Continued)

JDAM (Continued)

The figure below shows the strakes and JDAM tail kit that make up a JDAM weapon.



JDAM Advantages and Disadvantages. The reliability of the weapon is the best among PGMs. With hundreds of test drops, only one case of a weapon that didn't guide has been recorded. The problem is getting the correct coordinates into the weapon. Weather is not a factor to the weapon. It doesn't need daylight, a good infrared (IR) signature, or clear skies to guide to the target. The need for the target to be stationary is a requirement for JDAM use.

Fire Bombs

MK-77 Firebomb. The MK-77 Firebomb is the primary firebomb. It is filled with 75 gallons of fuel/gel mixture and weighs 520 lbs. Ground patterns vary greatly depending on A/C dive angle, airspeed and altitude, but the typical pattern is elliptical in shape about 215 ft long and 75 ft wide.

Fuel Air Explosive (FAE). The CBU-72 FAE is a free-fall unguided weapon. It contains three FAE bombs. It is effective

- Against personnel, light material targets, mines, and booby traps
- For clearing landing zones

The explosive force comes from the detonation of the fuel, which forms an aerosol cloud on impact. When detonated, the resulting over pressure produces target destruction. The total weight of the weapon is only 520 lbs., but the explosive overpressure of each of the three FAE bombs is equal to a MK-82. The F/A-18 or the AV-8 can deliver FAE.

Marine Aviation Ordnance (Continued)

Cluster Bomb Unit (CBUs). CBUs consist of a bomb casing filled with many smaller munitions. These munitions include antipersonnel, anti-material, and antitank weapons. The CBU systems provide high kill or damage probability against area, moving, and point targets.

MK-20 Rockeye. The MK-20 is optimized for use against area, armored targets. It is effective against

- Tanks
- Trucks
- Radar vans
- Missile sites
- Fuel storage tanks
- Surface ships

The MK-20 consists of a dispenser, a mechanical time fuse that opens the dispenser at a selected time, and 247 MK-118 bomblets. The MK-118 has a small, shaped-charge warhead that can penetrate six inches of armor plate. Each bomblet has two fuzes:

- One that will set off the shaped charge if it hits a very hard object
- One that will produce fragmentation effects if the bomblet hits soft material

The Rockeye can be employed from all United States (US) attack jets.

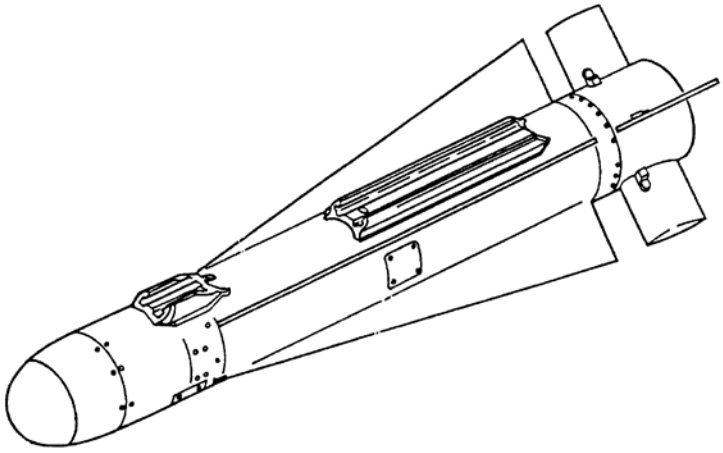
Combined Effects Munitions (CEM) (CBU-87). The CBU-87 (CEM) has improved effects in incendiary, fragmentation, and armor piercing capabilities. It consists of 202 bomblets in each container.

WARNING. Cluster munitions have an associated high dud rate. If the scheme of maneuver will require friendly forces to transit areas previously saturated, personnel should be warned of the hazard and move by vehicle through cleared areas if possible.

Marine Aviation Ordnance (Continued)

Air To Surface Guided Missiles.

