

**BY ORDER OF THE
SECRETARY OF THE AIR FORCE**

**AIR FORCE MANUAL 11-2F-22A,
Volume 3**



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Flying Operations

F-22A--OPERATIONS PROCEDURES

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This publication establishes effective and safe operations of the F-22A and implements Air Force Policy Directive (AFPD) 11-2, *Aircrew Operations*. This Air Force Manual (AFMAN) applies to all F-22A units in the Regular Air Force, Air National Guard and Air Force Reserve. It does not apply to the United States Space Force. Ensure all records generated as a result of processes prescribed in this publication adhere to Air Force Instruction (AFI) 33-322, *Records Management and Information Governance Program*, and are disposed of in accordance with the Air Force Records Disposition Schedule, which is located in the Air Force Records Information Management System. Refer recommended changes and questions about this publication to the office of primary responsibility (OPR) using the Department of the Air Force (DAF) Form 847, *Recommendation for Change of Publication*; route DAF Forms 847 from the field through the appropriate functional chain of command. Air Combat Command (ACC) Director of Operations (ACC/A3) will coordinate all changes to the basic volume with all major command (MAJCOM)/A3s. This publication may be supplemented at any level but route all direct supplements to Air Force Flight Standards Agency Flight Directives (AFFSA/XOF) and Air Combat Command Flight Operations and Training Branch (ACC/A3TO) for coordination prior to certification and approval. Field units below MAJCOM/direct reporting unit (DRU)/field operating agency (FOA) level forward copies of their supplements of this publication to their parent MAJCOM/ DRU/FOA OPR for post-publication review. **Note:** The above applies only to those DRUs/FOAs that report directly to Headquarters Air Force (HAF). Copies of MAJCOM/DRU/FOA-level supplements, after approved and published, will be made available on the e-Publishing website at <https://www.e-publishing.af.mil>. The authorities to waive wing or unit level requirements in this publication are identified with a Tier (“**T-0, T-1, T-2, T-3**”) number following the compliance statement. See Department of the Air Force Manual (DAFMAN) 90-161, *Publishing Processes and Procedures*,

for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the requestor's commander for non-tiered compliance items. Additional waiver authority to this publication is described in [paragraph 1.2](#).

SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. Major changes include the following: Incorporation of interim change 1, throughout the manual changed any reference of Experienced/Inexperienced pilot to 4-ship Flight Lead/Wingman. [Chapter 1](#), removed Tiering from [paragraph 1.1](#) per guidance in DAFMAN 90-161; [Chapter 2](#), updated TOLD and AGCAS for F-22 ops, added Electronic Knee Board, added reference to ACCI 11-270 for all electronics in cockpit; moved CBRNE from [Attachment 2](#) to [Chapter 2](#). [Chapter 3](#), updated ABOS and Ops Checks sections, added wording to minimum pattern and touchdown spacing, [paragraph 3.16.1](#) deleted reference to KC-10, added contract air refuelers and new [paragraph 3.20.4.5](#) concerning short field landings based on wake turbulence findings, modified touchdown spacing to match AFMAN 11-2F-22AV2, modified rejoin to match AFTTP 3-3.F22A (generally accepted practice), modified maintenance debrief procedures to specified CODE 3 RESTRICTED or CODE 3 FLYABLE, and new [paragraph 3.34](#). Laser Eye Protection per guidance in AFI 11-301V1. [Chapter 4](#), highly modified per AFMAN 11-202V3 ACCSUP: restrictions on HUD as a sole primary flight reference, adds new [paragraph 4.8](#) for Airspace Certifications to address questions concerning RVSM and RNAV approvals. New [Table 4.1](#) and new [paragraph 4.9](#) to address RNAV approvals and self-contained approaches. Adds new [Tables 4.2](#) through [Table 4.7](#) for flight plan filing codes; new [paragraph 4.11](#) for extreme latitude navigation per AFMAN 11-202V3 ACCSUP; [Chapter 5](#), clarified wording for negative G guns jink, deleted requirement to track pilot weapons hit/miss rate, clarified live ordnance section; [Chapter 6](#), deleted requirement to track pilot weapons hit/miss rate; [Chapter 7](#), corrected brake energy limits data, added 2-tank nominal abort speed, modified NORDO pattern procedure to match AFPAM 11-205, added thunderstorm avoidance and visible moisture airspeed information; [Attachment 2](#), completely revised all briefing guides.

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Chapter 1

GENERAL GUIDANCE

1.1. Responsibilities. This extends guidance from AFMAN 11-202 Volume 3, *Flight Operations*, to comply while operating an F-22A aircraft under normal circumstances. It is not a substitute for sound judgment or approval to override any existing aircraft limitation. Procedures not specifically addressed may be accomplished if they enhance safe and effective mission accomplishment. Deviations from these procedures require a specific waiver unless an urgent requirement or an aircraft emergency dictate otherwise. In that case, the pilot in command takes appropriate action to recover safely the aircraft.

1.1.1. Commanders. Commanders at their respective tier levels are responsible for complying with guidance in this manual. F-22A flying unit wing commanders, delegated no lower than the operations group commander (OG/CC), are responsible for providing local operating guidance to supplement the requirements in **Chapter 8** of this manual. In this manual, OG/CC includes the equivalent function in various organizations (Deputy Commander for Operations in combat wings, Fighter Group in Air Force Reserve units, etc.).

1.1.2. Wing Standardization and Evaluation (Stan/Eval) Function. Comply with AFI 11-200, *Aircrew Training, Standardization/Evaluation, and General Operations Structure*, AFMAN 11-202 Volume 2, *Aircrew Standardization and Evaluation Program* (as supplemented) and AFMAN 11-2F-22A Volume 2, *F-22A-Aircrew Evaluation Criteria*, that provide guidance for unit standardization and evaluation programs.

1.1.3. Pilots. Conduct or lead all aspects of flight (preparation, briefing, execution, debriefing, and documentation (as required)), to comply with this manual, Federal Aviation Regulations and Technical Order (TO) guidance. It is not a substitute for sound judgment. Procedures not specifically addressed may be accomplished if they enhance safe and effective mission accomplishment, or to safely recover an aircraft in an emergency.

1.1.4. Supplements. Comply with applicable supplements to all guidance referenced in this volume. Develop additional supplements per DAFMAN 90-161 guidance.

1.1.5. Aircraft Operating Limits. This publication does not override restrictions contained in TO 1F-22A-1, *Flight Manual—F-22A*, and all pilots will be familiar with current aircraft operating limits and flight restrictions prior to flight.

1.2. Waivers. Forward approved waivers through command channels to the appropriate MAJCOM/A3s and COMAFFORs for oversight purposes. The Commander Air Force Forces, MAJCOM/A3s (or equivalent) will notify ACC/A3 of waivers within 72 hours of issuance. Wing commanders will notify the publication OPR within 72 hours of waiver approval. **(T-2)** Per DAFMAN 90-161, Chapter 9, Waiver Process and Limitations; a copy of the approved waiver must follow within 30 days of issuance. **(T-1)** An email to the waived publication OPR that includes a completed DAF Form 679, *Department of the Air Force Publication Compliance Item Waiver Request/Approval* or equivalent will suffice. Commanders may waive non-tiered requirements but must send a copy of the approved waiver to the OPR of the higher headquarters publication being waived within 30 days of approval. **(T-1)** Tier 1, 2, and 3 waivers may be approved for a period not to exceed the requested waiver period or 30 calendar days after the approving commander's tour length, whichever is shorter. Because waivers are the expression of

a specific commander accepting risk, Tier 1, 2, and 3 waivers automatically expire 90 days after the change of command of the approving commander unless the new commander renews the waiver approval.

1.3. Mission Recording. Record from takeoff to landing. **(T-3)** If a mission is longer than flight recording will allow, record pertinent mission times and critical phases of flight.

1.4. Interfly Guidance. The OG/CC is the approval authority for interfly on aircraft under their control. In all cases, interfly pilots will be qualified in the F-22A.

1.5. Multiple Qualification. For ACC pilots and other MAJCOM pilots flying aircraft under ACC control, the differences between F-22A Block 20 vs. Block 30/35 are considered the same aircraft and only local differences training is required. The unit OG/CC may require academics and or a simulator mission prior to the first flight.

Chapter 2

MISSION PLANNING

2.1. Standards. The unit commander is the approval authority for unit standards. Wing Stan/Eval will review standards to ensure compliance with Air Force directives. **(T-2)**

2.2. Flight Material Preparation.

2.2.1. Mission Data Card. The minimum takeoff and landing data (TOLD) required on the mission data card is: maximum abort speed (clean or two tank); rotation speed; takeoff speed and distance; normal landing speed and distance; heavy weight (immediately after takeoff) landing speed and distance. Include wet or icy data if applicable based on location and potential for wet or icy runway surface. **(T-3)**

2.2.2. Local Area Maps. A local area map is not required for the F-22A if the aircraft tactical situation display or unit pilot aid includes jettison areas, divert information, controlled bailout areas, and a local area map of sufficient detail to remain within assigned training areas.

2.2.3. Charts. Department of Defense (DoD), *Flight Information Publications* (FLIP) enroute charts may be used instead of maps on navigational flights within areas that are adequately covered by these charts.

2.2.4. Low Altitude Maps.

2.2.4.1. Refer to AFMAN 11-202V3 (as supplemented) and MAJCOM guidance for low altitude (LOWAT) map requirements, marking and procedures.

2.2.4.2. Outside Continental United States, follow gaining MAJCOM, theater, or host nation guidance on mission planning. **(T-1)** If no such guidance exists, use the best charts or flight planning software overlay options available to accomplish the intent of maximizing traffic awareness and awareness of controlled airspace boundaries. **(T-1)**

2.2.5. Automatic Ground Collision Avoidance System (AGCAS). Pilots are responsible for knowing terrain level in the operating areas and when high altitude and non-standard days cause pilot selectable, GINS-based height above ellipsoid (HAE), to vary significantly from the barometric altitude displayed in the cockpit.

2.3. Advanced Technology Anti-G Suit/Upper Pressure Garment Use. Per AFMAN 11-301 Volume 1, *Aircrew Flight Equipment (AFE) Program*, and AFMAN 11-301 Volume 2, *Management and Configuration Requirements for Aircrew Flight Equipment (AFE)*, the following apply:

2.3.1. Pilots will wear anti-gravitational force (anti-G) suit during all flights regardless of anticipated gravitational load factor (Gs). **(T-3)**

2.3.2. Pilots will wear the upper pressure garment if sustained flight above Flight Level (FL) 440 is expected. **(T-1)** Below FL440, if the upper pressure garment is not worn, pilots ensure and confirm that the CRU-122 Vest Port Plug is installed. If for any reason the plug is missing the maximum G limit is 6 Gs.

2.4. Unit Developed Checklists.

2.4.1. Units are authorized to develop checklists to supplement or replace TO checklists (i.e., aircraft and weapons preflight) IAW AFI 11-215, *Flight Manuals Program*.

2.4.2. Local Pilot Aids. Wing Stan/Eval will ensure that locally produced pilot aids contain:

2.4.2.1. Briefing Guides. (T-2)

2.4.2.2. Local radio channelization and airfield diagrams. (T-2)

2.4.2.3. Emergency Information (impoundment procedures, emergency action checklists, no radio (NORDO)/divert information, and search and rescue procedures, etc.). (T-2)

2.4.2.4. Divert base information pertaining to navigation, communication, detailed fuel assumptions, and arresting gear information. (T-2) Examples: Bearing and range from home station, optimal cruise altitude, fuel assumptions, Air Traffic Control (ATC)/tower frequencies, Tactical Air Navigation System (TACAN)/Instrument Landing System, coordinate latitude/longitude, runway orientation.

2.4.2.5. Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) bingo fuel level from local operating areas, including detailed assumptions. (T-2)

2.4.2.6. Bailout and jettison areas. (T-2)

2.4.2.7. Cross-country procedures, to include command and control, engine documentation, oil analysis samples, classified media securing procedures and aircraft servicing. (T-2)

2.4.2.8. Advanced Programs Office phone number, after-hours cell number, if applicable, and email address. (T-2)

2.4.2.9. Other non-mandatory information typically includes stereo flight plans, standard departures, standardized waypoint libraries, local training areas, instrument pre-flight, and alert procedures. (T-2)

2.5. Bird/Wildlife Aircraft Strike Hazard (BASH) Programs. BASH and Bird Watch Conditions are defined in DAFI 91-202, *The Department of the Air Force (DAF) Mishap Prevention Program*, and DAFI 91-212, *Bird/Wildlife Aircraft Strike Hazard (BASH) Management Program*. The OG/CC will determine local BASH procedures. (T-3)

2.6. Minimum Formation Size Over Water. Pilots will accomplish planned flights over water, or outside of the local training area (deployments, cross countries, programmed delivery for maintenance inputs, etc.) with a two-ship as a minimum. (T-3)

2.7. Briefing/Debriefing. Flight Leads (FLs) are responsible for presenting a logical briefing that promotes safe and effective mission accomplishment. All pilots attend the flight briefing and debriefing unless previously coordinated with the FL and/or unit/squadron supervisors. (T-3)

2.7.1. Items listed in **Attachment 2** are briefed on every sortie. (T-3) **Attachments 3** through **7**, and **9** add mission specific details. **Attachment 8** is an all-inclusive briefing guide for Aerospace Control Alert (ACA) missions. Items published in AFIs, Air Force Tactics Techniques and Procedures (AFTTPs), or squadron/wing standards and understood by all participants may be briefed as “standard.” (T-3)

2.7.2. FLs will cover the following items for every sortie:

2.7.2.1. Review weather and other factors affecting flying operations (Air Force Handbook (AFH) 11-203 Volume 1, *Weather for Aircrew*), TOLD, foreign object damage (FOD) hazards and abnormal situations such as short/wet/icy runway, heavy gross weights, external fuel tank configurations, high density altitude and non-standard cable configurations. **(T-3)**

2.7.2.2. When dissimilar aircraft are flown in formation, brief flight responsibilities, proper formation position to ensure adequate wingtip clearance, and aircraft-unique requirements and emergency considerations for each phase of flight. **(T-3)**

2.7.2.3. Automatic ground collision avoidance system (AGCAS) settings for takeoff, tactical airspace, and recovery and when changeovers occur. **(T-3)** Local area AGCAS settings will be covered in unit standards. On cross-country sorties, AGCAS settings must be high enough to provide terrain clearance during the entire flight.

