

AIR DEFENCE ARTILLERY DOCTRINE

(ENGLISH)

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Issued on Authority of the Chief of the Defence Staff

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FOREWORD

1. B-GL-372-001/FP-001, *Air Defence Artillery Doctrine*, is issued on the authority of the Chief of the Defence Staff.
2. Suggestions for amendments should be forwarded through normal channels to the Director of Army Doctrine, attention DAD-7.
3. Unless otherwise noted, masculine pronouns apply to both men and women.
4. The NDID for the French version of this publication is B-GL-372-001/FP-002.

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CHAPTER 1 ROLE OF AIR DEFENCE ARTILLERY

INTRODUCTION

1. The air battle is an integral part of the joint and combined battle. This chapter defines the role of Air Defence Artillery (AD Arty) and relates the principles of war to Air Defence (AD). AD Arty is the term for the Land Force's contribution to joint counter-air operations. AD includes offensive and defensive actions to counter the air threat. This doctrinal manual expands on the operational use of army AD Arty as presented in B-GL-300-007/FP-001 *Firepower*.

2. **The Three Degrees of Control.** The airspace of a theatre is as important a dimension to joint operations as the terrain itself. Airspace is used for critical purposes including manoeuvre, firepower, reconnaissance and surveillance, transportation and battle command. Effective control and use of the airspace will decide the outcome of campaigns and battles.

3. Commanders must consider airspace and the apportionment of air power in planning and supporting their operations. Commanders must expect the enemy to contest their use of the airspace and must protect friendly forces from enemy observation and attack.

4. AD operations contribute to gaining and maintaining the desired degree of air superiority and force protection.

5. The three basic degrees of control of the air are defined as follows:

- a. **Favourable Air Situation.** A favourable air situation is one in which the extent of air effort applied by the enemy is insufficient to prejudice the success of friendly land, sea or air operations.
- b. **Air Superiority.** Air superiority is that degree of dominance in the air battle of one force over another which permits the conduct of operations

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by the former and its related land, sea, and air forces at a chosen time and place without prohibitive interference by the opposing force.

- c. **Air Supremacy.** Air supremacy is that degree of air superiority wherein the opposing air force is incapable of effective interference.

6. Synchronization of ground operations with air operations is synergistic and is a fundamental element of successful campaigns and battles. Air forces, through such missions as counter-air and close air support, directly support the land campaign. The Land Force's part in the theatre campaign is diverse and requires a multi-purpose combat capability. The destruction of enemy air assets by AD Arty is an important component of the theatre defensive counter-air mission.

ROLE

7. The role of the AD Arty is to prevent the enemy from interfering from the air with friendly force operations on the ground. This role encompasses many aspects, from protection of the force through passive measures to the protection afforded by the destruction of the enemy's air assets.

8. There are a number of terms which take on added meaning when employed in the role of AD Arty:

- a. **Prevention.** Prevention means that the enemy is not permitted to influence friendly force operations on the ground through the use of air assets. It does not prescribe the manner in which this prevention is to be accomplished. It is left to the AD Arty commanders to decide on the best method to fight the AD Arty battle.
- b. **Enemy.** The threat is not limited to attack aircraft and helicopters. The threat includes aircraft, air-launched missiles, surface-launched missiles, and aerial surveillance platforms. An expanded list of threats driven by technological advances and

proliferation now includes unmanned aerial vehicles, cruise missiles and tactical ballistic missiles.

- c. **Interference.** This broad term encompasses any type of interference that the enemy could impose from the air. It is not linked solely to direct attack but also encompasses intelligence, surveillance, and target acquisition and reconnaissance (ISTAR) assets.

DEFINITIONS

9. **Air Defence Artillery.** This includes all artillery weapons, both guns and missiles, which are designed primarily to destroy or neutralize enemy air vehicles, either to protect installations, designated areas and personnel, or to deny the enemy the use of airspace. It also encompasses equipment provided for target acquisition, fire distribution and control, communications, and movement, which is necessary for the effective employment of AD weapons.

10. **Categories of Air Defence.** The manoeuvrist approach to warfare requires the closest possible integration of AD systems into the joint and combined arms battle. The overall joint AD design for battle must integrate the coverage of the various weapons systems available into a layered structure. Layers must overlap in range and height to allow more than one system to engage the enemy. This is achieved by a mix of aircraft and both static and mobile AD Arty systems.

11. AD Arty weapons fall into three categories:

- a. High/Medium AD (HIMAD);
- b. Low Level AD (LLAD) categories of Short Range AD (SHORAD); and
- c. Low Level AD (LLAD) categories of Very Short Range AD (VSHORAD).

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12. HIMAD is the responsibility of the Canadian Forces air element with CF18 aircraft. Layered AD is depicted at Figure 1-1.

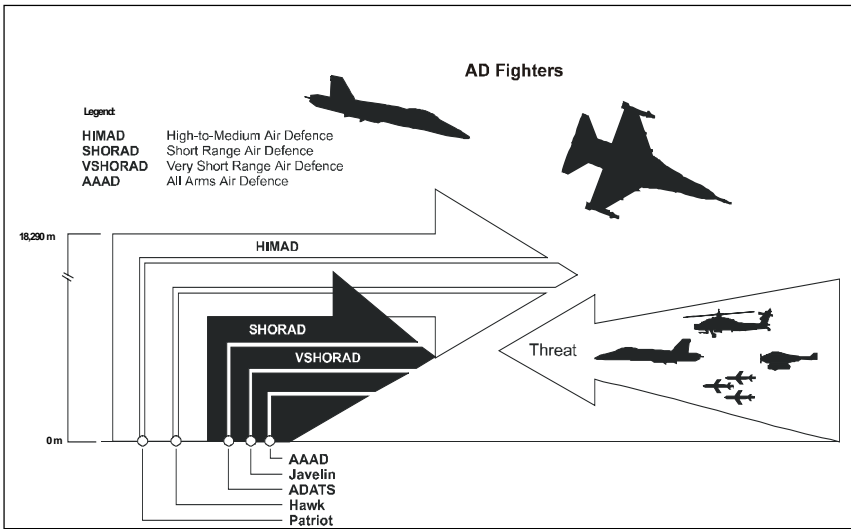


Figure 1-1: Layered Air Defence

FUNCTIONS OF THE AIR DEFENCE SYSTEM

13. An effective AD system must:
- a. detect, acquire, and identify a target;
 - b. intercept it; and
 - c. destroy or neutralize it before its weapons are released.
14. Neutralize means to render ineffective. AD Arty can achieve neutralisation in many ways; e.g., it can force premature weapon release (thus making the enemy weapons ineffective) or prevent enemy air operating in certain areas.

COMPONENTS OF THE AIR DEFENCE SYSTEM

15. A combination of counter-surveillance measures, emission control measures, and ground and airborne sensors linked by effective communications to interceptor aircraft and AD Arty provide the means of defeating the air threat.
16. Dedicated AD assets may be provided by all components. Resources of the active AD system include weapons, command and control, and additional contributing, systems.
17. The components of an AD system are as follows:
 - a. **Weapons Systems.** This includes an integrated mix of fighter aircraft and AD Arty systems.
 - b. **A Control and Reporting System.** An AD command and control system is required to link all the AD components and to provide the means to alert and control the AD weapons systems.
 - c. **AD Sensors.** A number of complementary systems are required to carry out surveillance and control functions.

PRINCIPLES OF WAR

18. AD operations are inherently joint and usually combined. AD Arty forces are versatile and agile and fight throughout the battlefield. Through aggressive planning and fully synchronized execution, AD Arty allows the commander at any level to maintain freedom of action. AD operations are integrated with campaigns fought at the operational level as well as battles and engagements fought at the tactical level.
19. **Selection and Maintenance of the Aim.** As with all arms, every operation must have a single, attainable and clearly defined “end-state,” which remains the focus of the operation and to which all efforts are directed. AD Arty commanders must understand the mission of the supported formation commander and the overall AD commander to effectively conduct the battle. If these missions are

not complementary, they must be re-examined. All commanders must clearly understand and communicate to their troops the overall intent of the higher command, their own mission, the tasks they must perform, and the reasons why. A sound tactical mission, widely known and understood, facilitates unity of command and, if necessary, choice of an alternative course of action.

20. **Maintenance of Morale.** The surprise and ferocity of air attack often has a detrimental effect on morale out of proportion to the actual physical damage inflicted. Provision of effective AD to a force has a significant morale enhancing effect.

21. **Offensive Action.** AD Arty is inherently defensive in nature. Through the aggressive deployment of AD Arty assets in a forward deployment posture and attrition tasks, AD Arty can achieve offensive action.

22. **Surprise.** The effects of concentration of force and economy of effort are enhanced by surprise. To surprise the enemy is to deny him any knowledge of our actions. AD Arty assets accomplish this through the destruction of enemy air ISTAR assets. AD Arty can also surprise the enemy air commander through the use of aggressive and/or unconventional tactics and by understanding the enemy's methods of operation.

23. **Security.** Protection of friendly forces is essential if combat power is to be created and preserved. AD Arty provides protection from air attack and surveillance.

24. **Concentration of Force.** To undertake any military operation, commanders must be able to concentrate their forces to achieve the aim in a decisive manner with a minimum of casualties. AD Arty allows formation commanders to concentrate their forces with a reduced risk of disruption by air assets.

25. **Economy of Effort.** AD units are unlikely to be so numerous that they are able to defend all ground assets. Priorities must be established so that AD can be focused on tasks **that will allow** the limited resources to have the greatest effect.

26. **Flexibility.** The ability to react quickly and anticipate changing circumstances leads to success. The aim and the intent of

plans and orders must be borne in mind. AD Arty must react quickly to changes in tactics of the enemy.

27. **Cooperation.** As AD is inherently a joint responsibility, AD Arty units must not only cooperate with other ground forces but must consider naval and air operations to best accomplish the aim.

28. **Administration.** Administration is key to all operations. AD Arty ensures that the force's administrative and logistic resources are protected from air attack, thus ground operations are not hindered by administrative deficiencies. Effective administration of manpower and equipment in AD Arty units allows for the efficient conduct and performance of the assigned mission.

AIR DEFENCE ARTILLERY OPERATIONAL CONCEPT

29. **General.** The AD Arty mission in operations concentrates on the protection of ground forces and the attrition of enemy air assets. AD provides the security coverage, under which all other forces can operate. The Army has the primary responsibility to provide Ground Based Air Defence¹ (GBAD) against the low-level air threat.

30. **Air Defence Artillery Operations.** The nature of operations at various levels within a theatre influences the tasks assigned to AD Arty resources.

31. **Theatre/Army Group.** Operations at these levels are conducted from relatively static locations. Movement will normally only occur for reasons of self-defence. AD resources protect important theatre/army group assets and lines of communications. HIMAD resources are commonly employed within these areas.

32. **Corps.** Operations at this level are characterized by rapid movement to reinforce divisional AD resources and protect critical

¹ The term GBAD is commonly used in United Kingdom AD terminology and is becoming increasingly accepted within American, British, Canadian, Australian Armies Standardization Program forums. It is not yet an accepted as a North Atlantic Treaty Organization term.

assets. Typically HIMAD and SHORAD resources are employed within the corps area.

33. **Division and Below.** Operations at these levels are characterized by frequent movements, protection of manoeuvre elements, and maximum attrition of enemy air assets. VSHORAD and SHORAD resources are commonly employed within the divisional area, weighted to the forward brigades, with the primary emphasis on their ability to manoeuvre with the supported formation.

TACTICAL FUNCTIONS OF AIR DEFENCE

34. The tactical functions of AD Arty are:

- a. early warning,
- b. protection,
- c. attrition, and
- d. airspace coordination.

35. **Early Warning.** Early warning is provided by AD weapons systems, other units, sensors, and links through the control and reporting system. All these elements report to the command and control organization, which, in turn, edits the information received and issues early warning. Further explanation is provided in Chapter 5.

36. **Protection.** AD Arty is deployed to provide protection by typically adopting one of the following types of defence:

- a. **Area Defence.** Area defence is a posture designed for the defence of a broad area. Joint air forces provide area defence for the theatre of war. AD of the theatre is provided by a combination of AD Arty and air assets. HIMAD (e.g., Patriot) provides area AD at high altitude for the theatre. SHORAD assets provide low-level area AD coverage, particularly for manoeuvre forces.

- b. **Point Defence.** Point defence is a posture designed for the protection of a limited area or point target, normally in defence of the vital elements of a force or of vital installations. VSHORAD units are integrated into the manoeuvre force to provide protection according to the manoeuvre commander's scheme of manoeuvre and AD priorities.
- c. **Route Defence.** Route defence is designed to provide protection along a designated route or axis of advance, or to protect various points along a given route.
- d. **Attritional Air Defence.** Attritional AD is designed to destroy or damage as many enemy air assets as possible. Deployment is affected more by considerations of coverage and likely air avenues of approach than by the location of friendly forces. The advantage of attritional AD is that every air vehicle destroyed will reduce the number of sorties that the enemy can fly. Deployment to achieve attrition cannot, however, be considered in isolation from positions of friendly forces/assets likely to be targeted from the air. It is probable that the best killing areas will be found at, or on the way to, the targets that the enemy is most likely to attack.
- e. **Airspace Coordination.** The purpose of an Airspace Control (Coordination) System (ACS) is to provide minimum risk to friendly air assets, minimum restrictions to AD weapons, and efficient operability in an Electronic Warfare environment. This subject is examined in greater detail in Chapters 5 and 6.

DEPLOYMENT POSTURE

37. AD Arty can be deployed in either an attritional (as described above) or defensive posture. Defensive AD is designed to

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protect those assets that are vital to the achievement of the commander's mission. It requires a high concentration of AD weapons systems, which inevitably reduces the overall AD coverage elsewhere. Because other assets are, therefore, likely to lack effective AD protection, commanders must understand the risks associated with their declared priorities.

CHAPTER 2 THREAT

INTRODUCTION

1. This chapter outlines the present and emerging air and missile threats facing ground forces. Understanding the threat is the first step in countering it. By focusing on an enemy's capabilities and methods of operations, Air Defence (AD) commanders can best employ AD resources to protect the force and selected assets, minimize casualties, and provide freedom to manoeuvre.

CHANGING NATURE OF THE THREAT

2. The dissolution of the Warsaw Pact and the disintegration of the Soviet Union have resulted in changes to the worldwide geopolitical structure. The North Atlantic Treaty Organization (NATO) no longer faces the threat of a communist block which posed a major threat to security. The focus on internal political and economic reconfiguration in the former Soviet Union and the elimination of the Soviet troop presence in central Europe have reduced the likelihood of a super power confrontation.

3. However, the world is now even more unstable due to increased nationalism and religious fundamentalism along with changing political affiliations and their ensuing conflicts. Regional conflicts and the proliferation of modern military technology mean that Canada as part of NATO or as part of a coalition must be prepared to deploy anywhere in the world with little notice, fully trained and ready to face the full range of threat capabilities.

4. Potential force projection missions range from operations other than war to full combat operations. Lack of a single, concrete threat doctrine and structure requires an army with operational flexibility and versatility.

5. New threats in regional conflicts will pose a serious challenge to military planners and commanders. In the future, we can expect to see future adversaries armed with the full spectrum of military hardware from pre-World War II vintage equipment to the

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most technologically advanced systems. Future adversaries will also differ in their dedication, competence and ability to employ their weapons effectively.

6. The AD commander and staff must consider the broad spectrum of potential air and missile threats to successfully protect the force and selected assets.

7. Numerous countries worldwide are employing Intelligence, Surveillance, Target Acquisition, and Reconnaissance (ISTAR) systems for the detection and location of ground targets particularly Air Defence Artillery (AD Arty) systems. These ISTAR systems include technical and human intelligence collection means, electro-optics, acoustic and seismic sensors, battlefield radars, Signals intelligence and aerial reconnaissance. Timely, accurate intelligence on the disposition and location of forces is a prerequisite for success in any military operation.

8. Conflicts in regions such as the Middle East, Eastern Europe, the Far East, Africa, Latin America, and South Central Asia represent potential threats to national and international interests. Countries in these areas have a wide range of ISTAR capabilities. However, even with limited ISTAR resources, most nations present an ISTAR threat to allied or coalition forces.

9. All ground manoeuvre forces require protection from enemy ground, air and naval attack. Successful counter-reconnaissance operations prevent the targeting and attack of friendly forces.

10. Threat reconnaissance efforts will be directed toward specific targets where information on allied or coalition force operations and intentions may be obtained. This information, when passed to fire support systems, enables the enemy commander to accurately engage friendly forces and inflict heavy casualties.

11. Unmanned aerial vehicles (UAVs) as well as fixed and rotary wing aircraft are threat reconnaissance systems that must be suppressed or defeated. Each one of these systems will operate against particular target types.

12. Helicopters equipped for optical reconnaissance can be expected to operate against corps and division forces.
13. UAVs will conduct ISTAR against tactical and operational targets throughout the theatre. These systems will emphasise rapid down link of collected information to artillery and Tactical Ballistic Missile (TBM) fire control centres and enemy manoeuvre forces.
14. Fixed-wing reconnaissance aircraft will normally operate against corps or theatre targets. The information they collect will normally be used to support targeting of deep attack assets, such as airfields or missile sites.
15. Denial of the enemy's ISTAR efforts is essential for force protection.

AIR DEFENCE ARTILLERY TARGETS

16. **Fixed-wing Aircraft.** Fixed-wing aircraft are presently the most predominant threat to land forces; however, they are also the least survivable of the air threat systems to be encountered. Notwithstanding the enemy could potentially use them to establish local air superiority or air parity.
17. The categories of threat aircraft include:
 - a. bombers, e.g. Backfire;
 - b. fighters, e.g. Fulcrum or Mirage III;
 - c. fighter-bombers, e.g. Fencer or Flogger;
 - d. ground attack fighters, e.g. Frogfoot; and
 - e. reconnaissance aircraft, e.g. Brewer.
18. However, the trend among potential threat nations is toward smaller air forces and multi-role aircraft due to escalating costs of fixed-wing aircraft. Multi-role aircraft, such as the improved Su35 Flanker, Mirage F1 and F/A18 Hornet, can be expected to eventually

replace many of the single-mission aircraft that are currently in operation.

19. Enemy air missions can include strategic attack, air interdiction, close air support, electronic combat and reconnaissance.