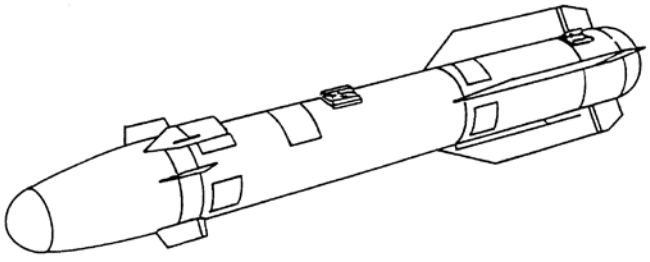
AGM-65 Maverick Missile. Used against armor and high value point targets. The Maverick is a LASER guided missile. Ranges for this missile can exceed 12NM. It has a 125-pound shaped-charge warhead designed to kill armor or other point targets. The Maverick is used by the F/A-18 and AV-8.



AGM-65 Maverick Missile

AGM-114 Hellfire Missile

Hellfire is a solid propellant, laser-guided, anti-armor missile that utilizes multiple warheads. A shaped-charge warhead is most common and can penetrate any known, fielded tank in the world. The Hellfire can also be fitted with a blast-fragmentation warhead, utilized against softer targets or buildings and a thermobaric warhead that utilizes overpressure to destroy targets in confined spaces such as caves, buildings, and ships. The AGM-114 provides pinpoint accuracy from a safe standoff distance. The AH-1W can carry the Hellfire. Hellfire has also been employed recently from the Predator Unmanned aerial vehicle (UAV). The Hellfire provides the AH-1W with the ability to engage multiple targets, offers increased standoff and lethality, and minimizes risk to aircrew by reducing or eliminating exposure time. The engagement range for the AGM-114 is 500-8000m.



AGM-114 Hellfire Missile

Marine Aviation Ordnance (Continued)

BGM-71 TOW Missile. TOW stands for tube-launched, optically-tracked, wire-guided missile. The TOW is a guided anti-armor missile that utilizes a shaped-charge warhead. The only aircraft that can fire the TOW missile is the AH-1W. The TOW offers point-of-aim, point-of-impact capability via a joystick and crosshair sights in the cockpit. Due to the requirement for the pilot to track the missile until impact, excessive exposure time can result at extended ranges. The engagement range for the BGM-71 is 500-3750m.

BGM-71 TOW

Rockets

2.75 Inch Rockets. The US Navy originally developed the 2.75-inch folding-fin aerial rocket (FFAR) for use as a free-flight aerial rocket in the late 1940s. Used during both the Korean and Vietnam wars, their role has expanded to include air-to-ground, ground-to-air, and ground-to-ground. The 2.75 inch rocket system has a rich history of providing close air support to ground forces. The 2.75-inch rocket can be fitted with multiple warheads for use in support of ground forces. HE, WP, and illumination are commonly used. The 2.75-inch rockets can also be fitted with a flechette warhead. The flechette warhead expels 2200 60-grain "nails" that cover an 80m x 80m area. The 2.75-inch HE rockets have an effective casualty radius (ECR) of 35m, similar to that of an 81mm mortar.

5-Inch "Zuni" Rockets. The Zuni rocket is simply a larger version of the "Mighty Mouse." As a fire support weapon, 5-inch rockets are primarily fitted with a HE warhead. Zuni rockets have an ECR of 50m, similar to that of a 155mm artillery round.

Marine Aviation Ordnance (Continued)

Guns

GAU-12 25mm. The GAU-12 25mm six-barrel gun pod is mounted on the centerline of the AV-8B Harrier. It has a 300 round capacity with a lead computing optical sight system (LCOSS) gunsight. The Harrier uses a 25mm depleted uranium [DU] round in the GAU-12 Gatling gun.