2.7.3. For all LOWAT mission briefings, place emphasis on obstacle/ground avoidance, altitude-warning features (low altitude warning), low altitude comfort level, and complacency avoidance. **(T-3)**

2.7.4. Flight briefings will be tailored to accommodate the capabilities of each flight member. FLs ensure briefing start time provides adequate time to discuss required briefing items depending on complexity of the mission and pilot capabilities. As a minimum, begin briefings at least 1.5 hours before scheduled takeoff. Complete ACA briefings prior to pilot changeover. **(T-3)**

2.7.5. Alternate Missions. FLs will brief an appropriate alternate mission for each flight. **(T-2)**

2.7.5.1. The alternate mission will be less complex than the primary mission. **(T-3)** FLs will brief specific mission elements that are different than the primary mission. Mission elements/events may be modified and briefed airborne if flight safety is not compromised. **(T-3)**

2.7.5.2. Standard Missions. Operations group standards may outline alternate missions that do not require a dedicated brief. Standard missions are limited to basic skill missions as outlined in *F-22A Ready Aircrew Program Tasking Memorandum* and AFMAN 11-2F-22A Volume 1, *F-22A Aircrew Training*.

2.7.6. If aircraft turn times do not permit mission brief(s) in addition to the initial flight brief, the following applies:

2.7.6.1. Upgrade missions will be flown on the first sortie (second sortie if the first is non-effective for weather, airspace, or maintenance). **(T-3)** The squadron operations officer will ensure subsequent missions will be of equal or less complexity with no additional upgrade training. **(T-3)**

2.7.6.2. Continuation training missions may fly their primary or alternate missions in any sequence. **(T-3)**

2.7.7. Deployed operations, exercise, and quick turn briefings. If all flight members attend an initial or mass flight briefing, the FL on subsequent flights need brief only those items that have changed from the previous flight(s) if within 24 hours.

2.7.8. Debriefing.

2.7.8.1. FLs will debrief safety of flight on all missions. **(T-2)** Review as much of the tactical portion of each mission as possible; however, FLs will ensure that all learning points of the mission(s) are debriefed. **(T-3)**

2.7.8.2. G-Tolerance Assessment. Aeromedical, flight physiology personnel and FLs periodically review the tactical portions of the sortie to assess flight member's anti-G straining maneuver (AGSM) effectiveness to identify pilots with poor AGSM technique or low G-tolerance. The squadron commander has the option of directing refresher centrifuge training per AFMAN 11-404, *Fighter Aircrew Acceleration Training Program*, and will evaluate AGSM effectiveness IAW this regulation. **(T-3)**

2.8. Fuel Conservation. Tech order climbs, cruising at max range, max endurance, and idle power max range airspeed descents will be considered to minimize fuel burn. Administrative phases of flight will be executed IAW optimum fuel profiles.

2.9. Altitude Reservation Planning. Movements that involve air refueling tanker operations may be coordinated through the Federal Aviation Administration Central Altitude Reservation Function. They can be reached through email: 7-AWA-CARF@faa.gov.

2.10. Electronic Flight Bag (EFB). Use of the EFB is permitted per AFMAN 11-202V3, as supplemented, and Air Combat Command Instruction (ACCI) 11-270, *Operations Mobile Devices*.

2.10.1. Units will establish a standard for what is loaded on the EFBs per Federal Aviation Administration (FAA), AFI/AFMAN, and unit standards. **(T-3)**

2.10.2. Flight without paper publications is authorized if the following criteria are met:

2.10.2.1. The pilot has two EFBs charged greater than 50%, plus 10% for each hour of flight;

2.10.2.2. For flights longer than 10 hours, the pilot will ensure EFB charge is sufficient for final approach and landing;

2.10.2.3. The pilot has ensured all EFBs are at the baseline configuration, defined on the ACC EFB SharePoint site.

2.10.3. Electronic Knee Board. A tablet for classified mission data. Must be approved by ACC/A3TV, EFB program management office, prior to use in the F-22A.

2.11. Carriage of Electronics in the Cockpit. Cell phones may be carried by pilots in the cockpit provided they are both powered off and stowed in a pocket. "Airplane mode" is not approved for being powered off. Cell phones will remain stowed even with the aircraft battery and engines off. (reference ACCI 11-270).

2.12. Aircrew Chemical, Biological, Radiological, Nuclear, and High Yield Explosive (CBRNE). Potential adversary use of CBRNE weapons against a friendly airfield presents a serious threat to flying operations. Although the most effective way for pilots to avoid this threat is to be airborne before those weapons are detonated/dispersed and then land at a field that has not been contaminated, all personnel must be prepared to operate from a field that has come under CBRNE attack. **(T-1)**

2.12.1. Mission Preparation. Be aware of the status of the CBRNE environment at the planned launch and recovery airfields, potential divert bases, and throughout the area in which the sortie may fly. Know the current and forecast surface wind direction and the mission oriented protective posture (MOPP) level in effect for relevant sectors of the airfield. Don appropriate aircrew chemical defense equipment or ground crew ensemble to match the appropriate MOPP level (reference AFTTP 3-4, *Airman's Manual*) and carry individual protective equipment as required. **(T-1)**

2.12.2. Stepping to Fly and Aircraft Preflight. This may entail donning aircrew ensemble or transitioning from ground crew to aircrew ensemble. Take precautions to protect pilots from injury and/or contamination while in transit from the squadron facility to the aircraft. **(T-1)** If possible, transport pilots in a vehicle that provides overhead cover (enclosed vehicle). If pilot travel on foot is unavoidable, choose a route that takes maximum advantage of available overhead cover (sunshades, buildings, etc.) to avoid agents that may be settling from the air. If extra pilots are available for preflight duties, consider assigning them to do so wearing ground crew ensemble. This may minimize exposure. If an attack (Alarm Red or theater equivalent) occurs during the step or preflight process, take cover and don appropriate MOPP. **(T-1)** This may require use of the ground crew mask. A hardened aircraft shelter (HAS) provides optimum protection, if available. Use caution if entering a HAS that contains aircraft and/or equipment. Close doors after entry. If a HAS or other overhead cover is not immediately available, accept the best rapidly reachable cover.

2.12.3. Engine Start to Takeoff. If a HAS is available, use it to minimize exposure time by accomplishing aircraft arming and end of runway procedures inside it (if local procedures permit) and by delaying taxi time, if possible, prior to takeoff.

2.12.3.1. Aircraft Launch to Survive. Units will develop local procedures to provide this option to the commander. **(T-1)** In general, aircraft may launch to survive any time after engine start if they have sufficient fuel and safe, expeditious access to a runway. This option may only be practical for aircraft that are near end of runway prior to takeoff or that have just landed.

2.12.3.2. Alarm Red (or theater equivalent) Prior to Taxi. If in a HAS, the normal procedure is to shut down. Engine noise may preclude effectiveness of normal alert notification procedures, so ensure ground personnel are aware of the alarm warning, assume proper MOPP, and close HAS doors. Use hand signals if necessary.

2.12.3.3. Alarm Red (or theater equivalent) After Taxi. Units typically establish procedures for this contingency depending on whether additional protection is available along the taxi route (empty HAS). Ideally, ground crew sheltering in such a HAS would be available to assist in normal engine shutdown procedures and to close HAS doors. If protection is not available, the best option may be to launch to survive. Maintain contact with command and control entities (Wing operations center, maintenance operations center, supervisor of flying, etc.) to ensure unity of effort in the overall plan. **(T-1)**

2.12.4. Takeoff to Landing.

2.12.4.1. Contamination. If chemical warfare agent contamination occurred prior to takeoff, flying the aircraft will dissipate the agent to some degree. The total amount of dissipation will be greater with lower flight altitudes and longer flight times. Because the

agent may have entered wheel wells, etc., consider flying in landing configuration to increase airflow to these areas (when outside threat environment). If contamination to open weapons bays is suspected, consider flying with weapons bay doors open (when outside threat environment). In any circumstances, merely flying the aircraft is unlikely to achieve complete decontamination.

2.12.4.2. Preparing to Land. Pilots will remain aware of the status of primary and alternate landing locations. Do not attempt to land during Alarm Red (or theater equivalent) situations unless there is no other option. Follow command and control directions and either hold or divert. If mission needs preclude divert, hold until the Alarm Red (or theater equivalent) has cleared or become an Alarm Black. Prior to landing, gain awareness of contaminated sectors of the airfield and of current/forecast surface winds. Use this information in conjunction with command-and-control direction to plan a route from landing to engine shutdown. The liquid deposition phase following a chemical warfare airburst attack can extend up to 1 hour. If landing during Alarm Black, expect a contaminated environment and MOPP 4.

2.12.5. Landing to Engine Shutdown. Take advantage of any protection available, minimizing taxi time and distance. Maintain contact with command and control to remain aware of unexploded ordnance and/or damage to airfield movement surfaces. **(T-1)** If a HAS is available and local procedures permit, accomplish aircraft de-arm and end of runway procedures there. If Alarm Red (or theater equivalent) occurs between landing and engine shutdown, considerations are like those discussed in the engine-start-to-takeoff section.

2.12.6. After Engine Shutdown. Don appropriate MOPP if not already worn. **(T-1)** If circumstances permit, accomplish normal post-flight inspection procedures. If the aircraft is not contaminated, close the canopy. If there is any suspicion of personnel contamination, pilots will process through an aircrew contamination control area. **(T-1)** Accomplish maintenance debriefings under cover to the maximum extent possible.

Chapter 3

NORMAL OPERATING PROCEDURES

3.1. Preflight. Pilots will check both sides of the engine inlets for foreign objects in the inlet ducts and ensure nose wheel chocks (if used) are removed from the nose wheel. **(T-1)**

3.2. Ground Communications and Visual Signals. The pilot accomplishes the ground crew briefing IAW the briefing guide in **paragraph A2.13.**

3.2.1. Normally, the pilot and ground crew communicate using the intercom during ground operations. Pilots executing a practice or actual scramble launch are not required to use intercom. To avoid excessive delays, be prepared to immediately transition to visual ground signals when faced with inoperative ground intercom. Visual signals are per AFMAN 11-218, *Aircraft Operations and Movement on the Ground*, AFTTP 3-3.F-22, *Combat Aircraft Fundamentals F-22A*, and this manual. The visual signals are conducted in a challenge and response fashion. All signals pertaining to the operation of aircraft systems originate with the pilot. The crew chief repeats the given signals when it is safe to operate the system. The pilot will not activate any system that could pose danger to the ground crew prior to receiving proper acknowledgment from ground personnel. **(T-1)**

3.2.2. The following signals augment AFMAN 11-218 and AFTTP 3-3.F-22:

3.2.2.1. *AUXILIARY POWER UNIT START.* With clenched fist, pilot makes a pulling motion.

3.2.2.2. *FLIGHT CONTROLS CHECK.* Raise arm, clench fist, and make stirring action.

3.2.2.3. *LOSS OF BRAKES WHILE TAXIING.* Lower tailhook.

3.2.2.4. *GUN ARMAMENT CHECK.* Point index finger forward with thumb upward simulating a pistol and shake head (yes or no).

3.2.2.5. *SIDE WEAPONS BAY DOORS OPEN/CLOSE.* Raise upper arms at a 90-degree angle to the body and bend the elbow to place hands in front of shoulders with palms facing down. Extend arm outward at the elbow to signal for door open. Retract arm inward at the elbow, to signal for door close. Extend/retract both arms to indicate the opening/closing of both doors.

3.2.2.6. *MAIN WEAPONS BAY DOORS OPEN/CLOSE.* Raise upper arm outward at a 90-degree angle to the body and bend the elbow at a 90-degree angle with palm facing down. Extend arm outward at the elbow to signal for door open. Retract arm inward at the elbow, to signal for door close. Extend/retract both arms to indicate the opening/closing of both doors.

3.2.2.7. *EXPENDABLE COUNTERMEASURE DOOR OPEN/CLOSE.* Raise arm outward at a 45-degree angle to the body with palm facing forward. Maneuver hand at the wrist in an up/down motion. The signal to open or close doors is the same. Complete this signal with both arms to indicate both doors open/close.

3.3. Aircraft Ground Operations.

3.3.1. Arming/de-arming may be completed in the chocks. **(T-3)** If operating off station or at a non-F-22A/ non USAF base, abide by local regulations.

3.3.2. The minimum taxi interval is 150 feet (ft) staggered or 300 ft in trail. **(T-3)** Spacing may be reduced when holding short of or entering the runway. Consider increasing taxi spacing when preceding aircraft engine exhaust may be ingested by onboard oxygen generation system.

3.3.3. Do not taxi during snow and/or icy conditions until the taxi route and runway have been checked for safe conditions (i.e., a minimum of Runway Condition Reading (RCR) 8 / field condition (FICON) 2 reporting at civilian airfields). **(T-2)** Under these conditions, taxi on the centerline with a minimum of 500 ft spacing. **(T-3)** FICON information is found in FAA Order JO 7930.107, *Field Condition (FICON) Reporting*.