20. Air defenders can expect enemy fixed-wing aircraft to be used against high-value targets, such as seaports, airports, troop concentrations, AD Arty units, battle command nodes and logistics sites. They will also attack targets of opportunity.

21. Ground forces can expect to find fewer enemy fixed-wing aircraft dedicated to support ground attack and reconnaissance operations. This does not mean that the manned fixed-wing threat has disappeared. The enemy may have the capability to peak in the beginning of a conflict especially in conjunction with a pre-emptive strike. The enemy may not be able to maintain that level of operations very long because of alliance or coalition counter air operations. Ground forces can however expect the enemy to establish a degree of local air parity or superiority. These aircraft would then become targets for AD Arty.

22. **Fixed-wing Aircraft Attack.** Fixed-wing attack aircraft are characterised by:

- a. Transit and attack speeds between 200 and 700 knots (100 and 350 m/s), with turns of up to seven Gs.
- b. Attack at either low (between 30 and 150 m) or medium altitude and possible transit altitude of less than 30 m.
- c. The ability to launch stand-off weapons in the form of:
 - (1) Tactical Air-to-Surface Missiles (TASMs);
 - (2) Antiradiation Missiles (ARMs); and
 - (3) Cruise Missiles.

- d. The ability to use other weapons such as free fall and Laser guided bombs (LGBs) which may be toss or loft delivered from ranges of up to 10 km. LGBs may be designated from another aircraft flying at low or medium altitudes or from a ground-based designator.
- e. Night and all weather attack capability by aircraft fitted with advanced sensors and navigation systems.
- f. Protective measures may include:
 - (1) Electronic Counter Measures (ECM), including chaff;
 - (2) Electronic Support Measures (ESM);
 - (3) Electro-Optical Counter Measures (EOCM), including flares; and
 - (4) other aircraft providing ECM and Suppression of Enemy Air Defences (SEAD).

23. **Fixed-wing Ground Attack Techniques.** Ground attack aircraft may attempt to penetrate friendly airspace at low or very low level before manoeuvring to attack. The method of attack will depend on the type of weapon being used, the aircraft delivering it, friendly air defences, terrain and weather conditions.

24. The most frequently used attack profiles are:

- a. **Laydown Attack.** Aircraft use bombs (slick or retard), napalm, fuel/air or chemical munitions. The aircraft flies, at low level, directly to its target and weapons are released at low altitude. Typical height and speed are 100 m and up to 600 knots.

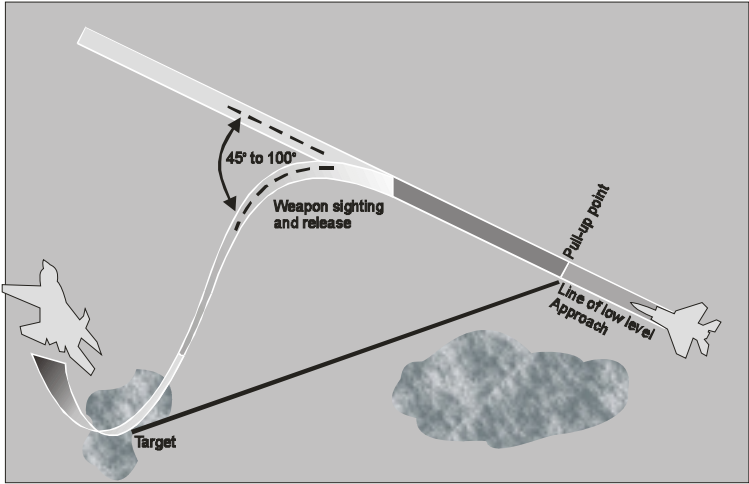


Figure 2-1: Laydown Attack

- (1) Advantages:
 - (a) maximum surprise and minimum exposure to ground fire; and
 - (b) attacks can be made under a low cloud base; and
- (2) Disadvantages:
 - (a) target acquisition can be difficult and weapon delivery inaccurate, particularly if the aircraft is not fitted with sophisticated navigational devices; and
 - (b) only certain types of munitions may be used, e.g. retard bombs, napalm.

b. **Offset and Pull-up Attack.** This profile is a pre-planned or Forward Air Controller controlled attack consisting of a high-speed (up to 600 knots) low level approach possibly from an Initial Point

(IP) usually 10 to 20 km from the target. Terrain features can be used to mask the approach to achieve surprise and the approach track is offset from the target. At a pre-planned Pull-up Point (PUP), 3 to 7 km from the target, the aircraft climbs to attack altitude, then turns and dives towards the target. Weapons may be released 500 to 3000 metres from the target for low level, and up to 6 km for medium level.

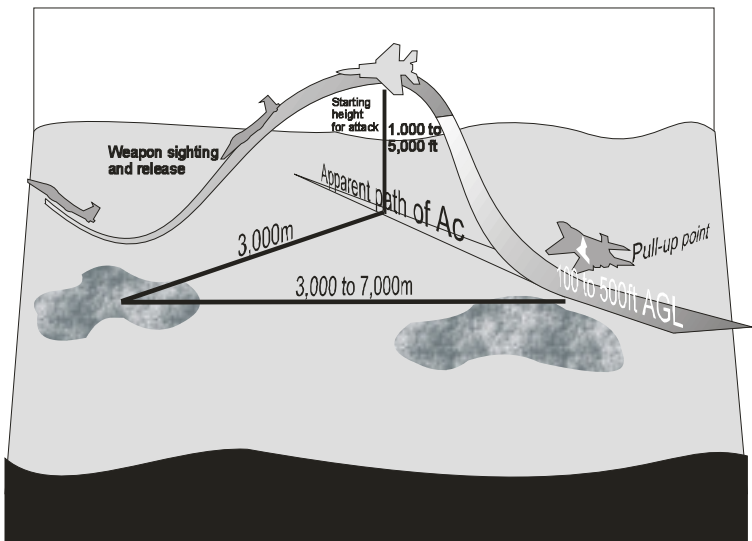


Figure 2-2: Offset and Pull-up Attack

- (1) Advantages:
 - (a) good weapon delivery accuracy; and
 - (b) easy target acquisition.
- (2) Disadvantages:
 - (a) high cloud base required; and

- (b) an attacking aircraft is vulnerable to ground fire during the pull-up manoeuvre.
- c. **Dive Attack.** This type of attack is usually employed against opportunity targets, using a shallow dive, directly towards the target, from cruising altitude.
- d. **Toss or Loft Bombing.** Toss or loft bombing is a pre-planned means of weapon delivery allowing the aircraft to attack 2 to 7 km from the target. The aircraft approaches the target at low level possibly from an IP. At the PUP the aircraft climbs and releases its weapon during the climb, tossing it at the target. With the advent of technical improvements this method offers a degree of safety for the pilot without sacrificing accuracy. This method can also be used with either air or ground laser designation of the target.

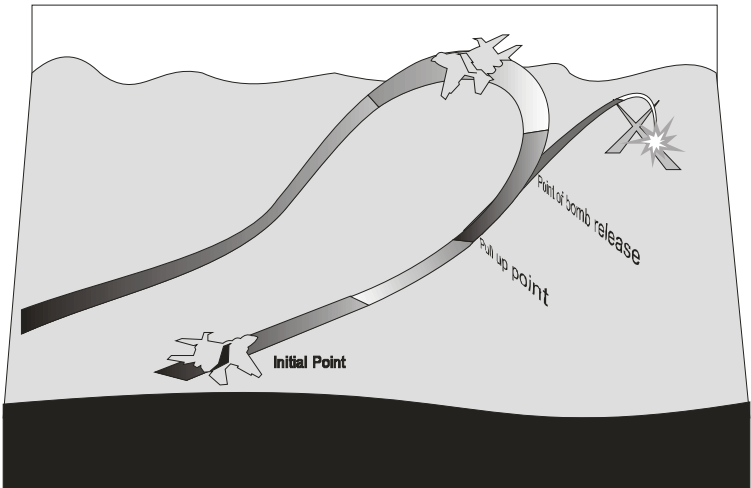


Figure 2-3: Toss Bombing

25. **Helicopters.** The versatility and survivability of helicopters make them ideal air assets for use in division and corps areas. Today, it is difficult to predict the helicopter tactics particular

to a region or country. However, tactics may be defined by pilot training and the capability of the platform. Adequately trained, these forces can employ tactics that will make them very difficult to engage. Specifically, low-flying helicopters are difficult to acquire and target. Air defenders can, in most cases, expect enemy helicopters to attack in pairs, taking full advantage of terrain masking techniques.

26. Typical characteristics of Attack Helicopters (AH) are:
- a. Transit speeds of up to 200 knots with turns of three to four Gs.
 - b. Attacks from the hover, preferably from behind cover or from a shallow dive.
 - c. Ability to launch stand-off attacks using:
 - (1) anti-tank missiles with ranges up to 10 km;
 - (2) unguided rockets with ranges of 2 to 3 km; and
 - (3) machine guns and cannon from ranges of 0.5 to 3 km.
 - d. AH can have a night and all weather capability using advanced sensors and navigation systems. They may also be fitted with Electronic Warfare (EW) systems such as radar warning receivers or jammers, and EOCM systems such as flares. These systems are designed to detect AD Arty systems and counter their target acquisition capabilities.
 - e. Armour to protect the crew and critical control systems.

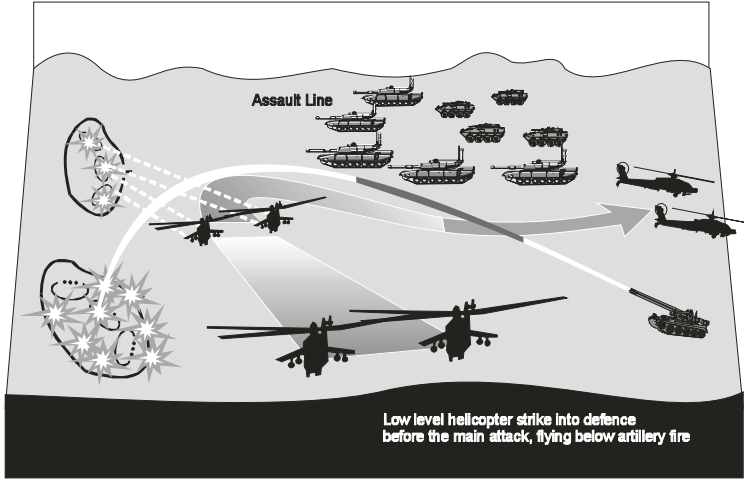


Figure 2-4: Helicopter Attack

27. The advent of the armed utility helicopter offers a cheaper but very effective alternative to the attack helicopter. Armed utility helicopters and AHs will serve as the principal close air support weapon system for many potential threat countries. They will pose a major threat to combat arms units in close operations.

28. Additionally, a number of potential threat countries actively train to conduct helicopter operations in support of national or military objectives. In most cases, helicopters will insert special operations forces in rear areas to disrupt friendly command and control facilities, and attack high-value assets. These troops are usually highly trained, extremely motivated and highly survivable once on the ground. Therefore, it is imperative to engage these forces before they land.

29. Depending on the enemy's capabilities, it could be possible to mount large-scale airmobile operations. These operations would be targeted against major crossing points, command and control installations, defiles, route junctions or any other objective that would facilitate the movement of follow-on forces.

30. **Unmanned Aerial Vehicles.** UAVs include powered and unpowered aerial vehicles such as remotely piloted vehicles, and drones. They have emerged as a new multifaceted threat. Their

small size, radar cross-section and ability to fly low and slow make them very difficult to detect and track.

31. The AD focus on the UAV threat is increasing for several reasons. First, UAV technology is readily available to many countries. Second, countries are able to procure them in large numbers because the costs of UAV systems are low compared to the cost of alternative systems with similar capabilities. Third, UAV systems are versatile and can perform multiple missions for the operational commander.

32. UAVs can be grouped into ISTAR, attack, deception or ECM mission categories.

33. **ISTAR Flight Profiles.** The flight profiles for UAVs collecting information for ISTAR purposes vary according to the mission. For example, surveillance missions require that the UAV be essentially on station. Thus, a figure eight or racetrack flight path is used. Deep reconnaissance and battle damage assessment missions require coverage over a specific area beyond the forward area. A zigzag flight path is usually flown for this mission. Variance to the flight paths just described can be made at the discretion of the operators.

34. **Attack Flight Profiles.** Attack UAVs fly different altitudes and profiles according to the mission at hand. They usually fly a straight path until they get to the target area when they may go into a programmable search or loiter mode to look for targets. Once the target is detected, the UAV will go into a terminal dive to destroy the target. However, the UAV could use a reconnaissance flight path as a deception technique.

35. **Deception and Electronic Attack.** Deception UAVs have proven their worth and utility in combat. These UAVs can be used to simulate combat formations and lure surface-to-air weapons and related command and control elements away from attacking aircraft. Glider decoys can also trick AD units into revealing their positions, making radars easy targets for air or antiradiation missile attacks. The emergence of low observable technologies and advances in sensor, system control and dispenser technology all contribute to the trend toward greater use of decoy-based countermeasures.

36. Another option for the operational use of UAVs in a deception role is as electronic attack jammers. Some countries have also produced communications jammer payloads for their UAVs. These electronic attack jammers combine the benefits of aerial electronic attack operations with the low cost and high survivability of UAVs.

37. **Cruise Missiles.** Cruise missiles are unmanned, powered, typically self-guided vehicles that fly at one or more predetermined constant cruise altitudes and can carry a nuclear or non-nuclear payload. Cruise missiles present a formidable challenge to AD Arty because of their ground, ship and air launch options, low-level flight profiles, long range, accuracy and low radar cross-section.

38. These capabilities can provide the threat commander more options for location of launch and direction of attack. This, coupled with a low-detection flight profile and the incorporation of low-observable technology, makes a cruise missile an extremely difficult target to detect and engage.

39. Cruise missiles come in a wide assortment of sizes and shapes with ranges varying from 50 to over 2,500 km. To date, the shorter-range anti-ship variants have proliferated the most. However, several countries are developing land attack cruise missiles employing new guidance technologies such as imaging infrared, millimetre wavelength and global positioning satellite.

40. Long-range cruise missiles such as the Soviet developed AS15 Kent and the US Tomahawk have not been widely exported due to complex programming requirements. However, as new technologies emerge, these systems could become more exportable. New technologies can also be expected to increase ranges, improve accuracy, and make cruise missiles less expensive and more attractive to developing countries.

41. The highly complex guidance package that makes long range cruise missiles effective against ground targets is very expensive to maintain and use. Most nations will have access to some of the support packages required to improve accuracy. However, the data coding and the intelligence target requirements necessary to support the system will limit the use by most potential threat countries.

42. These systems would most likely be used in a ground role against high-value, fixed, strategic, and theatre targets.
43. **Tactical Air-to-Surface Missiles.** TASMs are closely related to cruise missiles with the major difference that few have a range of over 150 km. They employ command to line-of-sight, semi-active laser, electro-optical and antiradiation homing seeker options. Because of their high speed and low radar cross-section, they also will be difficult to detect, track and engage.
44. **Antiradiation Missile.** The antiradiation missile (ARM) TASM poses a significant threat to AD Arty as an ARM can attack a radar from beyond the lethal range of the AD Arty system. ARMs are especially lethal when employed with decoy UAVs used to activate radars under attack.
45. Aircraft delivering laser type TASMs are vulnerable because these missiles have very short range and the launch aircraft must continue its dive toward the target until missile impact. The electro-optically guided systems provide better aircraft survivability because this type of missile possesses significantly greater range and consequently provides a greater stand-off capability to the launch aircraft. The use of any of the TASMs requires some degree of air superiority of the airspace over the battlefield.
46. **Ballistic Missiles.** High costs associated with fixed-wing aircraft and high attrition rates against western air forces make acquisition of ballistic missiles highly attractive. By targeting population centres and using unconventional payloads, missiles can be used to inflict unacceptable levels of damage on friendly forces. They are also procured as a retaliatory attack system and can be used as a first strike asset.
47. Their speed of delivery and versatility of launch make them suitable weapons for surprise attacks. In addition, the expanding use of sub-munition warheads and penetration aids make them highly challenging targets for antiballistic missile systems.
48. The primary motivations for a country to acquire ballistic missile technology are to change the regional balance of power and to increase the prestige of the country's armed forces. Development of ballistic missiles is an indicator of technological advancement of a

nation's military industry. Acquisition of even a few missiles with mass destruction payloads commands the recognition of other countries in world affairs.

49. The capability of inflicting massive damage on neighbouring countries could lead to regional instability, even if the intention to initiate conflict is absent.

50. **Strategic Level.** Strategic ballistic missiles are intercontinental ballistic missiles (ICBM) and submarine launched ballistic missiles (SLBM). These weapon systems represent a threat to NATO. Consideration of the strategic level is beyond the scope of this manual.

51. **Operational Level.** The psychological effect of tactical ballistic missiles (TBMs) was proven during Operation Desert Storm. Despite the severe inaccuracies of the Iraqi versions of the SCUD missile, they caused the theatre commander to consider the threat to non-military targets and devote limited military resources to the defence of geopolitical assets. It should be noted that TBMs can be used at both the operational and tactical level. The impact of TBMs on allied or coalition policy and operations will come in various forms and will complicate foreign policy. With TBMs, countries are able to apply military force far beyond their national borders. These factors have made TBMs the most proliferated air threat system.

52. The potential expansion of the battlefield by use of TBMs will compound planning and execution problems for the friendly commander. Due to the TBM's capability to hit targets far removed from the front, the commander will have to consider the security of widely dispersed assets and may be hard pressed to offer the protection required by all areas. Current accuracy, and intelligence and targeting limitations may not support the targeting of mobile military forces. TBM development and fielding continues to produce faster, more accurate delivery systems. Fixed installations such as airfields, seaports, logistics sites, and battle command facilities will be easier to target.

53. These weapon system launchers are highly survivable especially if used during periods of darkness or low visibility. Their mobility capability gives the enemy commander the ability to move

launchers to various locations and take maximum advantage of cover and concealment. This ability will enable most threat nations to conduct TBM attacks throughout the entire period of allied or coalition military operations.

54. Some threat nations have the ability to co-ordinate TBM attack with more than one launch against one or more targets within a specific time period. Most threat nations with TBMs also possess warheads of mass destruction for TBM use. These two factors can make an area defence a difficult challenge.