M61A1 "Vulcan" Cannon. The M61A1 utilized by F/A-18 aircraft is a 6-barreled weapon, with selectable rates of fire of either 4000 or 6000 rounds per minute. The F/A-18 has a capacity of 578 rounds of 20mm linkless ammunition. The gun's rate of fire, essentially 100 rounds per second, gives the pilot a shot density that will enable a "kill" when fired in one-second bursts. This high rate of fire maximizes its air-to-air kill capability, but this system is also highly effective against soft targets in the air-to-ground mode.

M197 20mm Turret System. The M197 utilized by the AH-1W aircraft is a lightweight, three-barrel Gatling type gun. The M-197 is mated to an ammunition storage and handling system that has a capacity of 750 rounds of linked ammunition. The M197 automatic gun has a firing rate of 650 rpm. Utilizing the PGU-28 semi-armor piercing, high-explosive incendiary (SAPHEI) round, the gun is highly effective against both lightly armored and soft targets.

GAU-16 50 CAL. This gun can be loaded in the door of assault support helicopters such as the UH-1N. It provides medium-range suppressive fire at a cyclic rate of 750-850 rpm. The gun can use either open iron sights or a laser pointer sight for use with Night Vision Goggles (NVG).

GAU-17 "Minigun". The GAU-17/A utilized on the UH-1N is a crew served, 6 barreled weapon, with a rate of fire of either 2000 or 4000 rounds per minute. In the UH-1N DAS configuration, the gun can be fixed forward and remotely fired by the pilot. The ammunition storage system has a capacity of 4000 rounds of linked 7.62mm percussion primed ammunition.

M240E. The M240E is simply an M240G medium machinegun modified to be fired from the door of the UH-1N. It fires 200 rpm at the rapid rate and a normal load out of 1000 rounds of 7.62mm.

Aircraft Capabilities

AH-1W Supercobra

- A maximum speed of 130 to 150 knots fully loaded
- Time on station from take-off to landing generally 1 + 45

Night Operations. All weapons on the AH-1W can be operated at night. The introduction of the night targeting system (NTS) aircraft enhances this capability. The NTS brings autonomous laser operations, forward looking infrared (FLIR), and laser range-finding to the battlefield. In addition, an extremely accurate GPS/INS system ties into the NTS to allow for 10-digit grid accuracy for targets.

Ordnance Knowledge

- Can carry 750 rounds of 20mm ammunition
- Fires 650 rounds a minute
- Has 2.75” rockets in 7-shot and 19-shot pods
- Has 5.0” rockets in 4-shot pods
- Can carry up to four Hellfire or TOW on either outside station

Table below describes the ordnance for the AH-1W.

Munition (Common Name)	Type/Range	Fuzes	Suitable For
HE frag	• 2.75” rocket/2500m • 5” rocket/3000m	• Impact • Proximity • VT	• Area targets • Personnel in the open • Light-skinned vehicles • Suppression
Flechette (2200 small darts)	2.75” rocket/1200 to 1500m	• Time • Motor burnout	• Personnel • Thin-skinned vehicles
Illumination	2.75” rocket/3500m	Time	• Illumination o 1,000,000 candlepower for 100 seconds (per rocket) • Marking
Smoke (white phosphorous/red phosphorous)	• 2.25” rocket/2500m • 5”rocket/3000m	Impact	• Marking • POL/fuel ignition
HE GP	5” rocket/3000m	Impact	• Concrete bunkers • Surface vessels • Light armored targets • Buildings • Personnel

Aircraft Capabilities (Continued)

Table below describes the precision-guided munitions for the AH-1W.

Munition	Min/Max Range	Suitable For
AGM-114 Hellfire • Guided on reflected laser energy • Shaped-Charge Warhead	500m/8000m	• Armor/all types • High value targets • Bunkers
BGM-71 TOW	Wire guided 500/3750	• Armor • Bunkers • Point targets • Vehicles

Table below describes the munitions for the AH-1W 20mm cannon

Munition	Range	Suitable For
PGU-28/B SAPHEI	2000m	• Aircraft • Light armor • Personnel

AV-8B Harrier

- Maximum speed is 585 knots at sea level
- Normal ordnance delivery speed is 420 to 480 knots
- Time on station after 30-minute transit is 20 to 40 minutes

Night Operations. All weapons on the AV-8B can be operated at night. The introduction of the LITENING II Pod enhances this capability. The LITENING pod brings autonomous laser operations, FLIR, laser range-finding, and IR pointer to the battlefield. In addition, an extremely accurate GPS/INS system ties into the LITENING pod to allow for 10-digit grid accuracy for targets.