3.3.4. Pilots will keep hands in view of ground personnel during quick check, arming or de-arming operations. **(T-1)**

3.3.5. Do not taxi in front of aircraft being armed/de-armed with forward firing ordnance.

3.4. Automatic Backup Oxygen System (ABOS).

3.4.1. For training missions, required minimum pressure for both left and right ABOS bottles is 900 pounds per square inch (PSI). For cross-country, deployment missions, ACA, or wartime missions, ABOS minimum bottle pressure must be in the full range of 1400-1800 PSI for both bottles.

3.4.2. The 900 PSI minimum in both bottles allows for recovery from a rapid decompression at FL600, and up to a 350 nautical mile (NM) divert range.

3.4.3. Ensure the ABOS switch is OFF before start and shutdown. **(T-3)** If the ABOS switch is not in OFF prior to start and electrical power is applied, ABOS may activate and deplete bottle pressure.

3.4.4. Following an aircraft ABOS modification, the ABOS check will be accomplished, and the sortie flown by a 4-ship flight lead (4 FL). **(T-2)**

3.4.5. After landing, aircraft with one or both bottles below 900 PSI will be called “Code 3 ABOS servicing.” (see [paragraph 3.4.1](#)) **(T-3)**

3.4.6. In ABOS equipped F-22As, operations are authorized to FL600. **(T-2)**

3.5. Flight Lineup. Flights line up as appropriate based on weather, runway conditions, and runway width. Use a minimum of 500 ft spacing between separated elements/flights. If runway width precludes line-up with wingtip clearance between all aircraft in the flight, use 500 ft spacing between elements or delay run-up until the preceding aircraft/element releases brakes.

3.5.1. Pilots will review TOLD prior to takeoff. **(T-3)**

3.5.2. Just prior to takeoff, all flight members inspect each other for proper configuration and any abnormalities.

3.6. Takeoff.

3.6.1. Do not takeoff if the RCR is less than 12 (i.e., braking action Medium at non-Air Force airfields, or FICON 4 for civilian airfields). **(T-3)** The OG/CC (or equivalent) may waive RCR

minimums for specified units operating in cold weather locations, but in no case will pilots takeoff with an RCR of less than 8 (i.e., braking action Poor). **(T-2)**

3.6.2. Use afterburner (AB) if computed military power takeoff distance exceeds one-half of the available runway. **(T-3)** Minimum runway length is defined using TOLD and expecting an immediate heavy weight landing on the same runway (see [paragraph 3.20.4.2.](#)).

3.6.3. A departure end arrestment cable must be raised for all takeoffs and landings. **(T-3)** When operating from airfields equipped with compatible, remotely operated cable(s), ensure the departure end cable is in the raised position, unless another departure end cable is rigged in the raised position. If an alternate landing airport is declared that does not have a departure end cable, units will have a process in place to comply or be waived at the appropriate level.

3.6.4. Use a minimum of a 15-second takeoff interval (20 seconds when using AB) between aircraft. Use a 20-second takeoff interval when executing a sensor trail departure. During periods of reduced visibility due to rain/de-ice chemicals, ensure preceding aircraft is visible before releasing brakes.

3.6.5. During rolling takeoffs, align the aircraft with the runway heading prior to advancing the throttles.

3.6.6. Steer toward the center of the runway at the start of the takeoff roll.

3.6.7. Wing or Group commanders may approve intersection takeoffs if operational requirements dictate.

3.6.8. Formation takeoffs are not authorized. **(T-1)**

3.7. Join-up/Rejoin.

3.7.1. Day weather criteria for a VFR join-up underneath: ceiling 1,500 ft and visibility 3 statute miles (SM).

3.7.2. In accordance with AFTTP 3-3.F-22A, at final level off, FLs slow to 300 KCAS or maximum range airspeed, whichever is lower, until join-up is accomplished unless mission requirements or local standards specify a different airspeed. **(T-3)** FLs will ensure the formation is within ATC standard formation if under an IFR clearance. **(T-1)**

3.7.3. FLs will brief abnormal rejoin specifics. In the absence of rejoin specifics, rejoin to spread for 2-ship, or for a 4-ship, trailing element rejoin to 1NM trail with wingmen in spread formation in accordance with AFTTP 3-3.F-22A.

3.7.4. Battle Damage Checks. When circumstances permit, FLs direct a battle damage check after each mission prior to, or during return to base. Except at night/instrument meteorological conditions (IMC), this check is mandatory following the expenditure of any ordnance. **(T-2)** Brief deconfliction responsibilities and position change procedures. Fly no closer than close formation spacing.

3.7.5. For Night join-up procedures, see Night Procedures ([paragraph 3.17](#)) and [Chapter 4](#).

3.8. Formation, Visual and Administrative. Instructor pilots (IPs)/FLs are responsible for ensuring flight roles and responsibilities of each flight member are established, briefed, executed and debriefed. If any flight member cannot fulfill their responsibilities, or other assigned tasks, they will immediately communicate that information to the flight/element lead. **(T-2)** IPs/FLs task

element leads/wingmen based on their ability to fulfill basic responsibilities and other assigned tasks. For additional formation considerations, reference AFTTP 3-3.F-22A and AFTTP 3-1.F-22A, *Tactical Employment F-22A*.

3.8.1. In IMC, the maximum flight size in close/route formation is four aircraft except when flying in close formation with a tanker (maximum flight size six, per North Atlantic Treaty Organization (NATO) Allied Tactical Publication (ATP) 3.3.4.2., *Air-to-Air Refuelling, Edition D, Version 1*; and ATP 3.3.4.2., *US Standards Related Document* (located at: <https://www.japcc.org/aar/>).

3.8.2. Pilots will not use rolling maneuvers to maintain or regain formation position below 5,000 ft above ground level (AGL) or in airspace where aerobatics are prohibited. **(T-2)**

3.8.3. Use airborne visual signals per AFPAM 11-205, *Aircrew Quick Reference to Aircraft Cockpit and Formation Flight Signals*. For four-ship flights, initiate configuration changes by radio call, when practical. Changes directed over the radio require an acknowledgement if the FL is unable to visually see the wingman (WG) reposition to the directed formation. A radio call is mandatory when directing formation changes at night or under instrument conditions.

3.8.4. For non-tactical portions of a sortie (i.e., navigation to/from airspace), ensure each WG has sufficient ability to navigate (visual, radar, operational Global Positioning System/Inertial Navigation System (GINS), received TACAN or received Instrument Landing System in the appropriate steering mode) prior to formation break up.

3.8.5. Changing Leads.

3.8.5.1. When flying in limited visibility conditions, pilots will initiate lead changes from a stabilized, wings level attitude. **(T-2)**

3.8.5.2. The minimum altitude for a lead change is 500 ft AGL over land or 1,000 ft AGL over water (for night see [paragraph 3.18.4.](#)).

3.8.5.3. Flight/element leads may not initiate a lead change from a visual formation unless the aircraft assuming the lead is in visual contact and in a safe position to do so.

3.8.5.4. Initiate a lead change by visual signal or radio call.

3.8.5.5. Renumbering the flight or passing the formation lead via the radio requires a verbal acknowledgment. All lead changes at night or in IMC are directed over the radio.

3.8.5.6. Acknowledge receipt of the lead by head nod or radio call, as appropriate.

3.8.5.7. A lead change is effective upon acknowledgment.

3.8.5.8. The former leader then assumes WG responsibilities unless otherwise briefed.

3.8.6. Visual Formation Maneuvering.

3.8.6.1. Flight/element leads consider WG/element position and ability to perform safely the formation maneuver.

3.8.6.2. WG/elements maneuver relative to the FL/lead element and maintain sight. Trailing aircraft/elements are responsible for deconflicting with lead aircraft/elements.

3.8.6.3. WG/elements cross above the FL/lead element when deconfliction is required in the LOWAT environment.

3.8.6.4. Loss of Visual. Use the following procedures when one or more flight members/elements lose visual contact while flying a visual formation.

3.8.6.4.1. Visual Formation. When any flight member/element has lost visual contact, initiate a positive maneuver away from the last known position and call “blind.” The remaining flight member/element immediately responds with “visual” and a position report. If also “blind,” transmit altitude and immediately deconflict from the altitude called by a minimum of 1,000 ft altitude separation (500 ft below 5,000 ft AGL). **(T-2)**

3.8.6.4.2. Beyond Visual Range and approaching the briefed Deconfliction Bubble (per AFTTP 3-1.F22A). If unable to gain visual contact, call “blind” with altitude (from the heads-up display (HUD) and/or standby flight group (SFG)) (“blind, 25 thousand”). The remaining flight member/element immediately responds with “visual”, or “blind” with an altitude and immediately deconflict from the altitude called by a minimum of 1,000 ft altitude separation (500 ft below 5,000 ft AGL). **(T-2)**

3.8.6.4.3. If visual contact is still not regained, the FL will take additional positive action to ensure flight path deconfliction within the flight to include a “Terminate” or “Knock-It-Off” (KIO) call if necessary. **(T-3)** Consider scenario restrictions such as sanctuary altitudes and/or adversary blocks. In all cases avoid climbs/descents through the deconfliction altitude. All flight members must visually clear their flight path.

3.8.6.4.4. Maintain altitude separation until visual or until assured deconfliction through communication or beyond visual range formation positions.

3.8.6.5. Two-ship visual formation deconfliction. The following rules apply for flight path deconfliction in 2-ship visual formations:

3.8.6.5.1. The WG is responsible for deconfliction from the FL.

3.8.6.5.2. The FL becomes responsible for deconfliction when:

3.8.6.5.2.1. Maneuvering places the FL well aft of the WG’s 3/9 line or forces the WG’s primary attention away from the FL.

3.8.6.5.2.2. The WG calls “blind” and the FL calls “visual.”

3.8.6.5.2.3. Primary deconfliction responsibility transfers back to the WG when visual and established in the directed formation position.

3.8.6.6. Three/four-ship (or greater) visual formation deconfliction. When flights of more than two aircraft are in visual formation:

3.8.6.6.1. Formation visual signals performed by a FL/element lead pertain only to the associated element unless specified otherwise by the FL.

3.8.6.6.2. Trailing aircraft/element(s) maintain sufficient spacing so that primary emphasis during formation maneuvering/turns is on deconfliction within elements, not on deconfliction between elements.

3.9. Tactical Formation. Reference AFTTP 3-1.F22A for tactical formation deconfliction and flight-member responsibilities.

3.10. Chase Formation.

3.10.1. Restrictions. Any pilot may fly safety chase for aircraft under emergency or duress conditions. Qualified pilots (including initial qualification training /mission qualification training pilots who have successfully completed an Instrument/Qualification evaluation per AFMAN 11-2F-22AV2) may chase as safety observer for aircraft performing simulated instrument flight or hung ordnance patterns. Specialized missions (e.g., developmental test and evaluation, operational test and evaluation, Weapon System Evaluation Program, live weapons delivery) and training conducted per AFMAN 11-2F-22AV1, may be chased by combat mission ready/ basic mission capable pilots designated by group/squadron commanders. All other chase events may only be flown by IP/flight examiners (FEs) or upgrading IPs under the supervision of an IP.

3.10.2. Procedures:

3.10.2.1. A safety observer in a chase aircraft, except IP/FE/specialized mission chase, maneuvers in a 30-60 degree cone with nose/tail clearance to 1,000 ft, to effectively clear and/or provide assistance.

3.10.2.2. IP/FE/specialized mission pilots may maneuver as necessary but maintain nose/tail separation until required to transition to close formation when deemed necessary by the IP/FE.

3.10.2.3. No chase aircraft will stack lower than the lead aircraft when below 1,000 ft AGL. (T-2)

3.10.2.4. Consideration will be given to the chase aircraft matching configuration of the aircraft being chased. Doing so allows for easier station keeping, decreased stall margin, and prevents AGCAS fly-ups in the event the chase aircraft accelerates above 250 KCAS within the warning envelope in accordance with TO 1F-22A-1. If necessary to chase an aircraft in the traffic pattern with gear up, disable AGCAS by setting the low altitude warning to 0, or stay below 250 KCAS.

3.11. Statics / Flyovers / Aerial Demonstrations. Comply with DAFI 11-209, *Participation in Aerial Events*, as well as all applicable MAJCOM directives for the specific rules, procedures, and approval processes for aircraft statics and flyovers. Additionally, pilots performing aerial demonstrations are governed by both DAFI 11-209 and AFMAN 11-246 Volume 1, *Air Force Fighter Type Aircraft Demonstrations (A-10, F-16, F-22, F-35)* for the specific rules and training requirements.

3.12. Maneuvering Parameters.

3.12.1. Minimum Altitudes. For aerobatics, pilots will remain above 5,000 ft AGL. (T-2) During nose high/low speed and advanced handling characteristics vertical maneuvering, ensure maneuvers are terminated to allow recovery above 5,000 ft AGL.

3.12.2. Avoid flight through wingtip vortices and jet wash. If it is unavoidable, reduce aft stick pressure prior to entering jet wash to limit excessive G excursions.

3.13. Operations (Ops) Checks.

3.13.1. Accomplish sufficient ops checks to ensure safe mission accomplishment. As a minimum, complete ops checks:

3.13.1.1. Passing 10,000 ft mean sea level (MSL) or at level off.

3.13.1.2. Prior to each engagement.

3.13.1.3. Following air refueling.

3.13.2. Minimum items to check are Integrated Caution, Advisory, and Warning System messages, total fuel, G-suit connection, oxygen system, cabin altitude, and AGCAS settings.