THREAT TO AIR DEFENCE ARTILLERY

55. Friendly AD Arty assets are a high priority target for enemy attack. Attacks against AD Arty are known as SEAD missions.

56. The direct threat to friendly AD Arty assets divides into three main categories:

- a. EW;
- b. air attack; and
- c. ground attack.

57. **Electronic Warfare.** AD Arty is critically dependent on the electromagnetic spectrum for Target Acquisition and command and control. This makes AD Arty vulnerable to EW systems. The threats are both ground based (EW units) or airborne. These vulnerabilities are two fold:

- a. Emissions from AD Arty radars and command and information systems are detectable by Electronic Warfare Support Measures systems (ESM). The detection and identification of AD Arty provides excellent information on likely intentions of our forces and what we consider vital to protect. The Gulf War has demonstrated that neutralisation of the AD Arty will be a priority for an adversary. ESM will be a critical means to provide target information on our AD Arty.

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- b. Once detected, identified and located, AD Arty will be targeted. One of the means available to neutralise AD Arty is the use of ECM. This will normally be in the form of jamming of the targeting system (radar) and communications. Specialised aircraft will use ESM systems to detect and identify AD Arty systems and destroy them with antiradiation missiles.

58. Additional details regarding EW and how AD Arty systems protect themselves from EW (Electronic Protective Measure) are available at Chapter 4.

59. **Air Threat.** All types of air vehicles can be targeted against AD Arty assets and may be supported by both enemy EW and ground attacks. In addition to attacking AD Arty weapon systems themselves, AD Command, Control, Communications and Information (C³I) resources are high value targets (HVT) which means that friendly AD Arty C³I protection is a high priority for AD Arty commanders.

60. Defensive measures may include the following:

- a. dispersion of C³I AD Arty assets;
- b. concealment;
- c. redundancy;
- d. mutual support between AD Arty weapon systems;
- e. deployment in depth; and
- f. emission control policy.

61. **Ground Threat.** AD Arty units can also expect to face two significant ground threats that can impact on AD Arty operations:

- a. deliberate ground attacks to destroy or neutralise AD Arty assets, e.g. indirect fire in the forward area; and

b. SEAD by combined ground and air attack.

62. Corps and theatre AD Arty assets, especially radars, are HVT for special operations forces and insurgent groups. These groups will attempt to conduct operations against AD Arty units to limit or shut down operations. Special operations forces and insurgent groups will be tailored differently from theatre-to-theatre.

63. The AD Arty unit commander must understand the ground force threat to his unit and tailor plans and security measures to reduce the impact of this threat.

CHAPTER 3

JOINT AND COMBINED AIR DEFENCE DOCTRINE

SECTION 1

INTRODUCTION

GENERAL

1. This chapter addresses joint and combined doctrine for Air Defence (AD) operations.
2. Joint operations are the integrated military activities of two or more service components of the Canadian Forces (CF). Joint operations pose a dilemma to the enemy. As the enemy attempts to avoid the efforts of one service component, it becomes vulnerable to attack by another.
3. Air Defence Artillery (AD Arty) contributes unique capabilities for sustained operations as part of a joint or combined force.
4. Combined operations involve military forces of two or more co-operating nations. If the relationship is longstanding and formalised, it is referred to as an alliance. If the relationship is short term, ad hoc, and less formal, it is referred to as a coalition.
5. Canada will often pursue its objectives through coalitions and alliances. Regional conflicts may involve coalitions that could be different from longstanding, familiar alliance structures. This implies the need for flexible interoperability, accommodation of allied or coalition objectives and capabilities and policy constraints. Maintaining cohesion and unity of effort requires understanding and adjustment to the capabilities, perceptions, and objectives of coalition members.
6. To achieve decisive victory, the Land Force must have the capability to deploy overwhelming combat power on the battlefield to defeat enemies quickly with minimum casualties. Successful AD operations are key to sustaining combat power in force-projection operations. AD Arty will be challenged to provide protection of committed forces and assets throughout the theatres of operations.

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7. To counter the spectrum of aerial threats, current doctrinal initiatives are built upon the AD goal of an integrated and co-ordinated defence. Air threats confronting the CF today and in the future are divided into those best addressed by manned aircraft and those best countered by surface-based systems. As such, air and surface-based AD seek efficiency by avoiding unnecessary duplication.

8. Canada presently relies on allies and coalition partners to counter ballistic missiles and satellites. Canada's AD Arty forces concentrate on defeating enemy aerial vehicles operating in the very low to low-level height bands. These threats include Unmanned Aerial Vehicles, helicopters, cruise missiles and any fixed-wing aircraft. Synergy in the joint and combined arena results from sound doctrine, proper training and the mutual application of joint force relationships and procedures.

COMMAND, CONTROL AND COMMUNICATIONS WITHIN THE JOINT OR COMBINED FORCE

9. General requirements for command, control and communications are contained in other CF publications. More specific Land Force oriented information is contained in Chapters 5 and 6 of this manual.

10. **Command.** The joint force commander assigns the joint force air component commander's responsibilities. Normally, the joint force air component commander is the service component commander who has the preponderance of air assets to be used and the ability to assume the responsibility.

11. Special operations forces, elements of service aviation, AD Arty and electronic warfare forces that may be committed to counter air operations remain under the command of their respective components.

12. AD Arty forces complement other counter air capabilities in protecting vital resources of the joint force command, and essential elements of combat manoeuvre units. AD Arty forces are normally either assigned to the service component headquarters or are organic to the manoeuvre elements.

13. Forces are integrated into the AD system according to the established joint operational procedures and the overall AD priorities of the joint force commander and their service component and intermediate commanders.

14. **Control.** The joint force commander exercises operational control of all assigned forces to ensure unity of effort. Normally, this authority is exercised through the service component commanders. The counter air campaign is conducted under the guidance of, and to achieve the objectives of, the joint force commander.

15. Co-ordination and Integration of land based and maritime AD. Land based and maritime AD resources are integrated into the joint force commander's DCA campaign concept of operations. Maritime AD resources are co-ordinated with the appropriate land based or airborne AD command and control network.

16. Similarly, land based AD resources employed in littoral operational areas are co-ordinated with the appropriate maritime AD command and control network.

17. **Communications.** Effective control of diverse systems requires the capability to collect, process, display and communicate vast amounts of information while denying the enemy access to the information.

18. Communications systems, including digital means, must be capable of providing secure near-real-time exchange of information between the joint force commander and subordinate commanders and forces. The systems must be sufficiently flexible and responsive to allow timely redirection of forces. Communications systems must have sufficient capacity, electronic protective measures and flexibility to accommodate information exchange among levels of command, even when an intermediate level has been disabled.

19. To speed the exchange of essential information, it may be necessary to delineate the extent and type of information to be passed to specific command and control levels. Data transferred between command and control levels to exercise counter air tasks calls for automated data processing.

20. The systems should have a redundancy and must have a backup capability and procedures to maintain continuity of operations should the primary system fail. Canada’s Land Force Command and Control System is evolving towards these ends.

**SECTION 2
COUNTER AIR OPERATIONS**

21. Counter air operations are combat operations directed against the enemy’s air offensive and defensive capability in order to attain and maintain a desired degree of air superiority (AAP-6).

22. Counter air operations are divided into two categories:
- a. offensive counter air (OCA); and
 - b. defensive counter air (DCA) operations.

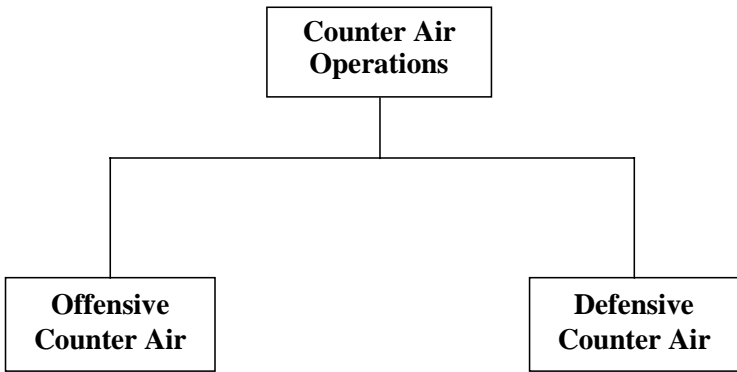


Figure 3-1: Categories of Counter Air Operations

23. Commanders conduct counter air operations to attain and maintain a desired degree of air superiority by the destruction or neutralisation of enemy forces. Their ultimate goal is to control the airspace to allow commanders to execute their plans. Both offensive and defensive actions are involved and passive measures are taken to minimize the effects of hostile air actions.

24. OCA operations range throughout enemy territory and are generally conducted at the initiative of friendly forces. DCA operations are generally reactive against enemy air activity.
25. It must be clearly understood that AD Arty is but a part of overall counter air Operations. AD Arty includes all artillery weapons that are designed primarily to destroy or neutralise enemy aerial vehicles, either to protect installations, designated areas and personnel or to deny the enemy the use of airspace. It also embraces equipment provided for target acquisition, fire distribution and control, communications and movement that is necessary for the effective employment of AD weapons.
26. **Objectives.** The objectives of counter air operations are to gain control of the air environment and protect the force and selected assets.
27. At the start of most operations, control of the air environment may range from complete domination by hostile forces to air supremacy by the joint force. It may also range from temporary, local air superiority to control over the entire area of operations or theatre.. Control may also vary over time.
28. The degree of control required depends on the situation. The joint force commander must ensure that his forces are capable of achieving sufficient air superiority to ensure protection of key assets and forces and freedom of action for critical operations.
29. When enemy air power threatens friendly operations, the requirement for friendly counter air must be a major consideration in the joint planning for those operations.
30. **Purpose of Counter Air Operations.** Counter air operations are designed to protect the force and to achieve air superiority.
31. Air superiority, at the critical time and place, provides friendly forces a more favourable environment in which to perform air, land and sea operations. Limiting the enemy's use of its air power increases friendly force's potential for success.

32. Protection conserves the fighting force so that commanders can apply it at a decisive time and place. Because offensive and DCA operations must often rely on the same airspace and resources, they cannot be considered in isolation from each other. The emphasis on either offensive or defensive counter air operations will depend on the overall situation and the joint force commander's concept of operations.

33. Counter air operations affect air, land, and maritime battles and often cross the boundaries between them. Thus, counter air operations are joint and the integration of all service components is required to fight the counter air battle.

34. **Offensive Counter Air.** OCA operations are mounted to destroy, disrupt or limit enemy air power as close to its source as possible. Further details on OCA can be found in Air force doctrine (B-GA-400-000 series). OCA divides into three components:

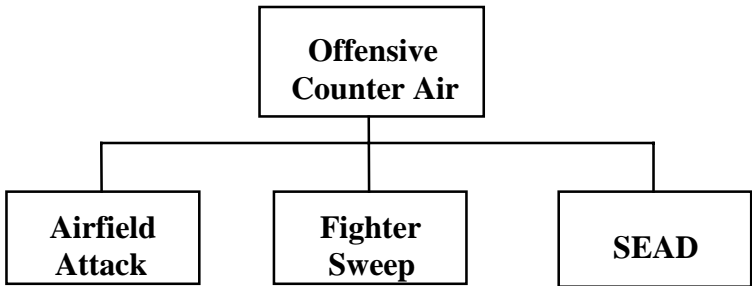


Figure 3-2: Offensive Counter Air Operations

35. **Defensive Counter Air.** DCA operations involve measures that are both active and passive, and rely for their effectiveness on detection and command and control systems. Active AD is split between AD Fighters and AD Arty:

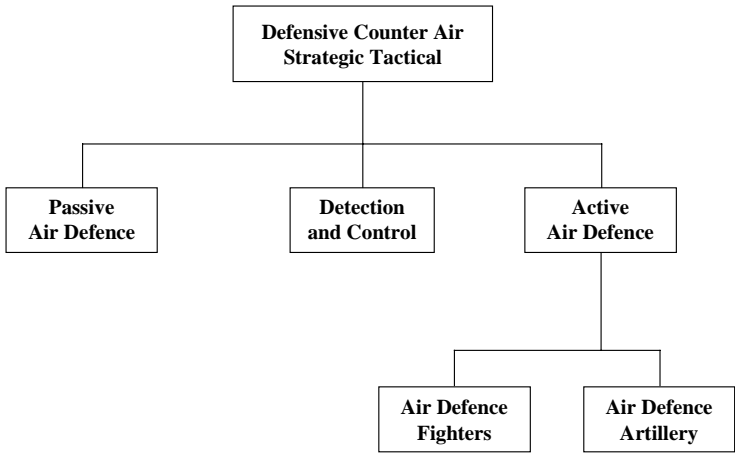


Figure 3-3: Defensive Counter Air Operations

36. **Passive Air Defence.** Passive AD is a subset of DCA operations. Passive AD consists of measures that enhance the survivability of friendly forces and installations from hostile air attack. It improves survivability by reducing the likelihood of being detected and targeted from the air and by mitigating the potential effects of air surveillance and attack. Passive AD measures by all members of the joint force are essential to force protection.

37. Depending on the situation and time available in the area of operations, a variety of actions can be taken to improve the joint force's passive AD posture. These actions may include:

- a. hardening of assets, including protection against electromagnetic pulse and transient radiation early effects;
- b. providing a capability for rapid battle damage repair;
- c. providing nuclear, biological and chemical defence equipment and facilities;
- d. providing sufficient assets to allow redundancy of systems and facilities;

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- e. providing alert, warning and all clear systems;
- f. adopting a comprehensive electromagnetic emission control policy, including infra-red and optical means;
- g. networking available communications and air, land and sea based sensor systems;
- h. providing camouflage, concealment, cover, dispersal and deception;
- i. repositioning electromagnetic emitters to prevent targeting;
- j. providing operations and communications security; and
- k. using limited visibility or hours of darkness for movement, resupply and supporting operations.

38. **Detection and Control Systems.** Two essential ingredients of effective DCA operations are comprehensive detection and control systems.

39. A detection system is required to provide adequate warning of the approach of enemy air resources and for alerting forces involved in DCA operations. The system will include ground and airborne Early Warning equipment. Ideally, the information from all sources will be merged into a complete “air picture”.

40. An AD command and control system is required to link all the AD system components and to provide the means to alert and control the AD weapon systems. To ensure economical use of forces it is essential to control the activities of the components of an AD system centrally, although units must be able to act independently if communication is lost.

41. The size of the territory to be defended may necessitate division into geographical areas; within each area, control must be centralized. The areas must be linked to a higher authority responsible for co-ordinating the operations of the entire

organization and disposing the available forces as the situation demands. This authority rests with the AD commander.

SECTION 3 ACTIVE AIR DEFENCE

FUNCTIONS OF ACTIVE AIR DEFENCE

42. Active AD protects friendly forces and designated assets by destroying attacking aircraft. Active AD operations use aircraft, AD Arty, maritime AD, electronic warfare support measures along with signals intelligence.

43. Effective AD operations must:
- a. detect, acquire, recognise and identify a target;
 - b. intercept the target; and
 - c. destroy or neutralise the target before its weapons are released.

FUNDAMENTALS

44. The fundamentals to successful counter air battle are as follows:
- a. AD assets of all services must be integrated. AD must be co-ordinated with operations at land and at sea.
 - b. AD forces must be equipped and trained to operate in an electronic warfare (EW) environment.
 - c. The level of alert status must be defined to enable AD elements to provide effective force protection.
 - d. Co-ordination within and between AD areas must be accomplished to ensure a unified response to

any threat and to ensure the most effective use of AD resources.

- e. Active and passive AD must be considered complementary parts of an overall AD capability.

METHODS OF AIR DEFENCE

45. Various methods for the organization of AD resources provide effective AD for the joint force. All forces employ self-defence measures.

- a. **Area Defence.** Area defence is a posture designed for the defence of a broad area. Joint air forces provide area defence for the theatre. High/Medium AD resources protect the manoeuvre forces and rear areas according to the Joint Force Commander (JFC), the Airspace Co-ordination Centre and corps AD priorities. Short-Range Air Defence (SHORAD) is very effective in fulfilling the requirement for effective area low level air defence.
- b. **Point Defence.** Point defence is a posture designed for the protection of a limited area, normally in defence of the vital elements of a force or of vital installations. Normally Very Short Range Air Defence (VSHORAD) AD Arty forces are employed in point defence.
- c. **All Arms Air Defence.** All arms AD is a posture developed by all friendly units to defend themselves against direct attack or threat of attack through the use of organic weapons and electronic warfare. All arms AD policies are established by the Area AD Commander (AADC).
- d. **Maritime Air Defence.** Maritime AD may encompass characteristics of all of the other three methods of AD. Maritime AD, also termed anti-air warfare, is conducted simultaneously with other

naval warfare tasks. Maritime AD requires the establishment of mutually supporting defensive positions to progressively absorb and weaken enemy attacks.

RESOURCES

46. Dedicated AD assets may be provided by all components. Resources of the active AD system will include weapon systems and command and control systems as well as additional contributing systems.

47. **Weapon Systems.** The critical components of an active AD system are the weapon systems. They are needed to intercept and destroy attacking enemy air before it can complete its mission.

48. A comprehensive AD weapons system will include an integrated mix of fighter aircraft as well as AD Arty systems. All systems have limitations such as reaction time, range, identification capability and flexibility of operation. However, vulnerability or disadvantages of one type of system are often offset or mitigated by the capabilities of another type of system.

49. Therefore, an effective active AD requires a mix of weapon types and systems. This balance is required not only between aircraft and surface-to-air weapons but also among the specific types of aircraft, missiles and guns.

50. **Control and Reporting System (CRS).** An AD command and control system is required to link all the AD components and to provide the means to alert and control the AD weapon systems.

51. This control must be performed centrally, although units must be able to act independently if communication is lost. Control authority is vested in the AD Commander who is normally the Air Component Commander.

52. The purpose of the CRS is to provide early warning through the detection and identification of aerial vehicles, to alert AD resources, to control and co-ordinate the AD forces to be used to intercept the target and to prevent the destruction of friendly aircraft.

53. **Command and Control System.** All AD operations are integrated through weapons control procedures, co-ordination with adjacent AD units, co-ordination between service components and through shared knowledge of the enemy and friendly situation.

54. Service components exercise both positive and procedural control of their assigned AD forces. An integrated AD requires the provision and exchange of essential real-time information. This information must include AD warnings that allow commanders to implement the appropriate active and passive AD measures.