Ordnance Loads and Profiles. If aircraft requires vertical takeoff (LHA/LHD), ordnance loads are reduced. The following table lists ordnance considerations for the AV-8B.

Aircraft Capabilities (Continued)

AV-8B Harrier	

Air-to-Ground Weapons	• 25mm cannon gun pod
	  o 300 rounds
	• Cluster bombs
	  o Rockeye (antipersonnel, antitank)
	  o APAM (antipersonnel, anti-material)
	• MK-82, 83
	  o General purpose bombs
	  o 500, 1000 pounds
	• GBU-12, 16
	  o Laser guided variants of MK-80 series bombs
	• GBU-38, 32 (JDAM)
	  o GPS-guided variants of Mk-80 series bombs
	• 2.75” and 5” rockets
	• AGM-65 Maverick (laser guided antitank missile)
	• Mk-77 Napalm

Special Purpose Equipment	• APG-65 radar
	  o Same radar as F/A-18
	  o Increases weapons delivery accuracy
	• GPS
	  o Extremely accurate
	• LITENING II Pod– used for
	  o Nighttime navigation
	  o Night attack
	  o When combined with GPS, can provide 10-digit grid to target
	• Laser spot tracker (LST)
	  o Detects laser energy directed on target from external source

F/A-18 Hornet

- Maximum speed is 550 knots at sea level
- Normal ordnance delivery speed is 480 to 540 knots
- Time on station after 30-minute transit is 30 to 55 minutes

Night Operations. All weapons on the F/A-18 can be operated at night. The introduction of the LITENING II Pod enhances this capability. The LITENING pod brings autonomous laser operations, FLIR, laser range-finding, and IR pointer to the battlefield. In addition, an extremely accurate GPS/INS system ties into the LITENING pod to allow for 10-digit grid accuracy for targets.

Ordnance Loads and Profiles. Four to eight 1000-pound bombs will be normal air-to-ground ordnance with either one or two external fuel tanks.

Aircraft Capabilities (Continued)

The table below lists ordnance for the F/A-18.

Air-to-Ground Weapons	• 20mm cannon – 578 rounds
	• Cluster bombs
	  o Rockeye (antipersonnel, antitank)
	• MK-82, 83, 84 (500, 1000, 2000 pound)
	  o General purpose bombs
	• GBU-12, 16, 10 (500, 1000, 2000 pound)
	  o Laser guided variants of MK-80 series bombs
	• 2.75” rockets primarily used for forward air controller-airborne (FAC(A)) missions with WP rounds
	• 5” rockets
	• AGM-65 Maverick (laser guided antitank missile),
	• MK-77 Napalm
	• GBU-38, 31, 32 (JDAM) (500, 1000, 2000 pound)
	  o GPS-guided variants of Mk-80 series bombs

Special Purpose Pods	• LITENING II Pod– used for
	  o Nighttime navigation
	  o Night attack
	  o When combined with GPS, can provide 10-digit grid to target
	• FLIR – slewable to track and laser designate targets
	• Laser spot tracker/strike camera (LST/SCAM)
	  o Front half of pod detects laser energy from external source (FAC)
	  o Rear of pod has 35mm camera that photographs target before, during, and after weapons impact)

Aircraft Capabilities Charts. Table lists capabilities for types of Aircraft.