3.13.3. The FL may initiate ops checks by radio call or visual signal and wingmen response is required.

3.13.3.1. Flight member(s) response to ops checks includes total fuel amount as read on the SFG. If wingmen are within 500 pounds of the FL fuel level, a “same” call may be used, or exact amount if below Joker fuel level (see [paragraph 3.19.1.](#)).

3.13.3.2. When external tanks are feeding, add a “tanks feeding” call to the normal ops check reply. Make a “tanks dry” call once the external tanks are confirmed dry. Once the “tanks dry” call has been made, no further reference to tanks need be made on subsequent ops checks. In the event of trapped fuel, an ops check indicates usable fuel.

3.13.4. G-awareness Exercise. Reference AFMAN 11-214, *Air Operations Rules and Procedures*, and AFTTP 3-3.F-22A. Unless performing a syllabus-required event (e.g., chase of a G-awareness exercise), flight members maintain a minimum of 6,000 ft separation between aircraft during the execution of all G-awareness exercises. During maneuver execution, use visual lookout and briefed formation position responsibilities as primary means of ensuring aircraft deconfliction. Set the intercom volume appropriately to evaluate execution of the AGSM for debrief purposes.

3.13.4.1. FL/element leads ensure the airspace intended for conducting the G-awareness exercise is free from potential traffic conflicts. Use ATC services to the maximum extent practical to make sure the airspace is clear. Conduct the G-awareness exercise in the following airspace with preference to the order as listed:

3.13.4.1.1. Special Use Airspace (e.g., Restricted/Warning areas, Air Traffic Control Assigned Airspace, Military Operating Areas and MAJCOM approved large-scale exercise/special mission areas).

3.13.4.1.2. Above 10,000 ft MSL outside of Special Use Airspace.

3.13.4.1.3. Inside the confines of a Military Training Route.

3.13.4.1.4. Below 10,000 ft MSL outside of Special Use Airspace.

3.13.4.2. FL/element leads flying outside of the continental United States follow gaining MAJCOM, theater or host nation guidance on airspace in which G-awareness exercises may be performed. If no gaining MAJCOM, theater, or host nation guidance is available, follow the guidance in [paragraph 3.13.4.1](#) to the maximum extent practical.

3.14. Radio Procedures.

3.14.1. Preface all communications with the complete flight call sign unless stated below. Transmit only that information essential for mission accomplishment or safe flight. Use visual signals when practical.

3.14.2. Acknowledge radio checks that do not require the transmission of specific data, and that cannot be visually confirmed by flight the FL, by individual flight members in turn (Example: “2,” “3,” “4”). Acknowledgment indicates the appropriate action is complete, in the process of being completed, or the flight member understands.

3.14.3. In addition to the radio procedures outlined in AFMAN 11-202V3 (as supplemented), specific mission guides, and FLIP publications, the following radio transmissions are required: Report gear down per AFMAN 11-202V3. A WG or chase need not make this call during a formation or chased approach.

3.14.4. All flight members will acknowledge understanding the initial ATC clearance. Acknowledge subsequent ATC instructions when directed by the FL. **(T-3)**

3.15. General Low Altitude Procedures.

3.15.1. Fly low-level formation positions/tactics using AFTTP 3-1.F-22A and AFTTP 3-3.F-22A, as guides.

3.15.2. All day formations positions are authorized at or above 500 ft AGL.

3.15.3. During flight briefings, review LOWAT flight maneuvering and observation of terrain features/obstacles in the LOWAT training area. FLs will emphasize AGCAS and “low altitude warning” settings and considerations, as well as AGCAS “paddle-off” considerations. **(T-3)** For LOWAT training over water/featureless terrain, include specific considerations with emphasis on minimum altitudes and spatial disorientation (SD).

3.15.4. Conduct all obstacle avoidance planning for LOWAT map requirements in accordance with AFMAN 11-202V3 (as supplemented). During the briefing, emphasize critical areas where obstacle awareness will be heightened.

3.15.5. At altitudes below 1,000 ft AGL, WG will not fly at a lower AGL altitude than FL. **(T-2)**

3.15.6. When crossing high or hilly terrain maintain positive G, and pilots will not exceed 120 degrees of bank. **(T-2)** Maneuvering at less than 1 G is limited to upright bunting maneuvers.

3.15.7. Pilots will go no higher than 12 degrees angle of attack when conducting ACA and low/slow visual identification procedures. **(T-3)**

3.15.8. The minimum airspeed for low-level navigation is 300 KCAS.

3.15.9. Minimum airspeed during LOWAT tactical maneuvering (below 5,000 ft AGL) is 350 KCAS.

3.15.10. Minimum Altitudes. The squadron commander determines and certifies pilot minimum altitudes per AFMAN 11-2F-22AV1, as supplemented. The following minimum altitudes apply to LOWAT training unless national rules or a training syllabus specifies higher altitudes:

3.15.10.1. 500 ft AGL for LOWAT Category I qualified pilots (AFMAN 11-2F-22AV1).

3.15.10.2. For night (without night vision devices (NVDs)) or IMC operation, the minimum altitude is 1,000 ft above the highest obstacle within 5 NM of aircraft position.

3.15.11. During all LOWAT operations, the immediate reaction to task saturation, diverted attention, KIO, or emergencies is to climb to a pre-briefed safe altitude (minimum 1,000 ft AGL).

3.15.12. Weather minimums for low-level training are 1,500 ft AGL ceiling and 3 SM visibility, or national rules if higher.

3.16. Air Refueling.

3.16.1. Pilots undergoing initial training in air refueling will not refuel with a student boom operator. **(T-2)** Pilots will inform boom operators when refueling from a particular tanker type (Multi-Role Tanker Transport, KC-46, contractor KDC-10/KC-707 or KC-135) for the first time.

3.16.2. Quick flow procedures are authorized and conducted per TO 1F-22A-1, ATP 3.3.4.2. and *US Standards Related Document*.

3.17. Night Procedures.

3.17.1. Night Lighting Requirements.

3.17.1.1. Wingtip position lights: Only one position light on each wing is required. However, if each wing only has one light, they must be on opposite sides: one upper, one lower (e.g., top left, bottom right). **(T-2)**

3.17.1.2. Landing and Taxi Lights: The landing light must be operational prior to takeoff during night operations. **(T-2)** If the taxi light is not operational, reassess if the landing light provides sufficient lighting to allow safe taxi. The taxiing aircraft will come to a stop if the area cannot be visually cleared without the taxi light. **(T-3)** If operating in daylight, either the landing light or taxi light is sufficient.

3.17.1.3. Anti-collision light: One operational anti-collision light (lighting set to ANTI-COLL/BRT) is required for night operations (ground and air). The anti-collision light can be turned off if it causes distraction to the pilot. If the anti-collision light is turned off while outside operational airspace, then at least one aircraft within a standard formation must have POSN/ANTI-COLL switch in the FLASH setting. Position lights in the FLASH setting meet AFMAN 11-202V3 requirements for anti-collision.

3.17.1.4. Night Ground Operations (for detailed explanation, refer to AFTTP 3-3.F-22A).

3.17.1.5. When ground personnel are working under the aircraft, ensure the POSN/ANTI-COLL switch is placed in BRT (position lights 100%, steady, anti-collision light off).

3.17.1.6. Pilots will taxi on the taxiway centerline with a minimum of 300 ft spacing. **(T-3)**

3.17.1.7. Use the taxi light while taxiing unless it might interfere with an aircraft landing or taking off. The taxiing aircraft will come to a stop if the area cannot be visually cleared without the taxi light. **(T-3)**

3.17.1.8. For taxi, set the POSN/ANTI-COLL switch in accordance with AFTTP 3-3.F-22A.

3.17.2. Night Takeoff. Set the POSN/ANTI-COLL switch to ANTI-COLL for takeoffs. Following takeoff, each aircraft/element climbs on runway heading to 1,000 ft AGL before initiating turns, except where departure instructions specifically preclude compliance.

3.17.3. Night Join-up. Weather criteria for night join-up underneath is a ceiling of 3,000 ft AGL and 5 SM visibility. FLs direct lighting adjustments for the flight based on environmental conditions and flight member feedback.

3.17.4. Night Formation Procedures.

3.17.4.1. When in non-visual formations at night, maintain aircraft spacing primarily by flying the published departure, sensors/data link, and timing. If aircraft spacing cannot be ensured, establish altitude separation (1,000 ft minimum) through communication. Pilots will always cross check instruments to ensure ground clearance. **(T-1)**

3.17.4.2. Do not change lead or wing formation positions below 1,500 ft AGL unless on radar downwind. Direct lead and position changes using the radio and from a stabilized, wings-level attitude.

3.17.4.3. Night Formation Parameters. References and parameters for night formation positions are specified in AFTTP 3-3.F22A.

3.17.5. Night Break-up. Prior to a formation break-up at night, the FL transmits attitude, altitude, airspeed, and altimeter setting, which is acknowledged by WG. WG will confirm their onboard systems required for independent night navigation are functional (GINS, Communications, Navigation, and Identification). **(T-3)**

3.17.6. Night Landing. Normally land from an instrument straight-in approach. Refer to AFMAN 11-202V3, as supplemented, and AFTTP 3-3.F-22A for specific procedures.

3.18. Night Vision Device (NVD) Procedures.

3.18.1. AFMAN 11-202V3, and AFMAN 11-214 outline NVD procedures. AFTTP 3-1.F-22A and AFTTP 3-3.F-22A incorporate expanded tactical guidance.

3.18.1.1. NVDs are only worn by qualified flight members or when upgrading with NVDs with a qualified NVD instructor in the flight.

3.18.1.2. FLs brief the appropriate time to don/doff NVDs for the sortie. Pilots will ensure deconfliction while donning/doffing. **(T-1)** Minimize time with NVDs in the “up” position due to the potential to liberate off the helmet under G and damage displays.

3.18.1.3. When operating in a visual formation outside of NVD route position, ensure a more frequent crosscheck of instruments to reduce possibility of SD.

3.18.1.4. FLs brief the appropriate NVD-compatible formation lighting levels for each flight member to set.

3.18.2. Pilots will preflight, test, and adjust NVDs in the unit “eye lane” prior to NVD operations. **(T-3)** Stow NVDs for takeoff. Do not don NVDs until at least 2,000 ft AGL in climbing or level flight. Pilots will doff NVDs no later than 5 minutes prior to landing unless NVDs are necessary to handle an emergency and will stow NVDs prior to the instrument approach final approach fix. **(T-3)**

3.18.3. With NVDs, pilots may operate below the route abort altitude/minimum safe altitude (MSA) down to a minimum of 1,000 ft AGL during high-illumination periods (as defined by AFMAN 11-214). Each pilot is the final authority to assess actual illumination for a particular mission element, based on visibility and terrain features/resolution.

3.18.4. NVDs may be worn for night tanker rejoins but are raised or stowed no later than the astern position.

3.18.5. NVD Battle Damage Checks. Fly no closer than NVD route formation (reference AFTTP 3-3.F-22A).

3.18.6. In-flight emergencies with NVDs. During in-flight emergencies, immediately assess whether the NVDs aid or hinder completing emergency procedures. If they are a hindrance or the emergency may deteriorate into an ejection situation, remove, and stow the NVDs.

3.18.7. Abnormal Procedures.

3.18.7.1. Lost sight. If sight is lost within a visual formation, execute appropriate lost wingman procedures ([paragraph 7.8.](#)). Consider highlighting position by increasing exterior lighting level, activating AB, or deploying chaff/flares as airspace allows.

3.18.7.2. In the event of NVD failure, pilots will ensure separation from other aircraft and the ground before attempting to remedy an NVD failure. (T-2) Appropriate steps are:

3.18.7.2.1. Transition to instruments,

3.18.7.2.2. Perform lost wingman procedures if appropriate,

3.18.7.2.3. Route abort/climb above MSA if appropriate,

3.18.7.2.4. Terminate/KIO (as applicable),

3.18.7.2.5. If other aircraft are in the vicinity, direct them to raise their external lights to non-NVD visible levels,

3.18.7.2.6. Attempt to regain NVD operation by switching to the opposite battery. If NVDs are still inoperable, once clear of other aircraft and terrain, change the battery. If these steps do not solve the problem, stow NVDs and proceed with non-NVD plan.

3.18.7.3. Inadvertent flight into weather. Encountering poor weather conditions during NVD operations may cause loss of situation awareness and pilot distraction/disorientation.

3.18.7.3.1. Single ship or separated from flight members:

3.18.7.3.1.1. Transition to instruments,

3.18.7.3.1.2. Route abort if LOWAT, otherwise climb/descend to visual meteorological conditions (VMC),

3.18.7.3.1.3. Terminate/KIO (as applicable).

3.18.7.3.2. Formation flight. If entering weather in formation or close proximity to other aircraft, perform the first five steps under NVD failure ([paragraph 3.18.7.2.](#)), as appropriate, then climb/descend to attempt to regain VMC.

3.19. Fuel Requirements.

3.19.1. Joker Fuel. A pre-briefed fuel state needed to terminate an event and proceed with the remainder of the mission.

3.19.2. Bingo Fuel. A pre-briefed fuel state that allows the aircraft to return to the base of intended landing or alternate, if required, using preplanned recovery parameters, and arriving with normal recovery fuel as listed below.

3.19.3. Normal Recovery Fuel. The fuel on initial or at the final approach fix at the base of intended landing or alternate, if required. Fuel quantity is established locally or 2,500 pounds, whichever is higher.