55. The exchange of real-time information requires the provision of adequate track capacity within systems and the cross telling of tracks using data processing systems and secure communications assets. When secure communications are not operational, enemy track information from airborne and ground-based sensors may be passed by non-secure data or voice broadcast.

56. The command and control system should be survivable and have redundancy.

57. AD sensors are normally optimised to perform specific surveillance or control functions.

58. To provide the spectrum of coverage required for AD operations, a number of complementary systems are necessary. They range from a mix of static and mobile equipment to strategic warning systems. Systems are netted to enable the gathering and dissemination of information to all AD forces under all operational conditions.

59. The command and control system may include:

- a. airborne and space-based early warning;
- b. early warning and surveillance systems;
- c. other networked civil and military sensors;
- d. low-level radar systems;

- e. mobile radars, including sea-based systems;
- f. strategic warning systems;
- g. intelligence systems;
- h. electronic warfare systems;
- i. communication systems; and
- j. data processing facilities.

60. **Additional Contributing Systems.** Contributing systems may include military and civilian assets. Depending on the situation, the following may be integrated with the AD system:

- a. **Airborne Early Warning Sensors.** Airborne sensors serve to overcome range and low-level detection limitations inherent in a surface-based sensor system and are integrated with surface systems. The use of airborne early warning systems will extend detection ranges and consequently increase the time available for reaction. At the same time, friendly positions will not be compromised and the threats from low-level surprise attacks will be significantly reduced.
- b. **Space-Based Warning Systems.** Space platforms provide warning of ballistic missile attack and other intelligence information to either national or theatre warning systems. Space-based systems can provide longer-range warning than airborne or surface-based sensors.
- c. **Intelligence Resources.** These may provide indications of imminent hostile activity, potential early warning and positive hostile identification before detection by the AD system. The maximum possible use of this information is essential. Clandestine sources may augment this information.

- d. **Sustainment and Support Services Agencies.** Adequate and timely support must be planned, co-ordinated and executed in order to provide the continuity and sustainability required to enable the AD force to accomplish its mission.

- e. **Civilian and Military Air Traffic Control Facilities.** Air traffic control facilities in the area of operation may contribute vital information to AD forces. These capabilities are exploited and where possible networked into the command and control system.

EXECUTION OF DEFENSIVE COUNTER AIR OPERATIONS

61. Execution of defensive counter air operations requires a control and reporting system capable of near real-time production and dissemination of tracking data necessary for the effective engagement of targets.
62. As an attack is detected, it must be identified. The information must then be disseminated as readily as possible. The detailed and timely track data permit the command and control system and integrated weapon systems to evaluate the track, determine the significance of the threat and either designate AD forces for interception or engagement or advise units of the passage of friendly aircraft.
63. **Hostile Act Criteria and Rules of Engagement.** To avoid fratricide and to ensure the force is protected by a seamless AD, engagement operations must be tightly controlled. This requires the delegation of engagement authority to the appropriate AD commanders, and the establishment of weapon control procedures and Rules of Engagement (ROE) by the AADC.
64. ROEs must include hostile act criteria. Details of hostile act criteria for Canada are contained in Quadripartite Standardization Agreement 1318 and QAP 218 Annex C. The component and supporting commanders are responsible for ensuring compliance

with the established roles of engagement. More information on the types of ROE is contained in Chapter 5 of this manual.

65. The optimum employment of AD weapon systems requires early identification of friend and foe to maximise engagement at maximum ranges while avoiding fratricide.

66. **Electronic Warfare.** The whole AD system chain, from sensors, Command, Control, Communications and Information to weapon systems must be designed to ensure that it can function in a hostile EW environment. It must gain control of the electromagnetic spectrum and exploit it to defeat the enemy.

67. **Employment of Air Defence.** Early warning of enemy air attack is vital if early engagement and defence in depth are to be achieved. Active AD is developed to permit the interception of intruding enemy aircraft as early as possible and as far forward as feasible.

68. Engagement should continue through weapons release, departure from the target area and return to base. AD engagement doctrine must ensure inbound threats are dealt with before continuing engagement against outbound aircraft.

69. **Weapon Systems Employment.** Weapon systems may be employed as follows:

a. **Fighter-Interceptor.** Fighters may fly three basic missions as follows:

(1) **Interception.** Intercept missions may involve three methods of assigning aircraft for intercept:

(a) scramble of aircraft from ground alert status;

(b) direction of aircraft from combat air patrols; or

(c) redirection of aircraft from other missions.

- (2) **Combat Air Patrol.** Combat air patrols enable rapid reaction to enemy intrusion and may be positioned well forward of areas to be defended. Patrols may also be conducted:
 - (a) over a specific area;
 - (b) in support of friendly air or surface forces;
 - (c) over critical areas of a combat zone; and
 - (d) over air, land and sea corridors.
 - (3) **Escort.** AD aircraft may conduct escort missions in support of other aircraft. Unescorted aircraft normally carry self-defence weapons.
- b. **Air Defence Artillery.** AD Arty weapons are primarily employed to protect the force either as point defence weapons or in area defence operations. They can also be used in an attritional role. AD weapons potentially offer large amounts of firepower and instant responsiveness to the assets defended. For maximum effect a mix of types of surface-to-air weapons should be employed in an integrated AD network. The optimal capabilities of each weapon system occur at different ranges and altitudes. Surface-to-air weapons provide the best overall coverage when their operations are both integrated and co-ordinated. Integration or co-ordination ensures both the minimum risk passage for friendly aircraft and the means to avoid conflicts in the employment of surface-to-air weapons and fighters.

WEAPON CO-ORDINATION

70. **Airspace Control.** Integrated employment of air-to-air and surface-to-air systems through co-ordinated detection, identification, assessment and engagement is necessary to prevent enemy surveillance and attack. Positive control and procedural measures may be implemented to ensure that friendly aircraft can safely transit the airspace without inhibiting AD or other friendly operations. Airspace Control increases operational effectiveness by promoting the safe, efficient and flexible use of airspace. Airspace Control is dealt with in detail in Chapter 6 of this manual.

71. Regardless of other controls and measures imposed within defended airspace, all AD forces must readily identify all aircraft in the area by electronic, visual or procedural means. Rapid, reliable and secure means of identification are critical to the effectiveness of AD as well as to the survival of friendly aircraft.

72. AD weapon systems are capable of autonomous operations if centralized control fails. In addition to centralized control, procedural means are used to permit the safe passage of friendly aircraft and to enable the effective use of surface-to-air weapons. This means that in the event of centralized control failure, the procedural means ensures that the system fails safe to protect friendly air assets.

73. To capitalise on the complementary capabilities of various weapon systems, integration or, as a minimum, co-ordinated use of AD systems within an area is necessary. Area control measures include AD operations areas and weapon engagement zones.

74. **Fighter-Interceptor.** Fighters are centrally controlled for intercept and combat patrol missions. Escort missions are not centrally controlled and can be autonomous.

75. **Interception.** Intercept missions are tasked by the agency controlling the specific sector of operations in response to assessment of hostile or potentially hostile targets or one of whose origin and purpose are unknown. When possible, aircraft will remain under the close control of the initiating control agency, although this control may be transferred to adjacent sectors of responsibility, if required. Control of an intercept mission may be

transferred to the pilot when the pilot is in positive contact with the target or when the environment precludes positive direction by the controlling agency.

76. **Combat Air Patrol.** Interceptors from combat air patrols may be tasked to intercept targets where warning of enemy air activity may be inadequate for aircraft on ground alert to achieve an interception before an enemy aircraft reaches its weapon release point. A controlling agency provides direction of intercepts from the combat air patrol location. Pilots may operate autonomously when on-board sensors detect the targets.

77. **AD Arty Weapons.** The effectiveness of AD Arty weapons is enhanced by highly reliable, automated links with air operations and an adequate identification process. This precludes engagement of friendly aircraft and unnecessary expenditure of AD resources.

78. Weapon control status and fire control orders along with other rules of engagement, are used to control AD Arty fire. All AD Arty assets in a given land area must be incorporated into the overall theatre AD procedures and weapon control measures established by the AADC.

79. SHORAD and VSHORAD systems are controlled by procedural means. Currently, AD communications and integration of sensor information is not yet sufficiently developed to permit "positive control". Canada along with NATO/ABCA nations is involved in the development of a Low Level Air Picture Interface (LLAPI). This, when combined with the Recognised Air Picture (RAP) and new robust communications links, may permit "positive control" in the future.

SECTION 4 COMBINED OPERATIONS CONSIDERATIONS

GENERAL

80. AD operations are likely to be conducted within the context of an alliance, coalition, or other international arrangement. Within this context, the JFC must consider those areas peculiar to combined

operations, which may influence the ability to achieve combined unity of effort.

81. Combined commanders and their subordinates identify the requirements and implications of combined operations, organize their forces, train for success and conduct combined operations as necessary.

RESPONSIBILITIES

82. Requirements, responsibilities and organizational considerations for conducting AD in a combined operations environment are similar to joint operations. However, special considerations and areas of emphasis are needed to ensure unity of effort with other nation's forces.

83. Each theatre and each country are unique. Even with formal alliances, there are varying national interests that should be identified and considered. Differences in doctrine, training, equipment and organization must be identified and considered when determining alliance interoperability requirements.

84. The combined force commander is responsible to both national and allied or coalition leaders. Leaders of the alliance or coalition must approve command relationships among the elements of the alliance or coalition.

ORGANIZATIONAL CONSIDERATIONS

85. When national forces of the combined force are not uniformly capable of actively defending against enemy air or missile capabilities, provisions must be made to ensure that AD and Tactical Missile Defence (TMD) assets are provided for defence within JFC established priorities. This may entail introducing AD and TMD assets from another nation or theatre. For this reason, AD units must train, orient and exercise to operate in the total spectrum of potential operational environments.

OPERATIONS

86. Consensus on the enemy threat, a clearly defined chain of command, and a responsive, interoperable command and control structure are crucial to successful combined AD operations. Particular care must be taken to ensure that national forces and selected designated assets are provided requisite protection from the effects of the threat. A combined commander may also consider augmenting the host nation AD Arty assets consistent with the overall mission.

87. **Factors.** Consideration must be given to the following factors:

- a. **Threat.** The threat to the total combined force, to include rear areas, must be considered. Consensus on the threat will facilitate the integration of national and alliance or coalition intelligence collection efforts, allocation of collection resources and threat evaluation.
- b. **Interoperability.** Command and control systems must be efficiently interoperable to respond to the needs of the combined command. Information critical to AD needs is identified and systems established to speed the flow of critical information throughout the combined chain of command.
- c. **Intelligence.** Intelligence requirements in support of AD operations must be determined and prioritised to plan the collection and analytical effort and to allocate appropriate resources to these functions. Canadian forces that are part of combined commands will be supported by other nations intelligence systems to augment our organic intelligence systems. These must be integrated to ensure responsiveness to operational needs.
- d. **Rules of Engagement.** ROE must be delineated, published and disseminated to and exercised by

alliance or coalition members for compliance. Any national ROE that differs from the combined commander's ROE must be identified, published and understood by all commands.

- e. **Warning.** Combined commanders must consider planning for and dissemination of warning and attack prediction to civil authorities. They must establish simple, effective AD warning systems.

- f. **Exercises.** The key to establishing and refining sound procedures is joint and combined exercises with full participation of command and control assets. Exercises provide an excellent environment for the simultaneous practice of multi-echelon responsibilities, to evaluate and to sustain the requisite skills and procedures for effective AD operations. Exercises are particularly helpful in adapting a unit to a new environment, subsequent to deployment from one geographic area to another. Exercises may also provide a deterrent effect.

CHAPTER 4 AIR DEFENCE ARTILLERY EMPLOYMENT AND DEPLOYMENT

SECTION 1 INTRODUCTION

GENERAL

1. Air Defence (AD) should be deployed to permit the interception of enemy air vehicles as far forward as possible, with engagements continuing through the point of weapon release and beyond.
2. In order to achieve this, early warning of enemy air attack is vital. The employment of AD weapons will be to a large extent dictated by the type of asset they are protecting and the characteristics of the weapon systems. The optimum capabilities of different AD weapon systems occur at different ranges and heights, and through co-ordination they are mutually supportive and provide the best coverage.

PRINCIPLES OF EMPLOYMENT

3. **Air Defence Operations.** There are four principles which commanders apply when planning active AD operations to achieve the optimum AD coverage. These principles are mass, mix, mobility and integration:
 - a. **Mass.** Mass is the concentration of AD combat power. It is achieved by assigning enough firepower to successfully defend the force or asset against air and missile attack or surveillance. To mass AD combat power, commanders may have to accept risks in other areas of the battlefield.
 - b. **Mix.** Mix is the employment of a combination of AD weapon and sensor systems to protect the force and assets from the air threat. Mix offsets the

limitations of one AD system with the capabilities of another and complicates the problem of the attacker. All joint and combined arms resources are considered when applying this principle. Proper mix causes the enemy to adjust his tactics. Tactics designed to defeat one system make the enemy vulnerable to another system.

- c. **Mobility.** Mobility is the capability to move from place to place while retaining the ability to perform the AD mission. The mobility of AD resources must be equivalent to the mobility of the supported force. First priority for mobility should be planning moves that support the accomplishment of the mission. Tactical situations may dictate additional moves to enhance survivability. Strategic mobility is essential to support force-projection operations.
- d. **Integration.** Integration is the close co-ordination of effort and unity of action which maximises operational effectiveness. It is applicable regardless of command relationships established. Active AD operations must be integrated into the supported commander's concept of operation. The AD plan entails vertical and horizontal integration of AD systems across the width and depth of the battlefield. This includes integration with joint and combined forces.

4. **Other Employment Considerations.** In addition to the major principles of Air Defence Artillery (AD Arty) employment the other important considerations are:

- a. **Reaction Time.** AD units must be responsive because of the rapidity of air attack and the correspondingly short identification and engagement times available.
- b. **Terrain and Weather.** Terrain may inhibit mobility, and also affect the principles of weapon mass. Weather may influence the time available to identify and engage hostile aircraft. Bad weather,

especially rain, can also degrade the performance of radars and laser guidance systems.

- c. **Movement.** Units moving are particularly vulnerable to detection and subsequent attack during periods of good visibility. AD protection of units on the move is critical and the AD commander must decide whether AD units should be pre-positioned or accompany these units during the move. It should be noted that coverage is reduced or eliminated by moving AD weapon systems. The decision will be influenced by the air threat, the nature of the move, the type of AD weapons available and the terrain.
- d. **Priorities.** There will rarely be enough AD Arty resources to adequately protect all assets. The commander must therefore set out his priorities for AD tasks according to their importance. It will be necessary for the ground forces to be prepared to defend themselves against air attack using All Arms Air Defence (AAAD) or passive measures.
- e. **Airspace Co-ordination.** Integration with other AD assets and airspace co-ordination measures may influence employment of AD weapons. Airspace Control is detailed in Chapter 6.
- f. **Electronic Warfare.** Electronic Warfare (EW) assets can provide information to AD units to assist in defeating the enemy's jamming and deception effort. Friendly jamming assets can be employed to disrupt enemy aircraft systems but must be co-ordinated with AD requirements. AD Arty can contribute to deception plans because AD emitters have distinctive signatures.

TACTICAL CONSIDERATIONS

5. Before AD planning and deployment occurs, the AD commander must know the supported force commander's concept of operations, his plan and his AD priorities. He will provide the

commander with advice concerning the best manner in which AD can provide the required protection. In concert with the commander, the AD commander will produce an AD estimate of the situation, which in turn yields a number of tactical considerations. This estimate will refine the commander's AD priorities based on his concept of operations and discrepancies can be addressed. This process is a continuous one that occurs at all levels employing an AD commander.

6. **Enemy.** An assessment of the enemy's air power, tactics and weapons will be deduced from the air Intelligence Preparation of the Battlefield and will provide deductions concerning the expected enemy air efforts against particular targets. This will be linked to an understanding of the enemy ground threat and its associated air effort and will lead to deductions on where the friendly AD effort must be concentrated.

7. Other aspects that must be considered are the enemy's use of EW and Suppression of Enemy Air Defences tactics and friendly electronic countermeasures (ECMs). Possible enemy airborne and air assault targets, locations of high priority assets such as communication centres, Command, Control, Communications and Information, headquarters, etc. will provide information concerning possible priorities for enemy air attack. Consideration of these factors in the AD estimate will produce a priority for AD Arty tasks, the type of AD Arty to be provided for each asset and an initial grouping of AD Arty resources required.

8. **Terrain.** A study of the terrain must be made in the AD estimate, as this will reveal the most probable air approaches for both fixed wing aircraft and helicopters. It will highlight obstacles that reduce observation and coverage, camouflage, communications, etc. The terrain surrounding that asset will heavily influence the number and type of AD Arty weapons and sensors required to defend a particular asset.

9. **AD Resources.** The number and type of AD Arty weapons and sensors available must be considered. It will seldom be possible to provide AD protection for all assets and some will have little or no effective AD coverage due to the lack of availability of AD Arty assets. The commander's plan and subsequent prioritisation of assets will determine where the AD commander must place emphasis for AD Arty defence.

10. **Time.** Time must be considered in view of the movement and deployment of AD weapons. Time for reconnaissance, movement, maintenance, resupply and reloading must all be considered in view of the time to be ready on a specific task.

PRINCIPLES OF DEPLOYMENT

11. In order to be effective, AD Arty is deployed in accordance with the principles of mutual support, all round defence, weighted coverage, early engagement and defence in depth. Which principles apply to a given situation depend on the estimate of the situation.

12. Principles of deployment include the following:

- a. **Mutual Support.** Mutual support is achieved by positioning weapons so that the fire of one weapon can engage targets within the dead zone of the adjacent weapon system. For gun systems, this dead zone is usually small. For missile systems, the dead zone can be large and the need for mutual support is important. Mutual support can also be used to cover non-operational AD units or equipment, units at lower states of readiness or units undergoing resupply or maintenance. Because of the many altitudes from which the threat can attack or observe, the defence planner must apply mutual support vertically and horizontally. Units, sub-units and individual weapon systems should be sited to cover the non-engagement zones of other units, sub-units or weapon systems.
- b. **All Round Defence.** All round defence is achieved by ensuring that assets are protected from an omnidirectional threat. This can be achieved through ensuring that fire units are deployed to cover all approaches or through the integration of all AD Arty assets in the area.
- c. **Weighted Coverage.** Weighted coverage is achieved by combining and concentrating fires towards the most likely air avenue of approach or

direction of attack. Based on the tactical situation, a commander may risk leaving one direction of attack lightly protected to weight coverage toward another direction. Nevertheless with the continuing improvement in Inertial Guidance Systems and Global Positioning Systems the omnidirectional air threat remains

- d. **Early Engagement.** Early engagement is achieved by positioning sensors and weapons so they can engage the threat before ordnance release or target acquisition. Ideally, AD Arty should engage and destroy the enemy before it can fire on or acquire the defended asset or force.
- e. **Defence in Depth.** Defence in depth is achieved by positioning sensors and weapons so the air threat will come under an increasing volume of fire as it approaches the protected asset or force. Defence in depth lowers the probability that the threat will reach the defended asset or force.