F/A-18 A/C and F/A-18D	
Crew	1 and 2, respectively
Performance	• Maximum level speed at sea level: 550 KIAS • Typical delivery speed: 500 KIAS • Time on station after 30-minute transit: 40 to 45 minutes
Payload	• 13,700 lbs • Air-to-ground: MK-80 Series/LGBs/JDAM, 2.75"/5" rockets, MK-20, CBU-78, MK-77, Maverick
Sensors/Self-Protection	LITENING II Pod • NVG • LST • Laser (Self) Designator
Comm/Navigation	• Two UHF (AM/FM) • Two VHF (AM/FM) • Radar

Aircraft Capabilities (Continued)

AV-8B	
Crew	1
Performance	• Maximum level speed at sea level: 500 KIAS • Typical delivery speed: 500 KIAS • Time on station after 30-min transit: 20 to 40 minutes
Payload	• 8,000 lbs • Air-to-ground: MK-80 Series/LGBs/JDAM, 2.75"/5" rockets, MK-20, CBU-/78, MK-77, Maverick
Sensors/Self-Protection	• Radar • LITENING II Pod • NVG • Laser Spot Tracker
Comm/Navigation	• Two UHF (AM/FM) • Two VHF (AM/FM)
AH-1	
Crew	2
Performance	• Maximum speed: 190 KIAS • Cruise speed: 130 KIAS • Time on station after 30-min transit: 45 to 55 minutes
Payload	• Hellfire • TOW • 2.7"/5" Rockets • 20mm turret gun
Sensors/Self-Protection	• FLIR via NTS • ALE-39 • Infrared radiation counter-measure • Laser designator
Comm/Navigation	• Two UHF (AM/FM) • Two VHF (AM/FM)
UH-1	
Crew	2 pilots, 2 crewchief/gunners
Performance	• Maximum speed: 130 KIAS • Cruise speed: 100 KIAS • Time on station after 30-min transit: 30 to 50 minutes
Payload	• 1,400 to 1,800 pounds • 6 to 13 pax, 6 litters • 7.62mm (GAU-17, M240E) • .50 caliber guns (GAU-16) • 2.75" rockets
Sensors/Self-Protection	• BRITESTAR FLIR w/ laser designator
Comm/Navigation	• UHF/VHF/HF

Aircraft Capabilities (Continued)

Capabilities

Battlefield Utility. Ground force commanders request CAS to augment organic supporting fires. CAS is used to attack the enemy in a majority of weather conditions, day or night. When CAS is properly employed, commanders can focus its firepower at the decisive time and place to achieve tactical objectives. Advances in tactics, techniques and procedures (TTP) and equipment have improved the ability of aircraft to provide close support. By using CAS, commanders can take full advantage of battlefield opportunities. The three-dimensional mobility of aircraft provides commanders with the means to strike the enemy swiftly and unexpectedly.

CAS Integration. CAS is integrated with other available supporting fires to support maneuver forces allowing the commander to *mass fires*. Whether conducting offensive or defensive operations, commanders plan for CAS at key points throughout the depth of the battlefield. The MAGTF commander establishes the priority for the assignment of CAS, so it supports his intent and concept of operations. Commensurate with other mission requirements, the Aviation Combat Element (ACE) commander postures aviation assets to optimize support to requesting units.

Range. CAS aircraft have the ability to deliver ordnance over the horizon, well beyond the range of surface-based fires. Refueling assets either on the ground or airborne can further increase aircraft range and weapons payload.

Maneuverability/Flexibility. CAS aircraft allow the attack of targets that other supporting arms may not be able to effectively engage because of limiting factors, such as type of target, the terrain, or the friendly ground scheme of maneuver. Aircraft can quickly adjust onto new targets of opportunity in a quickly changing battle space.

Speed/Shock/Surprise. Aircraft can get to the fight quickly, surprise the enemy from any direction, and drop large amounts of high explosive munitions on a target.

Shipboard Employment. CAS aircraft can be employed from carrier-based or amphibious shipping to provide support for movement ashore and inland when other surface-based fire support assets are unavailable.

Responsiveness. CAS aircraft on station can quickly acquire and engage targets on the battlefield in a more timely manner than surface-based fire support assets.