3.19.4. Pilots declare the following when it becomes apparent that an aircraft may land at the intended destination or alternate (if required) with:

3.19.4.1. Minimum Fuel. 2,100 pounds or less. Based on a 20-minute reserve at 10,000 ft MSL flying max endurance airspeed (fulfilling AFMAN 11-202V3 requirements).

3.19.4.2. Emergency Fuel. 1,200 pounds or less.

3.20. Approaches and Landings.

3.20.1. The desired touchdown point for a VFR approach is 0-1,500 ft from the runway threshold or the glideslope interception point for a precision approach.

3.20.2. Minimum pattern and touchdown spacing between landing aircraft is 3,000 ft for similar aircraft (e.g., F-22A versus F-22A), 6,000 ft for dissimilar aircraft (e.g., F-22A versus F-16) or as directed by MAJCOM or the landing base, whichever is higher. When wake turbulence is not expected and operationally necessary, pilots may reduce pattern/touchdown spacing to the 3,000 ft minimum. **(T-3)** However, desired spacing is 6,000 ft minimum for both similar and dissimilar aircraft.

3.20.3. Wake Turbulence Spacing. Wake turbulence can occur due to calm winds (winds less than or equal to 5 knots) or when landing with a light tail wind. Under these conditions, moderate to severe wake turbulence has been reported out to 7,000 ft touchdown spacing. Consider increasing touchdown spacing to 9,000 ft or more.

3.20.4. Landing Restrictions.

3.20.4.1. Pilots will land in the center of the runway and clear to the cold side of the runway when speed/conditions permit. **(T-1)** Do not delay clearing to the cold side. Delaying may create a conflict for subsequent landing aircraft.

3.20.4.2. When the computed landing roll exceeds 80 percent of the available runway, pilots will land at an alternate. **(T-3)** Aircraft landing at preplanned destinations or preplanned alternate airfields with less than 8,000 ft of runway length and without a compatible arresting gear (defined as any cable/arresting gear on the departure end or in the overrun capable of stopping the aircraft), requires OG/CC approval.

3.20.4.3. Do not land over any raised web barrier (e.g., MA-1A, 61QSII, BAK-15; definitions found in DoD FLIP, *Chart Supplement*). **(T-2)**

3.20.4.4. When the RCR at the base of intended landing is less than 12 (braking action Medium, or FICON 4 for civilian airfields), land at an alternate. If an alternate is not available, consider an approach end or midfield arrestment. The OG/CC or equivalent may waive the RCR minimum, but in no case will pilots land with an RCR of less than 8 (braking action Poor, FICON 2). **(T-2)**

3.20.4.5. Unless executing a short field landing, do not fly the final approach and landing using full speedbrake. This creates stagnant wake turbulence over the landing zone that can affect aircraft more than 6,000 ft spacing. When performing a short field landing, consider increasing touchdown spacing to 9,000 ft or more.

3.21. Overhead Traffic Patterns.

- 3.21.1. Overhead patterns can be made with unexpended live/inert ordnance. This does not apply to hung or misfired ordnance (secure or unsecure).
- 3.21.2. Initiate the break over the touchdown point or as directed.
- 3.21.3. Execute individual breaks in a 180-degree turn to the downwind leg at minimum intervals of 5 seconds (except IP/FE chase or when in line abreast formation).
- 3.21.4. Plan to be wings level on final at approximately 250 ft AGL and 1 NM from the planned touchdown point (e.g., 2.5-degree glide path).

3.22. Tactical Overhead Traffic Patterns. Tactical entry from any direction and any altitude is permitted when specifically approved by the tower. To expedite recovery, conserve fuel, and aid in aircraft sequencing, pilots will consider non-standard pattern entries.

- 3.22.1. Typically, tactical overheads are flown at an altitude and airspeed directed by local guidance or published. This procedure will be coordinated with ATC. **(T-2)**
- 3.22.2. No more than four aircraft are permitted in a tactical recovery formation. Aircraft/elements more than 6,000 ft in trail are considered a separate flight.
- 3.22.3. Normal spacing and parameters are established by base turn.

3.23. Touch-and-Go Landings.

- 3.23.1. Fly touch-and-go landings in accordance with AFMAN 11-202V3, as supplemented. Touch-and-go landings flown to regain landing currency require squadron commander approval.
- 3.23.2. Do not fly touch-and-go landings with hung ordnance, live external ordnance, or with fuel remaining in any external tank.

3.24. Low Approaches.

- 3.24.1. Observe the following minimum altitudes:
 - 3.24.1.1. Normal single ship low approaches - so that touchdown does not occur.
 - 3.24.1.2. IP/FE flying chase position - 50 ft AGL.
 - 3.24.1.3. Formation low approaches and non-IP/FE chase - 100 ft AGL.
 - 3.24.1.4. Chase aircraft during an emergency - 300 ft AGL unless safety or circumstances dictate otherwise.
- 3.24.2. During go-around, remain 500 ft below VFR overhead traffic pattern altitude until crossing the departure end of the runway unless local procedures, missed approach/climbout procedures, or controller instructions dictate otherwise.

3.25. Closed Traffic Patterns. Initiate the closed pattern at the departure end of the runway unless cleared otherwise by the controlling agency. From a formation approach or chase position, a sequential closed may be flown with ATC concurrence at an interval to ensure proper spacing. Plan to arrive on downwind at 200-250 KCAS.

3.26. Formation Approaches.

3.26.1. General.

3.26.1.1. Fly a published instrument approach or a VFR straight-in approach using the visual approach slope indicator, if available. In all cases, use a rate of descent similar to a normal precision approach.

3.26.1.2. Aircraft must be within 3,000 pounds weight of each other and symmetrically loaded. **(T-3)**

3.26.1.3. Position the WG on the upwind side if crosswind exceeds 5 knots.

3.26.1.4. Formation approaches will not descend below 100 ft AGL. **(T-3)**

3.26.2. Formation landings are not authorized. **(T-1)**

3.26.3. Formation drag procedures.

3.26.3.1. Formation drag landings are restricted to:

3.26.3.1.1. Daytime.

3.26.3.1.2. Weather: 1,500 ft ceiling/3 SM visibility.

3.26.3.1.3. Formation: two-ship maximum.

3.26.3.2. When directed to take spacing, the WG reduces power, extends the speedbrake and slows to no less than 200 KCAS while achieving 1.5 to 2.5 NM spacing.

3.26.3.3. Designate the preceding aircraft as a “Next to Shoot.”

3.27. After Shutdown Procedures. All flight members will accomplish a post flight walk-around. **(T-3)** The intent of this inspection is to find evidence of birdstrike, lost/damaged panels, and structural damage resulting from over-G or other in-flight abnormalities.

3.28. Mission Recording Operations.

3.28.1. Pilots will record missions from takeoff through landing if able (e.g., not applicable to missions/facilities unable to store/secure video data cartridges/data transfer cartridges properly). **(T-2)** For missions exceeding 120 minutes, record takeoff, landing, and applicable tactical events. Additionally, time, space, and position information will normally be recorded from takeoff through landing.

3.28.2. Unit commanders will develop F-22A mission recording and deletion procedures, and/or create storage procedures, to store content from every flight temporarily, which provides sufficient opportunity to identify and archive abnormal flight occurrences. **(T-2)**

3.29. Maintenance Debrief Procedures. Pilots will use Integrated Maintenance Information System to appropriately status each degraded or malfunctioning subsystem in accordance with the *F-22A Minimum Essential Subsystem List (MESL)*. **(T-2)** The presence of an Integrated Caution and Warning or fault reporting code is not required to assess a subsystem as degraded if observed performance was subpar. See DAFI 21-101, *Aircraft and Equipment Management*, and DAFI 21-103, *Equipment Inventory, Status, and Utilization Reporting*, as supplemented, for information on debrief coding for aircraft and subsystems.

3.29.1. Conditions rendering the aircraft unsafe for flight must be status “CODE 3 RESTRICTED.”

3.29.2. Failures not affecting safety-of-flight but causing a required subsystem to be unavailable or degraded beyond usefulness (e.g., RADAR FAIL or RW DEGD in all quadrants and bands) will be status “CODE 3 FLYABLE.”

3.29.3. Failures within any subsystem causing minor degradation, or failure of a non-required subsystem (e.g., IMU FAIL, or MLD FAIL on an FTU aircraft) will be status “CODE 2.”

3.29.4. When unsure of whether to status a subsystem as “CODE 3 FLYABLE” or “CODE 2” (e.g., RW DEGD in one band, two quadrants), pilots will follow local guidance and/or best individual judgment.

3.30. Wind and Sea State Restrictions. Pilots will not conduct training missions when surface winds along the intended route of flight exceed 35 knots steady state. **(T-1)** Refer to applicable AFMAN 11-202V3 MAJCOM supplement for additional guidance.

3.31. Transponder Operations. Operation per AFMAN 11-202V3 (as supplemented), and TO 1F-22A-1.

3.31.1. Identification Friend or Foe (IFF) Transponder. Altitude reporting (Mode C) may be turned off during tactical operations, in special use airspace, or on designated training ranges.

3.31.2. Identification Friend or Foe Interrogator. Outside of special use airspace, pilots limit interrogations to mission essential and safety of flight purposes. Pilots may perform an interrogator check momentarily for system verification purposes.

3.31.3. IFF Mode 5. Transponder use is authorized. Where authorized, Interrogator may be used (see [paragraph 3.31.2.](#)).

3.32. Weather Minimums. Refer to [Table 3.1](#) for a summary of weather minimums affecting F-22A operations.

Table 3.1. Weather Minimum Summary.

Event	Minimum (ceiling in ft AGL)
VFR Rejoin (Day)	1,500 ft/ 3 SM / 4.8 kilometers (KM)
VFR Rejoin (Night)	3,000 ft/ 5 SM / 8 KM
Low Level Navigation (Day)	1,500 ft/ 3 SM / 4.8 KM (notes 1&2)
Low Altitude Intercepts (Day)	3,000 ft/ 5 SM / 8 KM (note 3)
Notes: 1. Unless national rules are higher. 2. 2,000 ft/8 KM in countries where the minimum altitude is 1,000 ft AGL. Refer to <i>FLIP Area Planning</i> for low level routes. 3. 3,500 ft/8 KM in countries where minimum altitude is 1,000 ft AGL.	

3.33. Summary of Minimum Altitudes. Refer to [Table 3.2](#) for a summary of minimum altitudes that affect F-22A operations.

Table 3.2. Minimum Altitude Summary.

Event	Minimum AGL (ft)
Aerobatics/Air Combat Training/Advanced Handling	5,000
Lead Change	See note
Chase (Emergency)	300
Chase (FE / IP)	50
Formation Low Approach	100
Low Approaches	To not touchdown
KIO	1,000
Note: 500 ft over land; 1,000 ft over water; 1,500 ft at night/IMC unless on radar downwind.	

3.34. Laser Eye Protection. There is no MDS specific guidance. See AFI 11-301V1, *Aircrew Flight Equipment*.

Chapter 4

INSTRUMENT PROCEDURES

4.1. Primary Flight Reference. When flight conditions require sole reliance on instruments for aircraft control, use of the HUD must be cross checked with the heads-down instruments (i.e., SFG (if using a different GINS source than the HUD)). **(T-1)** The HUD is not certified as a single-medium (standalone) primary flight reference for sole use per Air Force Flight Standards Agency.

4.2. Takeoff and Join-up. If weather is below 1,500 ft AGL and 3 SM, pilots will climb on runway heading until above 1,000 ft AGL before initiating turns, except when departure instructions specifically preclude compliance. **(T-3)**

4.3. Trail Procedures.

4.3.1. General.

4.3.1.1. During sensor trail formations, basic instrument flying is the priority and not sacrificed when performing secondary tasks. To ensure proper spacing requires strict adherence to the briefed airspeeds, power settings, altitudes, headings, and departure routing. If task saturation occurs, prioritize aviate (airspeed, altitude and attitude), then navigate (fly published departure) and lastly communicate (e.g., “Raptor 2 negative contact, blind”). The FL will be directive to ensure safety of flight. **(T-1)** If unable to remain in a safely spaced formation the FL coordinates for separate ATC clearances.

4.3.1.2. Request non-standard formation from ATC if anticipated to remain greater than 6,000 ft in trail.

4.3.1.3. ATC instructions issued to the lead aircraft apply to the entire flight.

4.3.1.4. FLs will brief aircraft/element spacing. **(T-3)** Minimum spacing between aircraft when in non-standard formation is 9,000 ft and will be maintained using on board systems.

4.3.2. If flight member is unable to attain a “Next to Shoot:”

4.3.2.1. Transmit, “negative contact.” The FL communicates the initiation of turns. Subsequent aircraft delay turns to maintain the desired spacing.

4.3.2.2. Each aircraft/element maintains 1.5-2.5 NM spacing using aircraft systems.

4.3.2.3. During climbs and descents, each aircraft/element calls passing each 5,000 ft altitude increment with altitude and heading (or heading passing) until join-up, level-off, or the following aircraft/element communicates sensor or visual contact (e.g., “tied” or “visual”).

4.3.2.4. Each aircraft/element calls initiating any altitude or heading change. Acknowledgments are not required; however, it is imperative that preceding aircraft/elements monitor the radio transmissions and progress of the succeeding aircraft/elements and immediately correct deviations from the planned route.

4.3.2.5. Each aircraft/element maintains at least 1,000 ft vertical separation from the preceding aircraft/element until establishing sensor/visual contact, except in instances where departure instructions specifically preclude compliance. Pilots may reduce vertical separation to 500 ft if necessary to comply with MSA restrictions.