DEPLOYMENT POSTURES

13. AD Arty can be deployed in either an attritional or defensive posture (See Chapter 1).

AIR DEFENCE PRIORITIES

14. It is likely that there will be insufficient numbers of AD weapons and sensors available to protect all forces and assets. The AD Arty commander considers the mission, the threat and the supported commander's intent and concept of operations before establishing AD priorities. The commander, in conjunction with the AD Arty advisor, develops these priorities based on the factors of criticality, vulnerability and recuperability.

15. It must be emphasised that these factors are always examined with the supported commander's concept of operations and the threat's capabilities and doctrine in mind.

- a. **Criticality.** Criticality is the degree to which an asset or force is essential to mission accomplishment. Determination of the criticality of an asset or force is made by assessing the impact on the conduct of the operation that would result from damage to the asset or force. The degree of criticality is based on whether damage to the asset or force prevents, seriously interferes with, or causes only limited interference with the execution of the plan.
- b. **Vulnerability.** Vulnerability is the degree to which an asset or force is susceptible to surveillance and attack or to damage if attacked. Consideration should be given to the asset's or force's resilience to attack, its specific mission in the overall operation, its ability to disperse or displace to another position, its capability to provide for its own AD and the amount of protection afforded by its passive AD measures.
- c. **Recuperability.** Recuperability is the degree to which an asset or force can recover from inflicted damage in terms of time, equipment and available manpower to continue its mission. The AD Arty commander considers the time to replace soldiers, equipment or entire units, as well as whether a different element can perform the same mission.

16. **Air Defence Tasks and Coverage.** Following the assignment of AD priorities, the AD commander will determine the type of AD task that will provide the best coverage for those assets that require AD protection.

17. The types of AD task are:
- a. area defence;
 - b. vital point defence;
 - c. route defence; and
 - d. attrition.

Air Defence Artillery Doctrine

18. A defended asset may not necessarily have AD weapon systems in its immediate vicinity, but would still be defended under the overall AD coverage. This would apply to a group of point targets in close proximity where dedicated AD weapon systems to protect each are not available. In this case the AD commander, considering the terrain, numbers of AD weapon systems available and AD priorities, may task his resources with providing an area defence.

19. In order to be given the best AD protection the defended asset must be within the effective engagement envelope of a weapon system. The combined engagement envelope of all of the AD weapons on a task provides the AD coverage for a particular asset. This engagement envelope takes into account the characteristics of the different AD weapon systems used, their deployment, the likely enemy attack parameters, the surrounding terrain and the location of the asset.

20. To achieve the best possible AD coverage, a thorough reconnaissance must be conducted. Information gained is passed up the AD chain of command in order that AD coverage can be co-ordinated at each level. In this manner, an integrated AD defence of the entire area can be created.

21. The achievement of effective AD coverage in itself does not, however, guarantee that enemy air will not get through. It does provide a means to develop the defence and to ensure that the principles of AD employment are adhered to and will highlight those areas where the defence requires adjustment.

22. In general terms, the Air Defence Anti-tank System (ADATS) is best utilised to area defence and Javelin/35 mm guns are best suited to vital point defence. No further attempt will be made here to identify specific deployment parameters for each type of AD defence provided as each will vary according to the equipment used and their individual deployment characteristics.

SECTION 2

COMMUNICATIONS, ELECTRONIC WARFARE AND TARGET ACQUISITION

INTRODUCTION

23. Communications are a vital part of the control of AD fire and airspace control. They may be disrupted by enemy fire, ECMs, electromagnetic pulse, environmental factors or by equipment failure. EW can affect command and control communications, reconnaissance, surveillance and the guidance of weapons. Target acquisition, which is part of Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR), is a critical aspect of AD; without timely and accurate early warning and target acquisition of airborne targets, AD Arty cannot provide the maximum level of protection.

COMMUNICATIONS

24. The ability of AD commanders at all levels to react to rapidly changing situations on the battlefield depends on reliable communications. A network of communications extends through all levels of AD command and control. Although AD weapon systems are capable of operating autonomously, their capabilities are greatly enhanced by effective communications, which also provides the supported commander or formation with additional flexibility. There are four communication networks for AD purposes :

- a. **Command Net.** AD Arty command nets are used to issue orders and monitor deployment and for the passage of operational reports and returns. Effective communications on this net ensure that command is exercised at the highest practical level.
- b. **Control Net.** AD Arty control nets are employed specifically for the passage of weapon control orders, airspace control measures, states of readiness, allocation of targets and early warning data.
- c. **Early Warning Net.** An AD early warning net may be established to collect, process and disseminate

information from a variety of sources, such as early warning radars, cueing and alerting devices, higher level AD control and reporting centres and AD units. Although the establishment of an early warning net may duplicate the control net, in a high density combat zone this separate net may be required to effectively control the passage of early warning information.

- d. **Administration Net.** An administration net is established to co-ordinate administrative and combat service support functions and for the passage of administrative reports and returns.

ELECTRONIC WARFARE

25. The most relevant aspect of Information Operations with regard to AD Arty operations is EW. EW is defined in B-GL-300-005/FP-001 *Information Operations* as military action involving the use of electromagnetic (EM) energy, including direct energy, to exploit and dominate the EM spectrum or to attack an enemy. It encompasses the interception and identification of EM emissions, the employment of EM energy to reduce or prevent hostile use of the EM spectrum and actions to ensure its effective use by friendly forces.

26. The three divisions of EW are:

- a. electronic support measures (ESMs);
- b. ECMs; and
- c. electronic protective measures (EPM).

27. **Electronic Support Measures.** ESM is defined as the division of EW involving actions taken to search for, intercept and identify EM emissions and locate their sources for the purpose of immediate threat recognition. It provides a source of information required for immediate decisions involving ECM, EPM and other tactical actions.

28. ESM conflict-related information involves actions tasked by or under the direct control of an operational commander to search for, intercept, identify, and locate sources of intentional and unintentional radiated electromagnetic energy to detect immediate threats. ESM is the embodiment of combat information and capitalises on the timeliness of sensor-to-shooter systems. ESM can best be described as electronic reconnaissance and surveillance.

29. Adversary ESM systems are a threat to AD systems as previously discussed. Friendly ESM capabilities have the potential to detect, identify and located adversary aircraft as well. ESM information will allow AD systems to remain passive (and undetected) until a critical point. ESM aircraft threat warning information will need to be passed quickly to the AD system to be of value. This is an ISTAR, EW Co-ordination Cell and Air Defence Commander co-ordination issue.

30. **Electronic Countermeasures.** ECM is the attack component of EW. ECM is defined as the division of EW involving actions taken to prevent or reduce an enemy's effective use of the EM spectrum, through the use of EM energy. ECM can attack the adversary anywhere from his tactical formations, back to his national infrastructure. ECM includes electronic jamming, electronic deception and electronic neutralisation by the use of directed energy. The US Army uses the term Electronic Attack.

31. AD systems will be required to participate in electronic deception operations by actively emitting with both radar's and Command, Control and Information Systems (CCIS) to deceive the adversary ISTAR systems. This will be done in a co-ordinated deception plan.

32. **Electronic Protective Measures.** EPM is the protection of the friendly use of the EM spectrum. EPM is defined as the division of EW involving actions taken to ensure friendly effective use of the EM despite the enemy's use of EM energy. EPM covers the gamut of personnel, equipment, procedures and facilities.

33. The US Army uses the term Electronic Protection. AD systems must continuously train in an EW environment. The use of War Reserve Modes for radar's, anti ECM drills, alternate CCIS

systems and emission control (EMCON) measures are all means to ensure the AD system can achieve its mission.

TARGET ACQUISITION

34. **General.** The effectiveness of AD Arty is dependent on timely and accurate information of enemy air activity, and the rapid dissemination of this information to all affected air and ground forces.

35. Many AD weapon systems are equipped with integral sensors, but terrain, EMCON and deployment of the systems create gaps in coverage. Generally High/Medium AD systems will be equipped with sensors; Short-Range Air Defence systems may not be so equipped and would be dependent upon effective communications for early warning.

36. Early warning is required by friendly forces to initiate appropriate actions, such as alerting local AD weapons systems, ensuring the safety of friendly aircraft, initiating aircraft identification, warning friendly forces of impending attack and cueing weapon systems. This allows AD Arty to adopt the most appropriate alert status and associated weapon state of readiness. Early warning is defined as the early notification of the approach of airborne vehicles and includes both alerting and cueing.

- a. **Alerting.** The passage of information to friendly forces that aerial targets are approaching their position or area.
- b. **Cueing.** The notification of target direction, range, speed and preliminary identification.

37. Early warning is required by the following:

- a. **Air Defence Artillery Commanders.** Early warning allows the AD Arty commander to alert his defences, impose a higher level of readiness and initiate the passage of this information to higher formations.

- b. **Air Defence Units/Sub-units.** In response to early warning, procedures must be initiated to ensure thorough surveillance and target engagement.
- c. **Supported Forces.** Supported forces must be warned of the likelihood of air attack based on early warning, so that the supported commander can take appropriate actions. In addition, supported forces can provide early warning to AD Arty units from their operations, patrols, etc., but for this information to be effective, it must be timely.

38. **Equipment.** Target information can be obtained from a variety of active and passive sensors.

39. **Active Sensors.** Active sensors radiate electromagnetic energy and extract required information from the energy reflected by a target. These sensors can be detected and suppressed or avoided. Radar is the principle active sensor for surveillance and target acquisition. Active sensor characteristics are determined by the conflicting requirements for the:

- a. rates of information update;
- b. optimum acquisition ranges dependent upon the frequency band of the sensor and target altitude (which are affected by ground clutter and weather);
- c. capability to detect targets over a wide range of speeds;
- d. ability to distinguish targets in close proximity to each other;
- e. EPM devices to counter ECM;
- f. use of antiradiation missiles;
- g. degree of mobility required for the sensor vehicles; and
- h. multiple target tracking capability.

40. **Passive Sensors.** In principle, passive sensors radiate no electromagnetic energy and therefore cannot be detected. They acquire information from the electromagnetic or acoustic energy radiated by the target itself. A sensor by itself can only determine the direction to a source of acoustic energy, heat or high frequency radiation, or visible light. Range information is obtained by triangulation or with a range finder. An important passive sensor system is the human eye which, at the very least, can provide alerting information.

41. The coverage provided by sensors is terrain, range and weather dependent. Coverage assessment is required for all sensors prior to deployment; observers may be required to fill in gaps in sensor coverage or to compensate for deficiencies caused by a restrictive EMCON state.

INTELLIGENCE, SURVEILLANCE, TARGET ACQUISITION AND RECONNAISSANCE PLAN

42. The AD surveillance plan is combined into an overall ISTAR plan in conjunction with field artillery, signals, EW and intelligence.

43. Sensors and their use are co-ordinated and controlled in order to conform to the intentions of the commander and his overall plan. At each level of command, commanders will determine how their specific sensors will be employed to achieve the overall coverage of an area; in their plans the sensors of subordinate formations will be used in conjunction with the plan of the higher formation's commander. They should complement each other.

44. The AD surveillance policy will include specific guidance for the deployment and operation of AD radars and overall guidance for the operation of individual weapon system integral sensors.

45. An outline plan will be formulated using all available information concerning the air threat, ground threat, the supported commander's plan, the air approaches, data requirements and sensor information available from higher resources. Each level of command will then be tasked to provide coverage of an area of responsibility.

46. The plan must account for the all-weather day and night operation of sensors, and must provide for areas or gaps in coverage that must be covered by other sources, such as observers.

47. The ISTAR plan is the responsibility of the G3 executed by the G2 staff. In order to be fully integrated, AD Arty must liaise with Intelligence, EW and Air/Aviation staffs to co-ordinate the surveillance effort. Information requests must reach the G2 as early as possible so other sources can be tasked to gather information.

48. The main sources of intelligence are:

- a. Signals/EW units;
- b. Air/aviation staff personnel;
- c. ground troops;
- d. recce elements;
- e. locating artillery;
- f. AD sensors; and
- g. higher headquarters intelligence staff.

49. The aim is to cater to the priority intelligence requirements (PIR) as ordered by the supported commander. The AD Arty commander should gather information on the following PIR:

- a. enemy air/aviation organization and strength;
- b. employment of air/aviation resources;
- c. air approaches;
- d. likely enemy intentions; and
- e. likely enemy activities.

AIR DEFENCE INFORMATION PROCESSING AND DISSEMINATION

50. Information processing begins with data extraction at the sensor, continues at the appropriate AD Arty command post and is completed by passing the information gained to the user as alerting and cueing information.

51. Sensors pass AD alerting and cueing information on the AD early warning net. Currently this is done manually, so it is affected by human limitations and equipment characteristics, which affect information flow and limit the timeliness of the information. Automated Data Processing (ADP) equipment will greatly enhance the effectiveness of the system and speed up the reaction time of all users.

EMISSION CONTROL

52. Emission control is the selective control of emitted electromagnetic or acoustic energy. The aims of emission control are:

- a. to minimize the enemy's detection of emissions and exploitation of the information so gained; or
- b. to improve the performance of friendly sensors.

53. **Emission Control Policy.** The policy states what electromagnetic and acoustic emissions may be allowed, under what circumstances, and when. This policy is made by commanders above corps level, keeping in mind AD requirements, and with the advice of the AD commander.

CHAPTER 5 AIR DEFENCE COMMAND AND CONTROL

SECTION 1 INTRODUCTION

GENERAL

1. This chapter provides doctrine for Air Defence (AD) command and control. It should be read in conjunction with B-GL-300-003/FP-000 *Command* which describes the manoeuvrist approach and the concept of Mission Command. Effective command and control are vital factors in executing operations, surviving and winning quickly and decisively on future battlefields or in operations other than war.

SECTION 2 COMMAND

TACTICAL TASKS

2. Command of Air Defence Artillery (AD Arty) is normally retained at formation level to permit co-ordination of coverage and optimum use of AD Arty weapons. Under this arrangement an AD unit's command and control remain with the AD Arty commander. The Commanding Officer (CO) of an AD Regiment (regt) normally uses tactical tasks to identify the priority of effort and liaison requirements between AD batteries and supported formations/units.

3. **Selecting a Tactical Task.** To determine the most appropriate tactical task for accomplishing the AD Arty mission, the following questions need to be answered which are illustrated in the matrix at Figure 5-1:

- a. Who establishes AD priorities?
- b. Who co-ordinates terrain on which the AD Arty units will position fire units?

- c. Who positions AD Arty fire units?
- d. With whom should liaison be established?
- e. With whom should communications be established?

4. **Direct Support.** When in Direct Support (DS), the supporting AD unit's main focus in accomplishing tasks will be directed to a specific manoeuvre unit. The supporting AD Arty unit co-ordinates its movement and positioning with the supported manoeuvre unit. An AD unit in DS to a formation or unit would provide an AD cell to perform the function of an Airspace Co-ordination Centre (ASCC) and apply the airspace control measures or Weapon Control Orders from the higher AD commander.

5. **Reinforcing.** A reinforcing (R) AD Arty unit augments the coverage of another AD Arty unit and strengthens the AD of the force. A reinforcing AD Arty unit is positioned to protect one or more of the reinforced unit's priorities as specified by the supported AD commander. An AD unit reinforcing another AD unit would supplement its AD coverage but has no inherent requirement to establish communications or liaison with the Area Operational Commander, as this is done by the reinforced AD Arty Commander, e.g. a Short-Range Air Defence (SHORAD) troop (tp) reinforcing a Very Short Range Air Defence (VSHORAD) tp.

6. **General Support Reinforcing.** An AD Arty unit with a General Support Reinforcing (GSR) mission provides support for the force as a whole and secondarily augments the support provided by another AD Arty unit. An AD unit GSR to another AD unit would provide AD for the tasks specified by the higher AD commander, e.g. the battery commander (BC) of the GSR battery (bty) would apply the CO AD Regt priorities. The GSR BC would liaise with the DS AD bty in that area for his AD system locations.

7. **General Support.** An AD Arty unit in General Support (GS) provides support for the force as a whole. It is not committed to any specific element of the supported force. It does not support a specific unit within the larger unit's area of operations. An AD Arty unit in GS remains under the commander of its higher AD Arty commander, e.g. High/Medium AD (HIMAD) coverage extending over the forward brigades from AD units positioned in the rear brigade area.

8. **Command Terminology.** In some occasional tactical situations it may be necessary to group AD Arty elements (unit/sub-unit) with the supported commander directly (e.g. Division/ Brigade/Battalion), particularly when the supported force is separated from the normal formation to which it belongs. In these cases command relationships may be used.

9. In general these situations may include joint and/or combined operations such as airmobile operations, airfield or port defence or amphibious operations.

10. The following command relationships apply in these circumstances:

- a. **Operational Command.** Operational Command (OPCOM) is the authority granted to a commander to assign missions or tasks to subordinate commanders, to deploy units, to reassign forces and to retain or delegate operational and/or tactical control as may be deemed necessary. The OPCOM relationship does not place any restrictions on how a commander assigns tasks or employs components of the force assigned to him, i.e. if an AD regt is assigned OPCOM its sub-units can be given separate tasks. OPCOM does not in itself include responsibility for administration or logistics and these areas must be considered separately, e.g. attached for daily maintenance.
- b. **Operational Control.** Operational Control (OPCON) is the authority delegated to a commander to direct forces assigned so that the commander may accomplish specific missions or tasks which are usually limited by function, time or location, to deploy units concerned and to retain or assign tactical control of those units. It does not include authority to assign separate employment of components of the units concerned neither does it, in itself, include administrative or logistical control. If the relationship is other than normal combat supplies, the exact relationship must be specified; e.g. AD bty may be placed under OPCON of a wing for airfield AD.