Aircraft Capabilities (Continued)

Limitations

Weather. Bad weather can severely limit or preclude CAS operations. If fixed- or rotary-wing CAS aircraft cannot visually acquire the target area due to severe weather or poor visibility, they will be unable to safely deliver their ordnance. The FAC must also be able to visually acquire the aircraft in order to give clearance for ordnance delivery.

Time on Station. CAS support will be limited to how long an aircraft can remain on station. If aircraft must fly from far-away bases without en-route refueling assets, their time on station as well as the amount of ordnance they can carry to the fight will be reduced.

Vulnerability to Air/Ground Attack. CAS aircraft are vulnerable to enemy surface/air attack. These threats must be suppressed or eliminated for the proper delivery of ordnance as well as the protection of vital warfighting assets.

Conclusion. Maneuver commanders should be familiar with the employment of aircraft in support of the ground combat element (GCE) scheme of maneuver. The shock, surprise, and combat power that can be brought to bear when integrating surface fires with air underscore our tactical nature as a maneuver force. Our ability to act as a self-contained, self-supported combat force enables us to seize and maintain the initiative in the attack. The speed and responsiveness of CAS aircraft on the battlefield grants the maneuver commander momentum and flexibility. The use of air power allows the supported unit to shape the battle space in the close fight as well as deep into the enemy-held territory.

Summary

The fundamental principles of our combined arms philosophy centers on the massing of fires, both surface and air, to destroy the enemy's will and ability to fight.

References

Reference Number or Author	Reference Title
Joint Publication 1-02	DOD Dictionary of Military and Associated Terms
FMFM 2-7	Fire Support in MAGTF Operations
FMFM 6-18.1	TTPs for the Marine Corps Fire Support System
FMFM 6-9	Marine Artillery Support
FM 7-90	Tactical Employment of Mortars
MCWP 3-23	Offensive Air Support
MCWP 3-23.1	Close Air Support

Glossary of Terms and Acronyms

Term or Acronym	Definition or Identification
ACE	Aviation combat element
ADAM	Area denial artillery munitions
APAM	Antipersonnel, anti-material
ATF	Amphibious task force
BAD	Blast attenuation device
CAS	Close air support
CBU	Cluster bomb unit
CEM	Combined effects munitions
CG	Guided missile cruiser
CLGP (or copperhead)	Cannon launched guided projectile
DD	Destroyer
DDG	Guided missile destroyer
DP	Dual purpose
DU	Depleted uranium
ECR	Effective casualty radius
FAC(A)	Forward air controller (airborne)
FAE	Fuel air explosive
FASCAM	Family of scatterable mines
FDC	Fire direction center
FDO	Fire direction officer
FFAR	Folding-fin aerial rocket
FLIR	Forward looking infrared
FO	Forward observer
FSA	Fire support area
FSC	Fire support coordinator
FSCC	Fire support coordination center
GBU	Guided bomb unit
GCE	Ground combat element
GFCS	Gunfire control systems
GP	General purpose
GPS	Global positioning system
GTL	Gun-target line
GS	General support
HE	High explosive
ICM	Improved conventional munitions
INS	Inertial navigation system
IR	Infrared
JDAM	Joint direct attack munitions
LAR	Light Armored Reconnaissance
LCOSS	Lead computing optical sight system
LGB	Laser guided bomb
LNO	Liaison Officer
LST	Laser spot tracker
MAGTF	Marine Air Ground Task Force
NSFS	Naval Surface Fire Support

Glossary of Terms and Acronyms (Continued)

Term or Acronym	Definition or Identification
NTS	Night targeting system
NVG	Night vision goggles
RAAMS	Remote anti-armor mine system
RAP	Rocket-assisted projectile
SAPHEI	Semi-armor piercing high-explosive incendiary
TOW	Tube-launched, optically tracked, wire-guided
TTP	Tactics, techniques and procedures
UAV	Unmanned aerial vehicle
US	United States
VT	Variable time
WP	White phosphorous

Notes