4.3.2.6. In the event a visual join-up cannot be accomplished on top or at level off, the FL will request altitude separation for each succeeding aircraft/element to meet the requirements of the above paragraph. **(T-3)**

4.3.2.7. Pilots with known aircraft sensor instability will receive separate IFR clearances.

4.3.3. With “Next to Shoot.”

4.3.3.1. Each aircraft/element calls “tied” when a “Next to Shoot” is established with the preceding aircraft. Once all aircraft are tied, no further radio calls are required, unless contact is lost. FLs will ensure all aircraft acknowledge any changes to clearance. **(T-2)**

4.3.3.2. In flights of three or more aircraft, use all available aircraft systems (e.g., radar, data link, TACAN, air-to-air interrogator) to ensure that trail is maintained on the correct aircraft.

4.3.4. Sensor Trail Departures. Unless otherwise briefed, instrument trail departures are defined as (see AFTTP 3-3.F-22A):

4.3.4.1. 20-second takeoff spacing.

4.3.4.2. Military/AB power until 350 KCAS.

4.3.4.3. Set throttle to 90% in the climb while holding 350 KCAS or 0.88 Mach until reaching level-off altitude.

4.3.4.4. Once level, transition to max range airspeed until directed otherwise.

4.3.4.5. Limit all turns to a maximum of 30 degrees of bank unless local or published procedures demand higher bank angles.

4.3.5. Enroute Trail. FLs ensure deconfliction through briefed airspeeds and power settings as necessary.

4.3.6. IFR Trail Recovery.

4.3.6.1. Limit trail recoveries to a maximum of four aircraft.

4.3.6.2. Before beginning the recovery, FLs ensure that weather at the base of intended landing is at or above the highest pilot weather category in the flight or approach minimums, whichever is higher.

4.3.6.3. Do not terminate trail recoveries in simultaneous precision approach radar or airport surveillance radar approaches. Recoveries to separate approaches are authorized, however, split flights prior to final.

4.3.6.4. Regardless of flight number, the lead aircraft squawks the assigned Mode 3. Flight members will set Mode 3 subset (3d and 4th digits) per unit/local procedures or as directed by ATC.

4.3.6.5. Normally use a maximum of 30 degrees of bank in turns unless more is required to adhere to a published procedure or ATC instruction.

4.3.6.6. Once established on a segment of a published approach, each aircraft complies with all published altitudes and restrictions while maintaining trail separation.

4.3.6.7. Unless local procedures establish defined reference points for airspeed/configuration changes, the FL directs changes by radio.

4.3.6.8. Report the final approach fix or glide slope intercept on a precision approach.

4.3.6.9. Prior to the published approach, if contact is lost with the preceding aircraft, transmit “call sign, lost contact.” The preceding aircraft responds with altitude, airspeed and heading. FLs will establish altitude deconfliction and coordinate a separate clearance with ATC. **(T-3)** If contact is lost while established on a segment of a published approach, flight members will continue the approach but must confirm separation via navigation aids. If separation cannot be confirmed, pilots will execute missed approach or climb out as instructed by ATC. **(T-2)**

4.4. Formation Break-up. Formation break-up is defined as obtaining separate clearances and separate squawks. Formation break-up from a visual formation will be accomplished in VMC to the maximum extent possible. If IMC is unavoidable, breakup from a visual formation occurs with the FL maintaining a predictable flight path. Prior to a formation break-up, the FL ensures deconfliction by directing altitude, heading and airspeed. Prior to flight break-up, communicate any navigation stability issues (e.g., inoperable Communications, Navigation, and Identification, GINS, TACAN/Instrument Landing System).

4.5. Formation Penetration. If the overhead traffic pattern is closed but visual straight ins are permitted, restrict penetrations to two aircraft in route/close formation.

4.6. Formation Lead Change. In IMC conditions, pilots will not change lead position below 1,500 ft AGL unless on radar downwind. **(T-2)**

4.7. Instrument Approach.

4.7.1. The F-22A is Approach Category E (refer to AFMAN 11-202V3, as supplemented). Accomplish missed approach in accordance with flight manual procedures. Missed approach airspeed is 250 KCAS.

4.7.2. Pilots will use Approach Category D minimums at airfields where Category E minimums are not published. **(T-1)** Airfields with Category D minimums may be designated as an alternate (divert) airfield. Practice instrument approaches may be flown using Category D minimums if VMC can be maintained throughout the procedure. Under these circumstances, approach Category D minimums may be used provided:

4.7.2.1. A straight-in approach is flown.

4.7.2.2. The aircraft is flown at final approach airspeed of 165 KCAS or less.

4.7.2.3. The aircraft is flown at 255 knots true airspeed or less for the missed approach segment of the approach. At high-pressure altitudes and/or temperatures (see AFH 11-203V1), 255 knots true airspeed may not be compatible with published missed approach airspeeds and Category D approaches will not be flown.

4.8. Airspace Certifications. The following are documented approvals per direction in AFMAN 11-202V3 ACCSUP, paragraph 2.2.8. Pilots holding a current AF Fm 8 qualification/instrument checkride are RVSM and RNAV qualified. For the initial F-22A RVSM and RNAV evaluation and approval documents contact ACC/A3TO Flight Operations and Training Branch, acc.a3to@us.af.mil.

4.8.1. Reduced Vertical Separation Minimum (RVSM). All block F-22s are approved for restricted operation within RVSM airspace. Refer to TO 1F-22A-1, Chapters 2 and 7 (Reduced Vertical Separation Minimum (RVSM)) procedures with the following additional restrictions:

4.8.1.1. Pilots must use a robust instrument cross check while in RVSM airspace. Pilots must use the Altitude Hold Auto-Pilot (A/P) function during level cruise. **(T-1)**

4.8.1.2. If receiving an A/P FAIL ICAW, attempt to reset the Altitude Hold A/P function. If unable to engage the Altitude Hold A/P function, or if the A/P holds an altitude greater than 130 feet from the commanded altitude, hand flying in RVSM airspace is not recommended.

4.8.2. Area Navigation (RNAV). Refer to TO 1F-22A-1, Chapter 7, Reduced Vertical Separation Minimum (RVSM), sections on MNPS/RNP-10 and BRNAV restrictions and **Table 4.1** below.

Table 4.1. U.S. Standard RNP Levels. (see FAA Aeronautical Information Manual)

RNP Level	Typical Application	Route Width, Centerline to Boundary (NM)	F-22A Approved
10 (RNAV-10)	Oceanic/remote areas where performance based horizontal separation is applied	10.0	Yes
5 (RNAV-5)	En Route operations in Europe	5.0	Yes
4 (RNAV-4)	Oceanic/remote areas where performance based horizontal separation is applied	4.0	No
2 (RNAV-2)	En Route, T and Q Routes	2.0	No
1 (RNAV-1)	Terminal and En Route	1.0	No
0.3-1.0 (RNAV-0.3-1)	RNP Approach Segments	0.3-1.0	No
0.1-1.0 (RNAV-0.1-2)	RNP Authorization Required Approach Segments	0.1-1.0	No

4.8.3. Terminal RNAV. RNAV inside the initial approach fix is not authorized. RNAV (GPS) instrument approaches, and RNAV missed approach procedures, are not authorized. **(T-0)**

4.8.4. Codes for filing flight plans on the DD Form 1801, *International Flight Plan*, which follows the International Civil Aviation Organization (ICAO) format. See **Tables 4.2** through **Table 4.7** below.

Table 4.2. FAA Equipment.

☐ /A - DME w/ Mode C	☐ /I - RNAV w/ Mode C	☐ /T - no DME no Mode C
☐ /B - DME no Mode C	☐ /L - GPS w/ enrte/term/appr/RVSM	☐ /U - no DME w/ Mode C
☐ /C - RNAV no Mode C	☐ /M - TACAN no Transponder	☐ /V - GNSS w/ no Transponder
☐ /D - DME no Transponder	☐ /N - TACAN no Mode C	☐ /W - RVSM w/ Mode C/X - no DME no Transponder
☐ /G - GPS/GNSS w/ enrte/term/appr	☐ /P - TACAN w/ Mode C	☐ /Y - RNAV w/ no Transponder
☐ /H - RVSM w/ no Mode C	☐ /S - GNSS w/ Mode A	☒ /Z - RVSM w/ RNAV/Mode C, no GNSS

Table 4.3. ICAO Equipment.

☐ A - GBAS Landing Sys	☐ J2 - CPDLC FANS 1/A HFDL	☐ O - VOR
☐ B - LPV (APV with SBAS)	☐ J3 - CPDLC FANS 1/A VDL Mode A	☐ P1 - CPDLC RCP 400
☐ C - LORAN C	☐ J4 - CPDLC FANS 1/A VDL Mode 2	☐ P2 - CPDLC RCP 240
☒ D - DME	☐ J5 - CPDLC FANS 1/A (INMARSAT)	☐ P3 - SATVOICE RCP 400
☐ E1 - FMC WPRACARS	☐ J6 - CPDLC FANS 1/A (MTSAT)	☒ R - PBN Approved
☐ E2 - D-FIS ACARS	☐ J7 - CPDLC FANS 1/A (Iridium)	☐ S - (VOR, VHF RTF, ILS)
☐ E3 - PDC ACARS	☐ K - MLS	☒ T - TACAN
☐ F - ADF	☒ L - ILS	☒ U - UHF RTF
☒ G - GNSS	☐ M1 - ATC RTF (INMARSAT)	☒ V - VHF RTF
☐ H - HF RTF	☐ M2 - ATC RTF (MTSAT)	☒ W - RVSM
☒ I - Inertial Nav	☐ M3 - ATC RTF (Iridium)	☐ X - MNPS
☐ J1 - CPDLC ATN VDL Mode 2	☐ N - NIL	☒ Y - VHF 8.33 kHz spacing

Table 4.4. ICAO Surveillance Codes.

☐ A - Mode A	☐ G1 - ADS-C, ATN	☐ S - Mode S, ID and Alt
☐ B1 - ADS-B, Dedicated 1090 Out	☐ H - Mode S, ID, Alt, Enhanced Surv	☐ U1 - ADS-B, UAT Out
☐ B2 - ADS-B, Dedicated 1090 Out+In	☐ I - Mode S, ID no Alt	☐ U2 - ADS-B, UAT Out+In
☒ C - Modes A and C	☐ L - Mode S, ID, Alt, Squitter+Enh Surv	☐ V1 - ADS-B, VDL Mode 4 Out
☐ D1 - ADS-C, FANS	☐ N - NIL	☐ V2 - ADS-B, VDL Mode 4 Out+In
☐ E - Mode S, ID, Alt, Squitter	☐ P - Mode S, Alt no ID	☐ X - Mode S, no ID no Alt

Table 4.5. ICAO Wake Category.

☐ Light - 15,500 lbs or less	☒ Medium - 15,501 to 299,999 lbs	☐ Heavy - 300,000 lbs or more
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Table 4.6. ICAO Per-Based Nav (PBN).

☒ A1 - RNAV 10 (RNP10)	☐ C2 - RNAV 2 GNSS	☐ O1 - RNP 1 All Sensors
☐ B1 - RNAV 5 All Sensors	☐ C3 - RNAV 2 DME/DME	☐ O2 - RNP 1 GNSS
☐ B2 - RNAV 5 GNSS	☐ C4 - RNAV 2 DME/IRU	☐ O3 - RNP 1 DME/DME
☐ B3 - RNAV 5 DME/DME	☐ D1 - RNAV 1 All Sensors	☐ O4 - RNP 1 DME/IRU
☐ B4 - RNAV 5 VOR/DME	☐ D2 - RNAV 1 GNSS	☐ S1 - RNP APCH
☒ B5 - RNAV 5 INS/IRS	☐ D3 - RNAV 1 DME/DME	☐ S2 - RNP APCH & Baro
☐ B6 - RNAV 5 LORAN C	☐ D4 - RNAV 1 DME/IRU	☐ T1 - RNP AR APCH & RF
☐ C1 - RNAV 2 All Sensors	☐ L1 - RNP 4	☐ T2 - RNP AR APCH no RF

Table 4.7. STS Special Handling.

☐ ALTRV - Altitude Reservation	☐ HEAD - Head of state	☐ MEDEVAC - Medical evacuation
☐ ATFMX - ATFM exempt	☐ HOSP - Medical flight	☐ NONRVSM - Non-RVSM in RVSM
☐ FFR - Firefighting	☐ HUM - Humanitarian	☐ SAR - Search and rescue
☐ FLTCK - Flight check	☐ MARSA - Military separation	☒ STATE - Military/police
☐ HAZMAT - Hazardous material		

4.9. Live Fly of RNAV and Self-Contained Approaches (SCA). Per AFMAN 11-202V3 (as supplemented), paragraph 4.13., MAJCOMs are approved to use RNAV systems once pilots are trained and compatible underlying conventional NAVAIDs are tuned and monitored with the following restrictions:

4.9.1. Ground Training. Prior to live-flying an RNAV or SCA, pilots will complete a unit developed RNAV training program. **(T-2)** The training program will include both academics and simulator events, and accomplishment will be annotated on each Squadron's Letter of Qualifications (LOX) which indicates pilot certification. **(T-2)**

4.9.2. Live-fly. Pilots are authorized to conduct RNAV approaches after completion of F-22A RNAV ground training. Per AFMAN 11-202V3 ACCSUP, paragraph 15.2, pilots will only fly RNAV (GPS) approaches under VFR as a visual or contact approach due to the F-22A not having an FAA approved GPS for full RNAV use. **(T-0)**

4.9.2.1. Flying a published RNAV (GPS) approach or using GPS to fly a published TACAN or LOC approach (overlay approach). Per AFMAN 11-202V3 ACCSUP, paragraph 15.2, pilots will only fly these approaches under VFR and will comply with published lateral/altitude guidance.