- c. **Tactical Command.** Tactical Command (TACOM) is the authority delegated to a commander to assign tasks to forces under his command for the accomplishment of the mission assigned by higher authority. This is very rarely used for AD units.
- d. **Tactical Control.** Tactical Control (TACON) is the detailed and usually local direction and control of movement and manoeuvre necessary to accomplish missions or tasks assigned. The unit/sub-unit assigned TACON is responsible to initiate liaison with the gaining unit to co-ordinate movement and local defence within the established boundaries.

SECTION 3 OPERATIONAL/TACTICAL COMMAND AND CONTROL

11. The operational or tactical Command and Control of AD units is concerned with the deployment, tasking and Combat Service Support of AD forces. To maximise the effectiveness of scarce AD resources, command should be retained at the highest practicable level.

12. **Control Chain.** In an allied or coalition environment, the theatre commander assigns responsibility for overall AD and airspace control to a single Joint Force Air Component Commander (JFACC). This may be any commander, but is normally the Air Component Commander who is both the AD commander and the Airspace Control Authority.

13. The AD commander manages by co-ordinating and integrating the entire AD effort within the theatre. The AD commander may create AD regions and appoint a Regional Air Commander (RAC) for each. Area Air Defence Commanders (AADC) may also be appointed dependent on the scale of operations.

14. The RAC is normally also the Regional AD commander (RADC) but this position may be selected from any service component. The RADC is fully responsible for and has full authority for the AD of the region.

15. **Subordinate Levels of Command.** At each level of command, representatives of primary airspace users work together in a number of cells. These levels, which are shown in the table at Figure 5-2 may include the following:

- a. **Combined Air Operations Centre (CAOC).** The CAOC acts on behalf of the JFACC as the regional air-tasking agency.
- b. **Surface-to-Air Missile Operations Centre (SAMOC).** HIMAD units are controlled by the SAMOC and are likely to be placed TACON to the commander CAOC. Their deployment will always be co-ordinated into the regional integrated AD system.
- c. **Air Operations Co-ordination Centre (AOCC).** Each corps has its own AOCC which is responsible for the co-ordination of all Air Support on behalf of the corps. The AOCC is also responsible for the overall co-ordination of AD operations and Airspace Control Measures (ACM) in accordance with the theatre AD plan.
- d. **Air Defence Cells.** A brigade AD cell (BADC) and a division AD cell (DADC) or corps AD cell (CADC) are established. It is the headquarters where the AD Arty commander and staff perform their duties and act as arms advisors to the commander. The AD cell performs the planning and AD input to the ASCC.

AIR DEFENCE CONTROL CHAIN

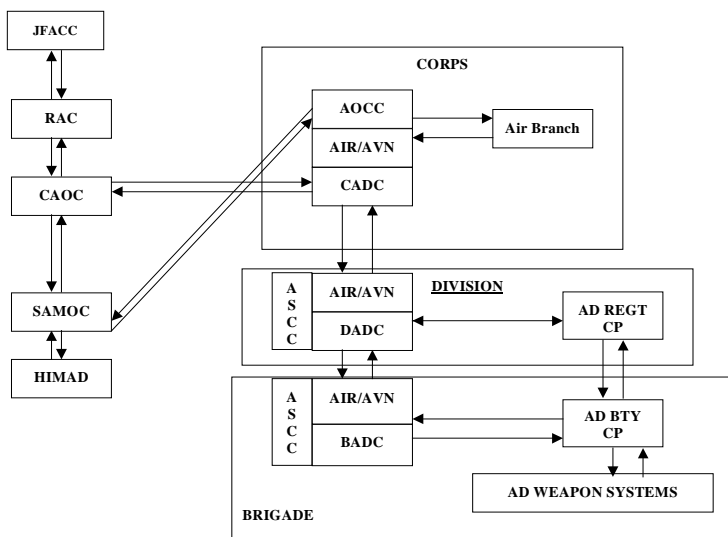


Figure 5-1: Air Defence Control Chain

16. Air Defence Management Function Procedures.

Management Function procedures facilitate the integration of AD into both the force commander's concept of operation and the battle for air superiority. The Air Defence Cell establishes AD engagement operations procedures. The principal users of the procedures are AD Arty units, but all participants in AD operations must adhere to these procedures.

17. Warning procedures and alert statuses prepare or cause units to build up for combat. Most warning procedures and alert statuses have specific application for AD forces.

18. **Level of Control.** Level of control describes the AD echelon at which positive management of the air battle is being conducted. This can be an AOCC, DADC/BADC, AD unit, sub-unit or the individual fire unit.

19. **Modes of Control.** The two modes of control are centralized and decentralized. The mode of control selected will depend upon the

capabilities of the Command, Control, Communications and Information system, the weapons systems being employed and both the friendly and enemy air situation.

- a. **Centralized Control.** This control mode is where a higher echelon authorises target engagements to fire units. Permission to engage each track must be requested by the fire unit from that higher AD echelon. Centralized control is used to minimize the likelihood of engaging friendly air while permitting engagements of hostile air only when specific orders are issued to initiate the engagement.
- b. **Decentralized Control.** This is the normal mode of control for SHORAD/VSHORAD, whereby a higher echelon monitors unit actions, making direct target assignments to units only when necessary to ensure proper fire distribution to prevent engagement of friendly aircraft and to prevent simultaneous engagements of hostile air targets. Decentralized control is used to increase the likelihood that a hostile air target will be engaged in a high-density environment.

20. **Autonomous Operations.** An autonomous operation is not a mode of control but a method of operation. It is adopted when directed or automatically when communications are lost with higher echelons. The unit commander assumes full responsibility for control of weapons and the engagement of hostile targets. SHORAD/VSHORAD systems almost always fall under this method of operation.

SECTION 4 AIR DEFENCE WARNINGS

21. Air Defence warnings (ADWs) represent the commander's evaluation of the probability of air attack within the Area of Operations (AO).

22. ADWs are routinely issued by the RAC but they can also be issued by any commander. In no case, however, can the local ADW be lower than the overall ADW issued by the RAC.

23. The issuance of an ADW is not tied to any other warning procedure or alert status but can influence AD Arty commander's decisions to adopt a higher or lower state of readiness. The accuracy and reliability of these warning is dependent on the early warning assets and communication systems in place.

24. These warnings are applicable to all units in the AO and are entailed to invoke preparations by the force and should therefore be distributed as widely and as quickly as possible. The three ADWs are:

- a. **Air Defence Warning Red.** Attack by hostile aircraft or missiles is imminent or in progress. This means that hostile aircraft or missiles are within a respective AO or are in the immediate vicinity of a respective AO with high probability of entry thereto.
- b. **Air Defence Warning Yellow.** Attack by hostile aircraft or missiles is probable. This means that hostile aircraft or missiles are en route toward an AO or unknown aircraft or missiles suspected to be hostile are en route towards, or are within, the AO.
- c. **Air Defence Warning White.** Attack by hostile aircraft or missile is improbable. ADW White can be declared either before or after ADW Yellow or ADW Red.

25. **States of Readiness.** States of readiness (SOR) describe the degree of readiness of AD Arty fire units and sensors. Their purpose is to increase the reaction time of AD Arty assets and personnel as well as indicate times for rest, resupply and maintenance.

26. Unit Standing Operational Procedures dictate precisely the actions to be taken on receipt of the SOR. Depending on the AD equipment employed the SOR could effect manning, system configuration or emission control.

27. Examples of states of readiness are:

- a. **Battle Stations.** Weapon/surveillance systems are ready to engage/track aircraft. Surveillance of assigned area is being conducted.

Air Defence Artillery Doctrine

- b. **Standby.** Weapon/surveillance systems are deployed and able to be brought up to battle stations within a specified period of time.
- c. **Released.** Weapon/surveillance systems are not expected to engage/track aircraft within a specified period of time. This period of time should be sufficient to permit rest, resupply, maintenance and repair.

28. A state of readiness may never be reduced without the authority of the headquarters that ordered that particular SOR. It may, however, be upgraded at any level if the situation dictates.

29. In order to avoid needles fatigue and strain on personnel, commanders at all levels should keep the state of readiness as low as possible while retaining the ability of rapid reaction to the air threat. This is only possible with accurate and reliable early warning.

30. **Rules of Engagement.** Rules of engagement (ROE) are the positive and procedural management directives which specify the circumstances and limitations under which forces will initiate or continue combat engagement with encountered forces.

31. The Joint Force Commander approves the theatre ROE. These established ROE enable the RAC to delegate the authority to execute AD operations.

32. The ROE also permit the RAC to retain control of the air battle by prescribing the exact conditions under which engagements may take place. ROE apply to all warfare participants in the theatre and are disseminated to all echelons of air, land and sea forces.

33. The following are the ROE applicable to all AD contributors:

- a. **Right of Self-defence.** Commanders at all echelons have the responsibility to take whatever action is necessary to protect their forces and equipment against air and missile attack. When under attack, the right of self-defence takes precedence over any other established rules and procedures that normally govern engagements. Self-defence for AD Arty

assets includes the forces or assets that they have been assigned to protect.

- b. **Hostile Act Criteria.** Hostile act criteria (HAC) are basic rules that assist in the identification of friendly or hostile air platforms. These rules are promulgated by the commanders of unified commands and by other appropriate commanders when so authorised. The commander who establishes the hostile act criteria parameters may consider the factors of speed, altitude and heading or other requirements within a specified volume of airspace. The commander may also consider specific enemy characteristics or hostile acts. Echelons having identification authority use hostile criteria to determine the identification of detected air targets. The highest echelon capable of managing engagement operations normally retains identification authority. Upon target detection, fire units with real-time data transmission capability assist the controlling authority by forwarding target information. The controlling authority makes final target identification and delegates engagement authority. Delegation of the controlling and identification authority to lower echelons is normal for AD Arty and non-AD Arty units that do not have real-time transmission capability for identification data. Such units have both identification and engagement authority.

- c. **Friendly Act Criteria.** The theatre rules of engagement will include criteria by which aircraft may be positively identified as friendly. These criteria are used to assist in the identification of aircraft as well as describe methods of allowing aircraft to identify themselves as friendly. These criteria are promulgated and controlled in the same manner as HAC.

34. **Weapon Control Status.** Weapon control statuses, WEAPONS FREE, WEAPONS TIGHT or WEAPONS HOLD, describe the relative degree of control of AD fire. Weapon control

statuses apply to weapon systems, volumes of airspace or types of aircraft. They are defined as follows:

- a. **WEAPONS FREE.** Weapons can fire at any air target not positively identified as friendly. This is the least restrictive weapon control status.
- b. **WEAPONS TIGHT.** Fire only at air targets positively identified as hostile according to the prevailing hostile criteria. Positive identification can be effected by a number of means to include visual identification (aided or unaided) and meeting other designated hostile criteria supported by track correlation.
- c. **WEAPONS HOLD.** Do not fire except in self-defence or in response to a formal order. This is the most restrictive weapon control status.

35. The degree or extent of control varies depending on the tactical situation. Establishment of separate weapon control statuses for fixed and rotary-wing aircraft and for missiles is normal. AD forces must have the ability to receive and disseminate weapon control statuses for all classes of air platforms.

36. The RAC/AADC normally delegates the authority for establishing rotary wing weapon control status to the appropriate manoeuvre force commander. The RAC/AADC may also delegate weapon control status for Unmanned Aerial Vehicles to the manoeuvre force commander.

37. The manoeuvre force commander may further delegate the authority to subordinate commanders, based on the tactical situation or operation.

38. Manoeuvre commanders who do not have authority to establish weapon control statuses still may direct more restrictive weapon control statuses in their AO.

39. **Fire Control Orders.** Fire control orders are commands, which are used to control engagements on a case-by-case basis, regardless of the prevailing weapon control status. Higher control

echelons use these orders when centralized control is in place or when monitoring the decentralized operations of subordinate units.

40. Fire control orders can be transmitted electronically or verbally however, not all of the fire control orders shown below can or will be used by every type of AD Arty unit.

41. Examples of fire control orders are:

- a. **ENGAGE.** This command is used to order a unit to engage (fire on) a specific target. This order cancels any previous fire control order, which may have been given on that target.
- b. **CEASE ENGAGEMENT.** This command is used to stop tactical action against a specified target. This order may be used to change an ongoing engagement of one target to another of higher priority or preclude the simultaneous engagement of a target. Missiles in flight are allowed to continue to intercept.
- c. **HOLD FIRE.** This command is used to stop firing against specific targets, which also includes the destruction of any missiles in flight fired at that specific target. This command may be used to protect friendly aircraft.
- d. **TRACK.** This command is used to direct a fire unit to acquire, track and report speed, altitude, heading and identification of the target track.

CHAPTER 6 AIRSPACE CONTROL

GENERAL

1. Air and Air Defence Artillery (AD Arty) operations could involve land, sea and air assets which may be controlled at theatre, corps, divisional or brigade level. The assets involved are routinely required to operate across boundaries and they invariably compete for airspace with other friendly air and AD Arty systems that contribute to the overall defensive counter-air operation.
2. The successful conduct of this requires the integrated operation of all available Air Defence (AD) systems. Command of airspace in any theatre of operations is exercised at the highest possible level, by the Airspace Control Authority (ACA). This is normally the senior air commander in theatre.
3. The key elements of an effective, integrated airspace control function are:
 - a. the formulation, documentation and dissemination of airspace control policy by the overall commander; and
 - b. a definitive plan developed by the ACA on that policy.

OBJECTIVE OF AIRSPACE CONTROL

4. The objective of airspace control is to maximise the effectiveness of military operations by promoting the ability of land, air and maritime forces to operate in an efficient, integrated and flexible manner with minimum mutual interference and without undue restraint and risk to friendly forces (ATP 40B).
5. The purpose of airspace control is to balance two conflicting requirements: optimising AD protection whilst allowing friendly air assets freedom to operate with minimum restriction. Minimising the danger to friendly air assets risks permitting hostile air assets to

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approach, without being engaged and to destroy assets vital to the success of the Joint Force Commander's (JFC)/ Combined Force Commander's (CFC) mission.

6. Conversely, achieving a very high probability of engaging all hostile aircraft may put friendly air assets at risk. The JFC must decide what balance of risk is acceptable. Airspace control is concerned with the control of all airspace users and of the AD weapons which are capable of engaging within that airspace.

7. To achieve the most benefit from all airspace users, an Airspace Control (ASC) System is utilised. The ASC is a procedural system designed to provide:

- a. minimum risk to friendly aircraft;
- b. minimum restrictions on AD weapons;
- c. separation of air and land operations in the airspace; and
- d. operability in a hostile electronic environment under conditions of electronic silence.

8. **Premises.** Two main premises of airspace control are:

- a. Restrictions cannot be avoided. Restrictions restrict where aircraft can fly and when land-based weapons can fire.
- b. The ASC must be effective under all conditions.

9. **North Atlantic Treaty Organization Doctrine.** ATP-40 (A) and (B) are North Atlantic Treaty Organization's (NATO) keystone documents for airspace control and all other documents that address airspace control are required to follow their guidelines. Nonetheless differing enemy and friendly force structures, commander's concepts of operation and operating environments will require variations in procedures.

10. **Concept.** ASC provides increased operational effectiveness by promoting safe, efficient, integrated and flexible use of airspace by

land, air and/or naval forces. The authority to approve operations is vested in the JFC / CFC.

11. The ACA is the subordinate commander, normally the air component commander, designated by the JFC to assume responsibility for the ASC system.

12. The ASC system is composed of different organizations, personnel and facilities from all services. Control facilities are linked with each other and with the ACA by communications and procedures to provide an integrated system.

13. The following command and control relationships apply:

- a. The ACA and the ASC system enhance the JFC's ability to employ forces. Hence, they should not be considered entities separate from the mission, authority and organization of the JFC.
- b. In appointing the ACA, a JFC does not alter the existing command relationship with subordinate commanders.
- c. The authority delegated to the ACA allows him to plan, organize and operate the ASC system through the establishment of an Airspace Co-ordination Centre (ASCC) at each level of command.

RESPONSIBILITIES

14. **Airspace Control Authority.** The ACA is appointed by the JFC. The Joint Force Air Component Commander is normally appointed the ACA as airspace control activities are most closely aligned with those of air operations. There may also be a Regional Air Commander depending on the scale of operations and a Sub-Area Airspace Control Authority designated by the ACA may be appointed to exercise overall responsibility for the airspace control system in a designated airspace control sub-area (See ATP 40B). The ACA is responsible for the operation of the ASC system based on the direction and policies received from the JFC. These include:

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- a. promotion of the safe, efficient, and flexible use of airspace within the combat zone;
- b. promulgation of changes in procedure and control methods in a timely manner;
- c. redesignation or modification of the Airspace Control Plan (ACP), airspace control procedures, airspace control sub-area(s), High Density Airspace Control Zone(s) (HIDACZ) and temporary Restricted Operations Area(s) (ROA);
- d. co-ordinating the establishment of terminal control zone and airport traffic control areas;
- e. integration and co-ordination of the ASC system with any existing civil, national or international air traffic control system;
- f. authorisation for deviations from established policies and procedures; and
- g. co-ordination with the AD commander and other affected subordinate commanders.

15. **Other Service Commanders.** The co-ordination of airspace control with adjacent or supporting operational commanders is considered during ASC planning. Mutual agreements regarding airspace control between ACA and other service commanders and supporting or adjacent authorities are required.

16. **Subordinate Commanders.** Each subordinate commander is responsible for:

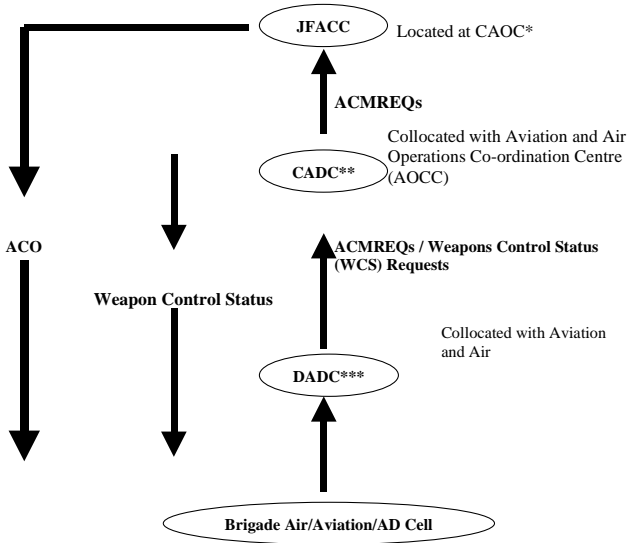
- a. employing organic weapons systems in accordance with the policies and procedures established by the ACA on behalf of the JFC;
- b. providing airspace control in designated airspace control sub-areas in accordance with policies and procedures promulgated in the ACP;

- c. forwarding requests for HIDACZ(s), ROAs and temporary airspace restrictions to the ACA; and
- d. proposing modifications or changes to the ACP, control measures and procedures to the ACA.