4.9.2.2. SCAs. Per DAFMAN 11-230, an SCA is a MAJCOM-approved arrival procedure that uses only the navigational equipment on-board the aircraft (GPS, airborne radar or other sensors). TERPS specialists will not develop or publish any SCA approaches other than Airborne Radar Approaches (ARAs). **(T-2)** The safety and flyability of pilot-developed SCAs is the responsibility of MAJCOM/A3, who will ensure each procedure complies with paragraph 15.3.7.. MAJCOM-Certified Procedures, AFI 11-202V3, and paragraph 4.1.. Special Use Instrument Flight Procedures, DAFMAN 11-230, prior to authorizing the SCA for flight.

4.9.3. Notify ATC of the approximate route of flight prior to commencing the approach (i.e., “Request VFR approach following track and altitudes for RNAV (GPS) Rwy 8”).

4.10. Simulated Instrument Flight. Follow the simulated instrument flight restrictions defined in AFMAN 11-202V3, as supplemented.

4.11. Extreme Latitude Navigation. Units tasked with operations in the areas of magnetic unreliability (north of 70°N latitude or south of 60°S latitude) refer to AFMAN 11-202V3_ACCSUP, Chapter 20. Units will prepare pilots for navigation referring to true north heading reference prior to deployment.

Chapter 5

AIR-TO-AIR WEAPONS EMPLOYMENT

5.1. References. AFMAN 11-214 contains air-to-air procedures, to include operations with live ordnance applicable to all aircraft. This chapter specifies procedures or restrictions applicable to F-22A operations. Missile and gun shot validity are assessable at weapons release IAW AFTTP 3-1. Shot Kill. For abnormal operating procedures (e.g., NORDO) see [Chapter 7](#).

5.2. Simulated Gun Employment. Missions may be flown with a loaded gun provided the gun is safe per TO 1F-22A-34-1-1, *Non-Nuclear Weapons Delivery Flight Manual—F-22A* and a trigger check is first performed with the master arm switch in arm, Embedded Training deselected, and rounds count G0 in the HUD and stores management display. Point the aircraft away from other aircraft and be in airspace over which bullet impacts are authorized in the event the gun fires. Trigger checks over inhabited areas or where bullet impacts are not authorized are prohibited. (T-1)

5.3. Maneuvering Limitations. Intentional negative-G gun defense is prohibited. (T-2) Unintentional momentary excursions during a low energy unload do not violate this intent.

5.4. Aerial Gunnery Tow Procedures. AFMAN 11-214 applies. In addition:

5.4.1. Aerial Gunnery Banner Chase. Enroute to the range, chase aircraft ensures a stable flying banner. While in straight and level flight, the chase pilot passes the direction of “banner lean” (if any) in clock position to the tow pilot. This establishes the best turn direction for employment (if banner is flying at the 10 o’clock position, the tow turns right).

5.4.2. Abnormal Procedures.

5.4.2.1. Unable to Release Banner. If possible, provide the tow aircraft with a chase (shooter desired), proceed to local jettison area and attempt jettison. If banner remains, recover per local procedures.

5.4.2.2. Banner Shot Off, Cable Remaining. Release cable in working area. The shooter rejoins with the tow aircraft to ensure no cable remains. If cable remains, recover per local procedures.

5.5. Live A/A Ordnance Procedures. Follow AFMAN 11-214, paragraph 4.2, for live missile and hot gun procedures. Pilots will not perform a trigger check with a hot gun. (T-1)

Chapter 6

AIR-TO-SURFACE WEAPONS EMPLOYMENT

6.1. References. AFMAN 11-214 contains air-to-surface procedures applicable to all aircraft. This chapter specifies procedures or restrictions applicable to F-22A operations. Employment validity is based on weaponeering (e.g., fuse arm and safe escape) for the ordnance used at weapons release IAW AFTTP 3-1. Shot Kill.

6.2. Simulated Off-Range Weapons Employment While Carrying Ordnance. Off-range is defined as an area or range in which ordnance release is either not authorized or in which unintentional or inadvertent release could result in ordnance impacting an area not authorized for that ordnance. AFMAN 11-214 and the following apply:

6.2.1. Pilots will not press the weapon release button with inert air-to-ground ordnance loaded unless the following conditions are met:

6.2.1.1. Embedded Training Mode On. **(T-1)**

6.2.1.2. Air-to-Air Master Mode selected. **(T-1)**

6.2.1.3. INHIBIT selected on the stores management display. **(T-1)**

6.2.1.4. No “Next to Bomb” (nothing in Bomb List). **(T-1)**

6.2.2. Pilots will not conduct off-range simulated weapons employment with hung ordnance. **(T-1)**

6.2.3. Pilots will not conduct any off range simulated weapons employment with live ordnance (except 20 millimeter (mm) gun per AFMAN 11-214) aboard the aircraft. **(T-1)**

6.2.4. With live ordnance loaded (other than 20mm with gun verified as safe IAW the steps within [paragraph 5.2](#)), pilots will ensure the MASTER ARM switch stays safe unless the aircraft is in appropriate airspace and preparing to employ live ordnance. **(T-1)**

6.3. Weather Minimums. Basic weather minimums established in AFMAN 11-214 apply.

6.4. Night Weapons Delivery/Range Operations. Procedures in AFMAN 11-214 apply.

6.5. Target Identification. Pilots will positively identify the target prior to weapons release. For wartime or contingency sorties, comply with rules of engagement. **(T-1)** Achieve positive identification by either visually acquiring the target or by confirming target location through valid on-board/off-board cues. Exercise caution when relying on a single cue to confirm target location. **(T-1)** Weapons delivery requires a complete understanding of how target(s) coordinates and elevation were generated, and that use of this data complies with all range procedures or Rules of Engagement.

6.6. Live Ordnance Procedures. When carrying live air-to-ground munitions, pilots will:

6.6.1. Comply with AFMAN 11-214.

6.6.2. Not make simulated weapons delivery passes on manned targets with live air-to-ground munitions loaded on the aircraft. **(T-1)**

6.6.3. Apply the following procedures when ground controllers are on Class B/C ranges:

- 6.6.3.1. Be familiar with applicable range weapons delivery procedures, appropriate targets and weapons footprints.
- 6.6.3.2. Ground personnel locations are briefed and acknowledged by all pilots. **(T-1)**
- 6.6.3.3. Do not expend ordnance if any doubt exists as to the ground personnel or intended target locations. **(T-1)**

Chapter 7

ABNORMAL OPERATING PROCEDURES

7.1. General. These procedures do not supersede flight manual guidance.

7.1.1. Pilots will not accept an aircraft with a safety of flight malfunction. (T-2)

7.1.2. Do not use a malfunctioning system unless it is required for safe recovery of the aircraft. Do not continue troubleshooting a malfunction after completing flight manual emergency procedures and the aircraft may be safely recovered.

7.1.3. Do not taxi the aircraft with nose wheel steering or brake malfunctions unless authorized by TO 1F-22A-1.

7.1.4. For actual or perceived flight control malfunctions, terminate maneuvering and take appropriate action.

7.2. Ground Aborts.

7.2.1. If a flight member aborts prior to takeoff, the FL normally renumbers the flight. FLs advise the appropriate agencies of such changes.

7.2.2. If the scheduled FL(s) abort, WG may not operate as a coordinated formation unless there is a qualified FL remaining in the formation. WG may depart as singles and execute the 'no FL' briefed plan. In the absence of a briefed wingmen-only game plan, execute a sympathetic abort or proceed with a pre-briefed single-ship mission.

7.2.3. Delayed aircraft either contacts the FL or executes a pre-briefed game plan prior to entering the fight.

7.3. Takeoff Aborts.

7.3.1. If an abort occurs during takeoff roll, notify tower and flight members when practical. Following aircraft alter takeoff roll to ensure clearance or abort takeoff if adequate clearance cannot be maintained. The phrase "Cable, Cable, Cable" indicates a departure-end cable arrestment. The phrase "Barrier, Barrier, Barrier" indicates a departure-end net arrestment. Local procedures will address net barrier raising procedures.

7.3.2. When applying the brakes during a takeoff abort and hot brakes are suspected (suspect hot brakes if aborting airspeed is in "caution zone" per TO 1F-22A-1, Figure 5-7, Brake Energy Limits – nominally 120 KCAS clean, 105 KCAS two tanks), declare a ground emergency, taxi the aircraft to the designated hot brake area, and follow hot brake procedures.

7.3.3. If aborting takeoff at or below 100 KCAS, consider lowering the tailhook. If aborting above 100 KCAS, lower the tailhook if there is any doubt about the ability to stop on the runway.

7.4. Air Aborts.

7.4.1. If an abort occurs after takeoff, all aircraft maintain their original numerical call sign.

7.4.2. Emergency aircraft will obtain a chase aircraft to the maximum extent possible. The FL determines if minor malfunctions require a chase aircraft. It is critical to consider compounding factors such as the nature of the emergency, local area familiarity, and weather conditions.

7.4.3. Pilots will abort the mission and land out of a straight-in approach, regardless of apparent damage, for any of the following:

7.4.3.1. Birdstrike/Foreign Object Damage.

7.4.3.2. Flight control system anomalies. This does not include flight control system Integrated Caution, Advisory, and Warning System notifications that reset per TO 1F-22A-1 procedures.

7.4.3.3. Single engine.

7.4.4. If an aircraft experiences an over-G, pilots will use the following procedures:

7.4.4.1. Perform a battle damage check. **(T-3)**

7.4.4.2. Terminate the mission and land as soon as practical from a straight-in approach. **(T-3)**

7.4.4.3. Document over-G in Integrated Maintenance Information System after flight. **(T-3)**

7.5. Engine Malfunctions. Report all engine anomalies during maintenance debriefing. **(T-3)**

7.6. Radio Failure.

7.6.1. General. Individual aircraft experiencing radio failure comply with procedures outlined in FLIP, AFPAM 11-205, AFMAN 11-202V3 (as supplemented), this manual, and local directives.

7.6.2. Formation.

7.6.2.1. Flight members who experience total radio failure while in close or route formation will maneuver within close/route parameters to attract the attention of another flight member and pass the appropriate visual signals. Terminate the mission as soon as practicable and lead the NORDO aircraft to the base of intended landing or a divert base (if required). Perform a formation approach to a drop-off on final with clearance to land on the intended runway unless safety considerations dictate otherwise.

7.6.2.2. If flying other than close/route formation when the radio failure occurs, the pilot of the NORDO aircraft will attempt to rejoin to a route position at approximately 500 ft on another flight member. The NORDO aircraft is responsible for maintaining deconfliction from other flight members until aircraft presence is acknowledged by a wing rock, signifying clearance to join. Once rejoined, the NORDO aircraft passes the appropriate visual signals.

7.6.2.3. If unable to rejoin with another aircraft and pre-briefed, the NORDO aircraft may proceed to a rendezvous point and hold. If no one has rejoined prior to reaching Joker fuel, the NORDO aircraft will proceed to the base of intended landing or a divert base. Aircraft experiencing any malfunctions/emergency in addition to NORDO, proceeds as required by the checklist.

7.6.3. Aerial Gunnery/Missile Firing NORDO Procedures:

7.6.3.1. Pilots will not fire without two-way radio contact. **(T-1)**

7.6.3.2. Shooting aircraft: safe the armament switches, rejoin on another member of the flight or the tow aircraft, per [paragraph 7.6.2](#).

7.6.3.3. Aerial gunnery tow aircraft: wing rock and continue the turn if an attack is in progress. The FL of the attacking aircraft will “knock off” the attack and rejoin on the tow’s wing, remaining clear of the target in the event the banner is cut. **(T-1)** The tow pilot passes standard hand signals to indicate any difficulty. The FL signals when the target is cleared for cut with a slicing motion across the throat. After the target is away and the FL determines there is no remaining cable, the tow aircraft recovers with an escort following the briefed NORDO recovery procedures. If cable remains, follow local procedures.

7.6.4. NORDO Recovery.

7.6.4.1. Apply the procedures in FLIP, AFPAM 11-205, AFMAN 11-202V3 (as supplemented), this manual, and local directives.

7.6.4.2. If a formation straight-in approach is flown and a go-around becomes necessary, the pilot flying chase will go-around, pass the NORDO aircraft and rock wings. **(T-2)** The NORDO aircraft executes a go-around, if the situation allows. If the NORDO aircraft is in formation as a WG, the lead aircraft initiates a gentle turn into the WG and begins the go-around.

7.6.4.3. A pilot flying a NORDO aircraft intending to make an approach-end cable engagement signals the escorting aircraft by extending the tailhook. If the NORDO aircraft is not escorted, fly a VFR recovery per AFPAM 11-205. If recovering via a straight-in, flash the landing light on final to signal the tower.

7.7. Severe Weather Penetration.

Avoid flight through severe weather. If unavoidable, FLs will ensure formation break-up and obtain separate clearances prior to severe weather penetration. **(T-1)**

7.7.1. Avoid thunderstorms and lightning within distance criteria established in TO 1F-22A-1, AFMAN 11-202V3 (as supplemented), and AFH 11-203V1.

7.7.2. Set airspeed per TO 1F-22A-1 thunderstorm penetration airspeed for flight through visible moisture, rain showers or thunderstorms.

7.8. Lost Wingman Procedures.

In any lost wingman situation, immediate separation of aircraft is essential.

7.8.1. Upon losing sight of the lead aircraft or if unable to maintain formation, the WG will:

7.8.1.1. Simultaneously execute the applicable lost wingman procedures, transition to primary flight instruments, and inform lead by transmitting “*call sign* is lost wingman.” **(T-1)** Refer to [paragraph 7.9](#) for specific SD considerations. Smooth application of control inputs is imperative to minimize the effects of SD.