METHODS FOR AIRSPACE CONTROL

17. There are two basic methods of exercising airspace control:
- a. **Positive Control.** A method of airspace control that relies on positive identification, tracking and direction of aircraft within an airspace, conducted with electronic means by an agency having the authority and responsibility therein. Positive control relies upon real time data using facilities equipped with capabilities such as radar, IFF and communications.
 - b. **Procedural Control.** A method of airspace control which relies on a combination of previously agreed and promulgated orders and procedures. Procedural control includes techniques such as the segmenting of airspace by volume and time, and/or the use of weapon control orders. This method is more restrictive than positive control but is less vulnerable to interference by electronic or physical attack. It ensures continuity of operations under adverse environmental conditions and must always be available to provide an immediate fallback system should positive control be degraded or when positive control is not considered appropriate to the operations being conducted. Routine co-ordination must be conducted to allow the ASC to be responsive to the needs of airspace users. It must allow changes to be made to airspace control measures in effect.
18. Routine Airspace Control Measure Requests (ACMREQs) are originated at formation level and passed through the ASC to the ACA for approval. After individual requests have been received,

vetted and approved, the ACA will issue airspace control orders (ACOs) which detail the adoption of specific airspace control measures. The formats for ACMREQs and ACOs are normally contained in the ACP, as are the timings for submission of ACMREQs.



* Combined Air Operations Centre

** Corps Air Defence Cell

*** Division Air Defence Cell

Figure 6-1: Airspace Control and Air Defence Information Flow

19. **Selection of Method.** A combination of the two methods of airspace control may be employed, as they must be complementary to each other. The degree to which each method is used should be determined from a consideration of the following factors:

- a. the nature and magnitude of the enemy threat and operations;
- b. the availability, capability and vulnerability of friendly airspace management facilities, including airborne and surface AD as well as peacetime air traffic control and terminal control facilities;

- c. the numbers, flight profiles and speeds of friendly aircraft;
- d. the type of terrain and likely weather conditions in the combat zone; and
- e. the number, deployment and characteristics of friendly surface weapons systems.

20. **Fundamentals.** Fundamentals of airspace control are discussed in terms of operations and procedures.

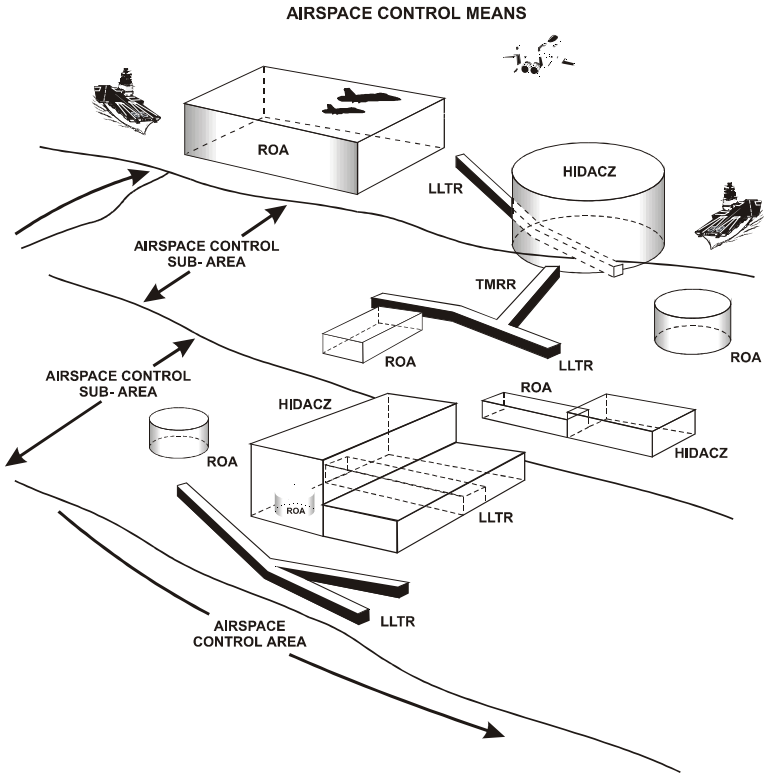
21. **Operations.** Airspace control must incorporate the following factors:

- a. All army, navy and air force airspace users are likely to interact, therefore, all users must be incorporated into the ASC.
- b. Airspace control must be co-ordinated with AD activities.
- c. Airspace is to be used with minimum restrictions, consistent with the degree of risk considered acceptable by the JFC.
- d. Full positive and full procedural control represent the extremes of a spectrum of control methods. The airspace control plan must accommodate any combination of such methods.
- e. Among users of the airspace, commonality is particularly important in navigational and geographic referencing, identification procedures, weapon control orders and terminology.
- f. Indirect fire is not normally stopped to allow aircraft movement.
- g. Optimum use is to be made of radar and other electronic systems for airspace control, consistent with radio electronic combat support considerations.

22. **Procedures.** Procedures must be established to facilitate airspace control. The most important factors are:

- a. procedures must accommodate both planned and immediate response missions;
- b. procedures must be simple as undue restrictions should not be imposed;
- c. procedures do not deny the right of self-defence to any airspace user;
- d. procedures must be flexible to accommodate navigation, sensor and weapon systems;
- e. procedures must take into account the different capabilities and requirements of the participant nations;
- f. procedures must recognise the limited time available for AD engagements because of the inherent flight characteristics of combat aircraft and missiles;
- g. procedures are to be compatible between air traffic control units, AD agencies and tactical elements;
- h. procedures must be capable of working in a hostile electronic environment or under electronic silence.

23. **Airspace Control Elements.** Measures provided for use by the ASC system when planning operations are airspace control area, HIDACZ and airspace restrictions.



*LLTR is Low Level Transit Route
 ** TMRR is Temporary Minimum Risk Route

Figure 6-2: Airspace Control Measures

24. **Airspace Control.** A service provided in the combat zone to increase operational effectiveness, by promoting the safe, efficient and flexible use of airspace.

25. **Airspace Control Area.** An airspace control area is a block of airspace laterally defined by the boundaries of the area of operations. It is the basic geographical element of an ASC system in a JFC's area of responsibility. The ACA will plan and co-ordinate airspace control operations in the control area using the facilities of subordinate commanders. The level of command within the airspace control area will depend upon the scale of operations being conducted

and may vary from theatre down to brigade. An airspace control area may be subdivided into airspace control sub-areas.

26. **Airspace Control Sub-area.** The number of sub-areas established will depend upon the capabilities of the commander's command and control facilities, the situation, geographical factors, the complexity of the airspace control requirements and AD requirements. Whenever possible, the sub-areas should conform to tactical boundaries.

27. **High Density Airspace Control Zone.** A HIDACZ is a block of airspace with defined dimensions, designated by the ACA, in which there is a concentrated employment of numerous and varied weapons/airspace users. Therefore, in addition to being an ASC organizational measure, a HIDACZ is also a control measure. The size of a HIDACZ depends on the tactical situation and should be kept to the minimum possible. Friendly air activity is limited to aircraft that have a specific function to perform within the boundaries of the HIDACZ. All other aircraft must avoid entering the HIDACZ. They are often established within the boundaries of the corps or division area but, in theory, could be established across boundaries. Within an approved HIDACZ, the authority to control the airspace is delegated to the commander of the formation requesting the establishment of the HIDACZ. The controlling authority will determine the procedural means of control within the HIDACZ, subject to limitations imposed by the ACA.

28. **Airspace Control Measures.** Airspace Control Measures (ACMs) are special restrictive measures applied to segments of airspace of defined dimensions. They are:

- a. **Restricted Operations Area.** Airspace of defined dimensions, designated by the ACA, in response to specific operational situations/requirements within which the operation of one or more airspace users is restricted. Examples of ROAs include aerial-refuelling orbits, concentrated interdiction areas, airdrop and search and rescue areas.
- b. **Weapons Free Zone.** A Weapons Free Zone (WFZ) is a volume of airspace around a critical asset which merits special protection by AD Arty. It is

established to permit maximum engagement of hostile aircraft. All friendly aircraft must avoid WFZ unless prior approval has been obtained from the designated controlling authority. Requests for the creation or implementation of WFZs can originate at any level in response to ground operations and will be staffed through ASC channels to ACA for approval.

- c. **Base Defence Zone.** A Base Defence Zone (BDZ) is a controlled area around an airfield used to enhance the effectiveness of local ground based AD weapon systems protecting it. The size of BDZs and procedures relating to their operation will be detailed in the theatre ACP and their effects on operation of the ground-based AD weapon systems will be contained in SOPs.
- d. **Hostile Aircraft Free Engagement Zones.** A Hostile Aircraft Free Engagement Zones (HAFEZ) is a volume of airspace within which Short-Range Air Defence (SHORAD) systems have freedom of engagement. AD weapon systems within the HAFEZ normally operate at WEAPONS FREE and all friendly aircraft must avoid this area. A HAFEZ is likely to be established when the enemy enjoys air superiority and in response to early warning of a major enemy air raid. HAFEZ will normally only be used during the early stages of conflict to cope with large initial raids, but their use at other times is not precluded.
- e. **Low Level Transit Route.** A Low Level Transit Route (LLTR) is a temporary corridor of defined dimensions which facilitates the low-level passage of friendly aircraft through airspace defended by friendly AD Arty and they should avoid HIDACZs or ROAs. It is designed to reduce the risk to friendly aircraft yet minimize constraints on AD Arty. LLTRs normally link with air routes at junction points (JPs) and with the Fire Support Co-ordination Line at forward points (FPs) and may also change direction at turning points (TPs). The

dimensions and weapon control status of a LLTR will be contained in the ACP/ACO. The ACP/ACO may also detail aircraft speed and formations permitted within LLTRs. They are activated by means of ACOs which will detail JPs, FPs and TPs as well as any other instructions such as activation time and direction.

- f. **Temporary Minimum Risk Route.** A Temporary Minimum Risk Route (TMRR) is a temporary route used to route air traffic between LLTRs or the rear boundary of the forward area and their operations area in direct support of ground operations. TMRRs may also be established between aircraft field sites and their operations area or to accommodate major operations within a corps area. TMRR dimensions are determined according to the mission but are typically 5 km wide. Due to the short tasking time required for activation of TMRRs they are not reflected in the ACO.

- g. **Standard Use Army Aircraft Flight Route.** Standard Army Aircraft Flight Routes (SAAFRs) are established to route helicopter traffic in the forward area in direct support of ground operations. SAAFR dimensions are determined according to the mission but are typically 2 km wide. Due to the short tasking time required for activation of SAAFRs they are not normally reflected in the ACO.

- h. **Time Slot.** Time slots are periods of time during which certain airspace activities within airspace of defined dimensions are constrained to permit other users greater freedom of operations. They should be kept to a minimum in order to preclude unnecessary airspace restrictions. At the end of the period the constraints are automatically cancelled.

- i. **Traverse Level.** The vertical displacement above SHORAD and Very Short-Range Air Defence systems is expressed both as a height (AGL) and altitude (AMSL) at which aircraft can traverse the

area. It may be extended across one or more HIDACZ or confined to the area over a ROA.

- j. **Airspeed Control.** Signifies a defined speed band within which aircraft may fly, normally as a supplement to other forms of identification or airspace control. It may be used in conjunction with other parameters, such as height, direction, area or time.

29. **Airspace Co-ordination Facility.** The ASC is a system of organizations, personnel, policies, procedures and facilities required to perform airspace control functions. This system is based on those facilities identified by their subordinate commander as also being capable of performing airspace control functions. These facilities are linked with each other and with the ACA by communications and/or procedures to form an integrated ASC. Operation of the ASC is effected by subordinate commanders by means of their facilities, in response to the ACA and the ACP.

30. An ASCC should perform the following functions and tasks within its defined area of responsibility:

- a. Co-ordinate AD, tactical air support, surface fire and air traffic information.
- b. Co-ordinate, assemble and display relevant airspace activity data.
- c. Advise the local commanders of possible conflict between friendly users and, in the light of the tactical situation; obtain priorities for each of the major users.
- d. Minimize the risk to high priority systems by the use of positive and/or procedural control measures.
- e. Inform airspace users of the priorities in force and planned control procedures.
- f. Liase with adjoining facilities to ensure mutual awareness of relevant planned activity.

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- g. Seek guidance from higher authority when unable to resolve conflicting priorities. It must be emphasised that conflicts that cannot be resolved to the satisfaction of all parties will normally result in giving the right of way to the air force assets.

31. An example of an Airspace Co-ordination Facility established within the Fire Support Co-ordination Cell at a brigade headquarters is the Airspace Co-ordination Centre. In a brigade, this is formed from the Brigade AD Cell and the Aviation and Air cells. The senior artillery commander is responsible to the brigade commander for airspace co-ordination. He will normally delegate this function to the commanding officer of the AD unit/sub-unit.

CHAPTER 7

AIR DEFENCE ARTILLERY IN OPERATIONS

OFFENSIVE OPERATIONS

1. Victory can only be achieved through offensive operations. The key to success is seizing and maintaining the initiative. One key factor to this is an appropriate tempo and Air Defence Artillery (AD Arty) plays a key role in ensuring the momentum required for offensive operations is maintained by protecting the ground forces, resupply routes or combat support elements.
2. AD Arty support to offensive operations is critical at various times during the advance, attack and reorganization.
3. AD priorities must be established by the Air Defence (AD) commander to ensure effective and continuous support for the offensive operation.
4. Where appropriate, Javelin or Air Defence Anti-tank System (ADATS) might be deployed forward with advancing troops with the principal role of destroying helicopters.
5. During the preparation and approach stages of an attack, consideration for AD cover should be given to assembly areas, the approach march routes, flank protection forces and artillery positions. During the attack, the priority may shift to protecting the attacking force. As the attack progresses the protection of reserves and lines of communication may take on increasing importance. The AD commander must, therefore, have a detailed understanding of the commander's plan. He should ensure that he retains sufficient control of AD assets to be able to react to changes in the plan, redeploying sub-units from lower to higher priority tasks as the situation demands.

AIR DEFENCE FUNDAMENTALS IN OFFENSIVE OPERATIONS

6. Due to the nature of offensive operations, High/Medium AD coverage may not extend far enough forward to include manoeuvre forces. Organic Short-Range Air Defence (SHORAD) / Very Short

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Range Air Defence (VSHORAD) will likely be the only ground based AD available to manoeuvre forces until HIMAD resources can be redeployed far forward to provide coverage.

7. This means early warning may be reduced although it may be provided from higher AD levels including airborne resources.

8. Fundamentals in planning AD Arty in offensive operations are:

- a. **Information Gathering.** Knowledge of enemy activities and intentions, and the terrain over which manoeuvre must be conducted is vital to AD planning. There will be little opportunity for reconnaissance forward of the main forces and AD commanders must make best use of maps and photographs in order to determine how best to deploy their resources. AD commanders must determine early in the operation planning process exactly what the commander's mission and concept of operation are.
- b. **Simplicity.** Plans for AD Arty must be kept simple to avoid confusion and degraded coverage due to readjustment of groupings and tasks.
- c. **Depth.** Depth in AD Arty is achieved by ensuring a constant forward adjustment of AD Arty assets which allows no gaps in coverage to develop between the lead manoeuvre elements and the rear assets.
- d. **Mutual Support.** AD Arty sub-units employed on offensive tasks must be mutually supporting and movement within sub-units must be mutually supported.
- e. **Balance.** AD assets should be grouped to provide protection for the covering force, the leading battle groups, the reserves and other important combat support and service arms that are vital to the operation.

AIR DEFENCE FUNDAMENTALS IN DEFENSIVE OPERATIONS

9. The operational plan for a defensive battle will be based on the degree of mobility possible, the value of particular obstacles and the availability of troops.

10. AD Arty will mirror the operational plan by deploying mobile AD Arty where the battle is likely to be fluid and keeping the less mobile AD equipment in the more static areas. The detailed characteristics of the AD equipment must be taken into account.

11. There will be occasions however when it is necessary to deploy less mobile equipment forward either because of the intention to hold a particular area of ground, or because of a lack of more mobile equipment's capable of achieving the coverage required under the prevailing weather conditions or at night.

12. Likely tasks for AD Arty in defensive operations include the protection of troops in forward areas including covering forces, Command and Control assets, critical points such as reserve demolitions, Combat Service Support resources, fire support systems including gun batteries, reserves, airfields and Forward Area Replenishment Points.

13. The assessment of enemy air avenues of approach and tactics against fixed, high value assets is a major factor in achieving the optimum deployment of AD systems.

14. Defensive operations are those for which the integrated AD Arty system was designed. They are characterised by detailed planning and deliberate deployment.

15. HIMAD systems are deployed to form the framework of the overall AD Arty plan. SHORAD/VSHORAD are deployed in accordance with the priorities of the manoeuvre force commander and are included in the integrated AD system where possible.

16. Fundamentals in planning AD Arty defensive operations are:

- a. **Information Gathering.** The enemy will strive to gain information concerning our organization,

deployment and order of battle. Depending upon the commander's mission and his intentions, AD Arty can prevent the enemy from gaining information by the early engagement and defeat of Unmanned Aerial Vehicles and by strict enforcement of emission controls.

- b. **Terrain.** The commander's selection of key terrain and vital ground will influence the selection of the type of defence and the priorities for AD Arty. AD coverage must include the surveillance of all major air approaches. AD weapon system positions should offer concealment and cover from direct enemy observation and should, if possible, be near friendly units so local defence can be integrated.
- c. **Coordination.** AD Arty must be integrated into the commander's plan. This will encompass the coordination of AD Arty operations with the supported arms and higher, lower and flanking units or formations.
- d. **Mutual Support.** AD sub-units must be mutually supporting. The degree of mutual support depends upon the terrain, the assets being protected, the air approaches, and the characteristics of the AD weapons used.
- e. **Depth.** Depth can be achieved by deploying AD weapons throughout an area. Enemy air could attack from any direction or height, therefore depth must not be thought of in terms of front to rear, but laterally and vertically as well. Air approaches to protected assets must be covered well forward of the aircraft Line of Weapon Release (LWR) and beyond.
- f. **Manoeuvre.** AD units must be able to regroup quickly between tasks to meet the changing threat in various phases of the operation. In addition AD units should have the same mobility as the supported arms to provide continuous protection and to move

to new fire positions following engagement or detection to enhance their survivability.

- g. **Coverage.** The effectiveness of the AD provided to a formation will be determined by the effectiveness of the coverage. This coverage must include all AD weapons on all given tasks, including those from higher formation, which contribute to the AD of the entire area. Coverage could then be adjusted, coordinated and improved.

AIR DEFENCE FUNDAMENTALS IN DELAYING OPERATIONS

17. It is likely that Delaying operations may be conducted in a hostile air environment. It is also unlikely that sufficient AD resources will be available to provide cover throughout the area of operation.

18. Priorities of tasks must therefore be established and redeployment planned to ensure effective AD at critical times and points.

19. AD will be particularly important as the delaying force hands over the battle and conducts a rearward passage of lines. The confused situation which may well exist at the hand-over line will create significant airspace control difficulties, particularly if friendly Close Air Support (CAS) and Attack Helicopters (AHs) are used to assist the delaying force break contact.

20. Delaying operations are characterised by the following fundamentals:

- a. **Offensive Action.** AD Arty must be employed aggressively to reduce the effects of enemy air support, particularly Intelligence, Surveillance, Target Acquisition and Reconnaissance. Without a clear picture of friendly dispositions, the enemy will be forced to gather this information using slow, less efficient ground reconnaissance.

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- b. **Manoeuvre.** AD Arty must continually manoeuvre to readjust coverage over the delaying force and to protect the disengagement and movement of the delaying forces. Possible AD tasks may include protection of field artillery units and antiarmour weapons or tanks.
- c. **Balance.** The AD Arty commander must ensure that not all his resources are committed to the delaying force. He must employ resources in the main defensive positions to cover the withdrawal of the delaying force, and some resources to cover the withdrawal routes.
- d. **Terrain.** The delaying force will use the terrain in order to slow the enemy advance. This may or may not work to the advantage of AD Arty. The AD Arty commander must make the best possible use of the existing terrain in order to determine the most likely enemy air approaches, the best coverage, and the best possible locations for deployment.
- e. **Time and Space.** The delaying force will delay the enemy for as long as possible and then withdraw. Throughout they may be subject to air attack and AD must be prepared to provide protection during the fighting as well as the withdrawal. Time must be allowed for withdrawal of the supporting AD Arty, which must strive to provide complete coverage of the supported force.
- f. **Security and Protection.** To prevent surprise, AD Arty assets must not be caught off-guard during their own movement. To preserve the security of the delaying force, AD Arty may be tasked to provide point defence of features such as crossing sites, choke points and routes used by the delaying force.

AIR DEFENCE FUNDAMENTALS IN TRANSITIONAL PHASES

21. **Withdrawal.** Defence against enemy air attack will be critical during a withdrawal. There are unlikely to be sufficient organic AD Arty resources to provide comprehensive coverage throughout the whole area of operations, so priorities of tasks must be established.
22. A balance will have to be struck between protecting the withdrawing force and defending those preparing and occupying the next main position. AH and CAS may well be employed to enable the protective element to disengage.
23. If VSHORAD is deployed with the protective element, great care will be needed to avoid fratricide and appropriate Weapon Ccontrol Status (WCS) will have to be imposed. There are no specific fundamentals to the conduct of the withdrawal. Fundamentals pertaining to the delaying operations are applicable.
24. **Relief.** Priorities for AD Arty during relief operations must be clearly stated. The unavoidable concentration of units during relief operations will increase vulnerability to air attack and may therefore require additional AD Arty resources or an adjustment of the AD posture.
25. The two primary tasks for AD Arty are likely to be support to the relief of committed forces and increased coverage over all the main relief routes.
26. Where AD units are themselves either relieving or being relieved in place, it will be usual for AD systems of similar types to take over the deployment sites of the in place AD units and adjust as necessary once that phase is complete. The relieving AD force takes over airspace control, using as many of the existing airspace control means as possible, to maintain continuity for transiting aircraft. Particular emphasis must be placed on coordinating this handover to maintain the integrity and effectiveness of the current airspace control measures.
27. Detailed liaison with the in place AD force will be necessary. Our intentions must be concealed from the enemy and therefore

security will be an important factor. Deception should include normal patterns of activity and increased use of radio and active sensor emissions should be avoided.

28. **Advance to Contact.** When an advance or pursuit is conducted against relatively light ground force opposition, enemy air attack may present the greatest threat.

29. This means that AD Arty should move forward with the leading ground elements to establish a protected environment through which the main body may move.

30. Apart from the intimate AD support of mobile formations during the advance, likely AD tasks include protection of vulnerable points on the route and cover for critical operations such as attacks, river crossings or breaching operations. It will be necessary to decide early which routes and areas must be defended by AD Arty so that detailed planning and reconnaissance can be carried out.

31. In a rapidly moving advance, any AD detachment commander may be expected to carry out his own reconnaissance, regardless of his equipment. In some cases the provision of AD coverage may dictate the speed of advance. Nevertheless, close coordination of movement will be needed to ensure coverage remains balanced throughout the deployment.

32. **Meeting Engagement.** It will not be possible to plan in detail for meeting engagements and much will depend upon the organization for movement laid down in the commander's plan. This should take into account enemy air/aviation/Electronic Warfare and Suppression of Enemy Air Defences capabilities.

33. In principle, mobile AD weapons should be allocated to support forces on the move and be deployed to give as much forward protection as possible.

34. **Link-up Operations.** During Link-up operations, WCS must be disseminated in a timely fashion to ensure that AD Arty units do not engage friendly aircraft that may be supporting the link-up units. In particular, mobile AD units must be tightly controlled and may have to adopt a more restrictive WCS than the Airspace Control Order (ACO) specifies.

35. The ACO is only applicable for properly co-ordinated systems the exact positions, arcs and coverage of which are known. Weapon systems may be redeployed once the link-up is complete to ensure a robust, integrated defence without duplication.

36. **Airfield/Installation Operations.** Airfield AD is unique in its command, control, deployment and support arrangements of AD units. As a result, this form of AD deployment deserves separate consideration. Because of the nature of an airfield, planning its defence requires a detailed study of the assets to be protected and the extent of protection required.

37. **Type of Protection.** An area defence is the most likely type of protection to be used, with individual weapon systems sited to cover the most likely aircraft approaches. Depending upon the number of attack aircraft the enemy uses, some are likely to get through the defences; the numbers and types of AD Arty assets deployed will affect the success of the attack. The worst case scenario is a coordinated, massed attack against one or a number of vital assets on the airfield.

38. In providing airfield AD, the AD Arty commander must first consider the enemy methods of attack against the airfield. Runway attacks will depend on the types of ordnance technology available to the enemy.

39. In addition there are numerous other small, point targets on the airfield including radar, fuel storage areas, ammunition storage, etc. These point targets may be attacked from any direction depending on the terrain, and may be attacked using stand-off weapons.

40. The AD Arty commander must try and ensure that hostile aircraft attacking these targets can be engaged before their LWR. This will assist him in deciding where to deploy his AD weapons to obtain the best coverage of all likely targets which must be protected. He may decide that point defence is only required on certain assets with the majority falling under the area AD coverage.

41. Once the AD commander has determined the number of weapon systems required to protect the airfield facilities, he must then determine the number of weapon systems to be deployed outside the airfield defence zone in order to provide early warning and depth to

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the AD coverage. These weapons will generally be deployed for an area defence and in some cases in an attrition role.

42. The benefits of having them deployed some distance from the airfield defence zone are:

- a. to disrupt the attacker before the LWR is reached;
- b. to provide early warning and depth to the inner ring of AD coverage which assists against saturation by massed attack; and
- c. to disrupt the enemy's plan of attack to such an extent that he must realign his tactics in order to engage the AD before he attacks the airfield.

43. AD gun systems, with their high rate of fire and rapid reaction are normally deployed in the ring AD of the airfield. SHORAD systems because of their greater range will be deployed further out from the airfield in an attrition role. HIMAD systems may be employed to protect the area encompassing the airfield, but will not generally be deployed within its confines.

44. **Command and Control.** Control of AD will be exercised from the Wing Operations Centre (WOC).

45. The WOC is an airforce organization responsible for planning and control of airfield tactical air operations within the Base Defence Zone (BDZ). It is commanded by the Base commander and the SHORAD commander is responsible to him for all SHORAD operations. Special airspace control measures apply within the BDZ to ensure the safety of friendly air assets operating out of the airfield. These are explained in detail in B-GL-372-002/FP-001.

GLOSSARY**TERMS AND ABBREVIATIONS**

ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
AAAD	DAATA	All Arms Air Defence	
AADC	cmdt DAAZ	Area Air Defence Commander	A duly appointed commander responsible for the Air Defence of a designated area.
ABCA	ABCA	America, Britain, Canada and Australia	
ACA	ACEA	Airspace Control Authority	The commander designated to assume overall responsibility for the operation of the airspace control system in the airspace control area.
ACC		Air Component Commander	
ACM	MCEA	Airspace Control Measures	Procedural measures that when established, reserve airspace for specific airspace users, restrict the action of airspace users, control the actions of specific airspace users and/or require airspace users to accomplish specific actions. Airspace Control Measures can also be used to identify friendly users, providing separation from other friendly airspace users and avoiding the risk of being engaged by friendly Air Defence weapons.

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ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
ACMREQ		Airspace Control Measure Request	
ACO	OCEA	Airspace Control Orders	
ACP	PCEA	Airspace Control Plan	
ACR		Airspace Control Request	
AD	DAA	Air Defence	All measures designed to nullify or reduce the effectiveness of hostile air action.
AD Arty	AAA	Air Defence Artillery	The term includes both gun and missile weapon systems.
ADATS	ADATS	Air Defence Anti-tank System	
ADC		Air Defence Commander	
ADP		Automatic Data Processing	
ADW		Air Defence Warning	
AEW		Airborne Early Warning	
AGL		Above Ground Level	
AH	HA	Attack Helicopter	
AMSL	AMSL	Above Mean Sea Level	
AO	Z op	Area of Operation	
AOC		Area Operations Centre	The principal air operations installation from which

ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
			aircraft and air warning functions of combat air operations are directed, controlled and executed.
AOCC		Air Operations Co-ordination Centre	An Air Force unit collocated with the Corps Headquarters that is responsible for all co-ordination and liaison functions between the Corps and the appropriate Air Headquarters.
ARM	MAR	Antiradiation Missile	
arty		artillery	
ASC	SCEA	Airspace Control	A service provided in the combat zone to increase operational effectiveness, by promoting the safe, efficient and flexible use of airspace. Airspace control is provided in order to permit greater flexibility of operations, while authority to approve, disapprove or deny combat operations is vested in the operational commander.
ASCC	CCoordEA	Airspace Co-ordination Centre	
BADC		Brigade Air Defence Cell	
BC		Battery Commander	
BDZ	ZDB	Base Defence Zone	A zone established around airbases to enhance the effectiveness of local ground based Air Defence systems.
bty		battery	

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ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
C2		Command and Control	
C ³ I	C ³ I	Command, Control, Communications and Information	
CAOC	CCOA	Combined Air Operations Centre	This is a theatre level element of the Air Command and Control structure that plans and tasks offensive and defensive air operations on behalf of the Regional Air Commander.
CADC	CDAAC	Corps Air Defence Cell	
CAS	AAR	Close Air Support	Air action against hostile surface targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces as well as direct or indirect final guidance to the target.
CCIS	SICC	Command, Control and Information System	
CF		Canadian Forces	
CFC		Combined Force Commander	
CL		Centre Line	
CM		Cruise Missile	
Comd		Commander	
CP		Command Post	
CRC		Control and Reporting Centre	A subordinate air control element of the tactical air

ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
			control centre from which radar control and warning operations are conducted within its area of responsibility.
CRS	SDC	Control and Reporting System	
CSS		Combat Service Support	
DADC	CDAAD	Division Air Defence Cell	
DCA	ODPA	Defensive Counter Air	
DE		Direct Energy	
DMED		Digital Message Entry Device	
DP		Delivery Point	
DS	AD	Direct Support	
EA		Electronic Attack	
EAW		Early Warning	
ECM	CME	Electronic Counter-Measures	
EM		electromagnetic	
EMCON	CONEM	Emission Control	
EOCM	EOCM	Electro-Optical Counter Measures	
EP		Electronic Protection	
EPM	MPE	Electronic Protective Measures	
ESM	MSGE	Electronic Support Measures	
EW	GE	Electronic Warfare	
EWSM		Electronic Warfare Support Measures	

ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
FAC		Forward Air Controller	
FARP		Forward Area Refuelling Point	
FCO		Fire Control Order	
FEBA		Forward Edge of the Battle Area	
FLOT		Forward Line of Own Troops	
FP		Forward Point	
FSCC		Fire Support Co-ordination Cell	
FSCL		Fire Support Co-ordination Line	
GBAD	DAABS	Ground Based Air Defence	
GPS	GPS	Global Positioning Systems	
GS	AG	General Support	
GSR	AGR	General Support Reinforcing	
HAC		Hostile Act Criteria	
HAFEZ	ZTLAH	Hostile Aircraft Free Engagement Zone	
HIDACZ	ZCEAHD	High Density Airspace Control Zone	High Density Airspace Control Zones are areas of intense ground operations over which friendly aircraft may be at risk from friendly Air Defence weapons. Aircraft movement therefore requires co-ordination. A High Density

ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
			Airspace Control Zone is requested by a land force commander who then controls all air activity within it. It will normally be specified in the Airspace Control Plan.
HIMAD	DAAMH A	High and Medium Air Defence	
HVT		High Value Target	
ICBM	MBI	Intercontinental Ballistic Missile	
IFF		Identification Friend or Foe	
INS		Inertial Guidance Systems	
IO		Information Operations	
IP	PI	Initial Point	
IPB		Intelligence Preparation of the Battlefield	
ISTAR	ISTAR	Intelligence, Surveillance, Target Acquisition and Reconnaissance	
JF		Joint Force	Elements of more than one service of the same nation.
JFACC	cmdt CAFI	Joint Force Air Component Commander	
JFC	cmdt FI	Joint Force Commander	
JFHQ		Joint Force Headquarters	
JP		Junction Point	

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ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
LCC		Land Component Commander	
LGB	BGL	Laser Guided Bomb	
LLAD	DABA	Low Level Air Defence	
LLAPI	IISABA	Low Level Air Picture Interface	
LLTR	RTBA	Low Level Transit Route	A temporary corridor of defined dimensions established in the forward area to minimize the risks to friendly aircraft from friendly Air Defence or surface forces.
LO		Liaison Officer	
LWR	LLA	Line of Weapons Release	
LZ		Landing Zone	
MCC		Maritime Component Commander	
MF		Management Function	
MLAD		Medium Level Air Defence	
NATO	OTAN	North Atlantic Treaty Organization	
OCA	OOPA	Offensive Counter Air	
OOTW		Operations Other Than War	
OPCOM	OPCOM	Operational Command	
OPCON	OPCON	Operational Control	

ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
PIR	BPR	Priority Intelligence Request	
PTL		Primary Target Line	
PUP		Pull-up Point	
QSTAG		Quadrupartite Standardisation Agreement	
R	R	Reinforcing	
RAC	cmdt Raé	Regional Air Commander	
RADC	cmdt DAAR	Region Air Defence Commander	
RAP	IAC	Recognised Air Picture	
regt		Regiment	
ROA	ZOR	Restricted Operations Area	A Restricted Operations Area is a volume of airspace, either rectangular or circular, reserved for use by friendly aircraft involved in a special operation and which requires protection from friendly Short-Range Air Defence / Very Short-Range Air Defence weapons and isolation from other friendly air operations.
ROE		Rules of Engagement	Directives issued by competent military authority which specify the circumstances and limitations under which forces will initiate and/or continue combat

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ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
			engagement with other forces encountered.
RP		Replenishment Point	
SAAFR	RVSAAT	Standard Army Aircraft Flight Routes	
SACA		Sub-Area Airspace Control Authority	
SAMOC	COMSA	Surface-to-Air Missile Operations Centre	
SEAD	SDAE	Suppression of Enemy Air Defence	
SHORAD	DAACP	Short-Range Air Defence	
SLBM	MBLS	Submarine Launched Ballistic Missile	
SOR		State of Readiness	
TACOM	TACOM	Tactical Command	
TACON	TACON	Tactical Control	
TACS		Theatre Airspace Control System	
TASM	MTAS	Tactical Air-to-Surface Missile	
TBM	MBT	Tactical Ballistic Missile	
TEL		Transporter, Erector, Launcher	
TMD	MDT	Tactical Missile Defence	
TMRR	RTRM	Temporary Minimum Risk Route	A Temporary Minimum Risk Route is a temporary bi-directional route used to route fixed-wing aircraft

ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
			between Transit Routes or the rear boundary of the forward area and their operation areas in direct support of ground operations. The dimensions will be mission specific. The period of validity will be specified by the originating authority and will normally be in operation for the duration of a specific mission.
tp		troop	
TP		Turning Point	
TR		Transit Route	A Transit Route is a temporary bi-directional corridor of defined dimensions, established in the forward area to minimize the risks to friendly aircraft from friendly Air Defence. The dimensions are mission specific and the centre line will be defined in the Airspace Control Orders by a series of points.
UAV	VATG	Unmanned Aerial Vehicle	
USOP		Unit Standing Operational Procedures	
VSHOR AD	DAATCP	Very Short-Range Air Defence	
WCO		Weapon Control Order	The order which promulgates the Weapon Control Status.
WCS		Weapon Control Status	

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ABBREVIATION		TERM	DEFINITION
ENGLISH	FRENCH		
WFZ	ZTL	Weapon Free Zone	An Air Defence zone established around key assets or facilities which merit special protection by ground based Air Defence assets, other than airbases, where weapons may be fired at any target not positively identified as friendly.
WOC		Wing Operations Centre	