7.8.1.2. After executing a lost wingman procedure, do not attempt rejoining with the flight until obtaining permission from the FL. **(T-2)**

7.8.1.3. When able, obtain a separate clearance.

7.8.1.4. Observe all published terrain clearance limits.

7.8.2. Two- or Three-Ship Flights (three-ship echelon, refer to four-ship procedures):

7.8.2.1. Wings-level flight (climbing, descending, or straight and level). Turn away using 15 degrees of bank for 15 seconds, then resume original heading.

7.8.2.2. Turns.

7.8.2.2.1. Outside the Turn. Reverse the direction of turn using 15 degrees of bank for 15 seconds. Continue straight ahead to ensure separation prior to resuming the turn.

7.8.2.2.2. Inside the Turn. Momentarily reduce power to ensure nose-tail separation and direct the FL to roll out of the turn. Maintain the original turn. The lead aircraft may only resume the turn when separation is ensured.

7.8.2.3. Final Approach. Momentarily turn away from lead to ensure clearance and execute the published missed approach procedure.

7.8.2.4. Missed Approach. Momentarily turn away from lead to ensure clearance and continue the published or assigned missed approach procedure. Climb to 500 ft above missed approach altitude.

7.8.3. Four-Ship Flights. Number 2 and 3 follow the procedures outlined in [paragraph 7.8.2](#) above. Number 4's initial action assumes that number 3 has also gone lost wingman. In addition to [paragraph 7.8.1](#), aircraft number 4 applies the following:

7.8.3.1. Wings-Level Flight (climbing, descending, or straight and level). Turn away using 30 degrees of bank for 30 seconds, then resume the original heading.

7.8.3.2. Turns.

7.8.3.2.1. Outside the Turn. Reverse direction of turn using 30 degrees of bank for 30 seconds to ensure separation from lead and number 3.

7.8.3.2.2. Inside the Turn. Momentarily reduce power to ensure nose-tail separation and increase bank angle by 15 degrees. Direct the lead aircraft to roll out. The lead only resumes the turn when separation is ensured.

7.8.4. FLs must acknowledge the lost wingman's radio call and, when appropriate, transmit attitude, altitude, heading, and airspeed. **(T-2)**

7.8.5. If a WG becomes separated and any aircraft experiences radio failure, the aircraft with the operational radio obtains a separate clearance. The NORDO aircraft turns the IFF Mode 3C to 7600 while proceeding with previous clearance. If an emergency along with radio failure, set IFF function access button to EMERG (or IFF SET M3 7700 C) for the remainder of the flight.

7.8.6. Only practice lost wingman procedures in VMC.

7.9. Spatial Disorientation. Conditions that prevent a clear visual horizon or increase pilot tasking are conducive to SD. To prevent SD, an increased instrument crosscheck rate is paramount. If SD symptoms are encountered:

7.9.1. Single Ship.

7.9.1.1. Concentrate on flying basic instruments with frequent reference to the HUD. The SFG may be used as an alternate attitude reference if it is using a different GINS source

than the HUD (i.e., HUD on GINS 1 and SFG on right upfront display). Consider selecting attitude mode on the primary multi-function display.

7.9.1.2. If symptoms persist and conditions permit, fly straight and level flight until symptoms abate, usually within 60 seconds. Consider using the autopilot.

7.9.1.3. If necessary, declare an emergency and advise ATC.

7.9.1.4. It is possible for SD to proceed to the point where the pilot is incapacitated and unable to see or interpret the flight instruments. In this situation, aircraft control may be impossible. If this occurs, the pilot will consider ejecting.

7.9.2. Formation Lead.

7.9.2.1. Advise the WG that FL has SD and comply with procedures in [paragraph 7.9.1](#).

7.9.2.2. Use the WG to confirm attitude and provide verbal feedback.

7.9.2.3. If symptoms persist, terminate the mission and recover the flight by the simplest and safest means possible.

7.9.3. Formation Wingman.

7.9.3.1. Advise lead of the disorientation.

7.9.3.2. Lead transmits aircraft attitude, altitude, heading, and airspeed.

7.9.3.3. If symptoms persist and conditions permit, establish straight and level flight for 30-60 seconds.

7.9.3.4. If the above procedures are not effective, FL will consider passing the lead to the WG, provided the FL is able to maintain situational awareness from a chase position. Transfer lead while in straight and level flight. Once assuming the lead, maintain straight and level flight for 60 seconds. If necessary, terminate the tactical mission and recover by the simplest and safest means possible.

7.9.4. Greater than 2-Ship Formation. FL will separate the flight into elements to handle a WG more effectively with persistent SD symptoms. Establish straight and level flight per [paragraph 4.4](#). Plan to keep the element with the SD pilot straight and level while the other element separates.

7.10. AGCAS Event. If any pilot experiences an AGCAS activation, allow the aircraft to perform the recovery, recover to a safe altitude, and assess the situation.

7.10.1. If the pilot determines this was a valid fly-up (auto recovery required to prevent flight into terrain) or is uncertain of validity:

7.10.1.1. Advise FL or WG of the fly-up.

7.10.1.2. Discontinue the mission and return to base.

7.10.1.3. Archive the mission recording of the entire sortie for review.

7.10.1.4. Complete and submit an AGCAS Class E report to the flight safety office; **(T-1)**

7.10.1.5. Notify unit leadership of the incident.

7.10.2. If the pilot determines the fly-up was not required to prevent flight into terrain—a “nuisance fly-up”—the mission may be continued at the FL’s discretion. Report the fly-up post-flight to the flight safety office.

7.10.3. Despite the presence of nuisance fly-ups, the intent is for pilots not to become desensitized to ACGAS fly-ups. For this reason, pilots will not real-time assess and paddle off AGCAS unless safety of flight is a factor (nuisance fly-up on takeoff, converging flight paths during a basic fighter maneuvers engagement, etc.).

7.11. Physiological Event. If an event occurs or is suspected:

7.11.1. If part of a formation, advise FL or WG of the physiological event.

7.11.2. Known or suspected physiological event. Per TO 1F-22A-1, activate back-up oxygen supply and control rate and depth of breath (e.g., 1 breath every 5 seconds) to address aircraft breathing system sequence issues (e.g., insufficient partial pressure of oxygen, rapidly changing oxygen concentrations, mask pressure/flow timing, valve malfunctions, cabin pressure fluctuations, regulator pressure/flow lag). In a purely hypoxic situation, expect recovery within 30 seconds of backup oxygen system activation. If symptoms remain, drop mask if aircraft is below 10,000 ft cabin altitude to optimize normal breathing. Outcomes of irregular breathing (hypocapnia, hypercapnia, etc.) can manifest as hypoxia-like symptoms, and may take 5-15 minutes to resolve. If able, consider autopilot/holding while symptoms subside before entering critical phases of flight.

7.11.3. Restrict flight to no more than 2Gs and 60 degrees of bank.

7.11.4. Declare an emergency and advise ATC.

7.11.5. Recover the aircraft utilizing a straight in approach. If known or suspected physiological event, only taxi to clear the runway, do not taxi to parking.

7.11.6. Await the arrival of Medical, Safety, and AFE personnel after landing. Unless medically necessary, leave pilot flight equipment switches and connections in place until documented by Medical, Safety and AFE personnel. **(T-1)**

7.11.7. Report any suspected or confirmed aircraft system malfunctions to maintenance and any pilot flight equipment issues to aircrew flight equipment personnel.

7.11.8. Pilots will archive the mission recording of the entire sortie for review or aid in root cause analysis (Safety, F-22A Program Office, Aerospace Physiologist, Flight Surgeon, etc.). **(T-1)**

7.11.9. Complete and submit an in-flight emergency report to the flight safety office. **(T-1)**

7.11.10. Notify unit leadership of the incident.

7.12. G-Induced Loss of Consciousness. If an event occurs or is suspected:

7.12.1. If part of a formation, advise FL, or WG of the loss of consciousness event.

7.12.2. Follow guidance in [paragraph 7.11.3](#) through [paragraph 7.11.10](#) above.

7.13. Armament System Malfunctions.

7.13.1. Inadvertent Release. Release due to a malfunction of the armament system. In the event of a suspected inadvertent release:

7.13.1.1. Record switch positions at the time of inadvertent release and provide to armament and safety personnel. Record the impact point, if known.

7.13.1.2. Safe the armament switches and do not attempt further release. Treat remaining stores as hung ordnance and follow hung ordnance procedures during recovery.

7.13.1.3. If remaining stores present a recovery hazard, jettison them in a suitable area on a single pass, if practical.

7.13.2. Failure to Release/Hung Ordnance. If ordnance fails to release when all appropriate switches are set:

7.13.2.1. Attempt to release store(s) per TO 1F-22A-34-1-1. If unsuccessful, and there is not an unsafe condition, then follow hung ordnance recovery procedures.

7.13.2.2. If an unsafe condition exists with the stores, attempt to jettison store(s) using selective jettison procedures.

7.13.3. Hangfire/Misfire.

7.13.3.1. A missile that fires but fails to depart the aircraft is a hangfire. If this occurs, the missile will be closely observed and safety checked by a chase pilot.

7.13.3.2. A missile that fails to fire when all appropriate switches were selected is a misfire. If this occurs, safe the Master Arm switch and follow the hung ordnance recovery procedures or comply with pre-briefed procedures.

7.13.4. Hung Ordnance/Weapons Malfunction Recovery.

7.13.4.1. If practical, visually inspect the area for damage to aircraft, weapons bay doors, or ordnance.

7.13.4.2. Declare an emergency for hung ordnance. **(T-2)**

7.13.4.3. If available, obtain a chase aircraft (not applicable at night unless NVD capable chase is available) and avoid populated areas and close trail formations.

7.13.4.4. Close weapons bay doors prior to landing per TO 1F-22A-34-1-1.

7.13.4.5. Land from a straight-in approach.

7.13.5. Miscellaneous Procedures.

7.13.5.1. Do not attempt to expend ordnance using a delivery system with a known weapons release malfunction.

7.13.5.2. When abnormal missile launch or erratic missile flight is noted after launch, obtain a chase aircraft for a visual inspection (if possible) to determine if any damage has occurred.

7.14. Post Arresting Gear Engagement Procedures.

7.14.1. Do not shut down the engine(s) unless directed by the ground crew, there is a fire, or other conditions dictate.

7.14.2. Raise the tailhook on the ground crew's signal.

7.14.3. Do not taxi until directed.

7.14.4. Comply with local directives as outlined in the local supplement to [Chapter 8](#) of this publication.

7.15. Practice of Emergency Procedures.

7.15.1. Simulated Emergency Procedures will not be accomplished in flight. Pilots will only practice emergency procedures in a simulator (full mission trainer), weapons and tactics trainer, or another accredited F-22A simulator. **(T-2)**

7.15.2. Aborted Takeoff Practice. Pilots will only practice aborted takeoffs in a simulator. **(T-2)**

7.16. Search and Rescue Combat Air Patrol (SARCAP) Procedures. If a pilot ejects or aircraft crashes, immediately attempt to locate the survivor and initiate rescue efforts. Expect that the survivor may initially suffer from shock or have delayed reactions due to ejection injuries. The following procedures are by no means complete and will be adjusted to meet each unique search and rescue situation:

7.16.1. Knock off maneuvering.

7.16.2. Establish a SARCAP commander.

7.16.3. Squawk Mode 3 7700 to alert ATC/command and control facility of the situation.

7.16.4. Communicate the emergency and aircraft/flight intentions immediately to applicable control agencies. Use guard frequency only if necessary.

7.16.5. Mark the last known position of survivors/crash site using any means available (Markpoint, TACAN, GINS, ATC/ground controller position and/or visual references).

7.16.6. Remain above the highest ejection altitude, if known, or the highest observed parachute(s) until determining the position of all possible survivors.

7.16.7. Deconflict from other aircraft assisting in the SARCAP by altitude to preclude midair collision. Establish high/low altitude deconfliction as necessary to facilitate communications.

7.16.8. Revise Bingo fuels or recovery bases as required to maintain maximum SARCAP coverage. Do not overfly the adjusted Bingo fuel.

7.16.9. Relinquish SARCAP operation to designated rescue forces upon their arrival.

7.16.10. Follow local or prebriefed procedures.

Chapter 8

LOCAL OPERATING PROCEDURES

8.1. General. This chapter provides a consolidated framework for wings to supplement (per DAFMAN 90-161) local operating procedures. Units composed of multiple aircraft types may publish guidance in a single, stand-alone local operating instruction/manual instead of supplementing this AFMAN. Added or stand-alone procedures will not be less restrictive than those contained elsewhere in this volume. This chapter is not intended to be a single source document for procedures contained in other directives or regulations. Avoid unnecessary repetition of guidance provided in other established directives; however, reference to those directives is acceptable when it serves to facilitate the location of information. This chapter is authorized to be issued to each pilot. Units may supplement the following paragraphs for local operating guidance:

- 8.1.1. Section A. Introduction.
- 8.1.2. Section B. General Policy.
- 8.1.3. Section C. Ground Operations.
- 8.1.4. Section D. Flying Operations.
- 8.1.5. Section E. Weapons Employment.
- 8.1.6. Section F. Abnormal Procedures.
- 8.1.7. Attachments (Illustrations).

8.2. If Applicable Procedures. If applicable, include procedures for the following in the appropriate section above:

- 8.2.1. Command and Control.
- 8.2.2. Fuel Requirements and Bingo Fuels.
- 8.2.3. Diversion Instructions.
- 8.2.4. Jettison Areas, Procedures and Parameters (IFR/VFR).
- 8.2.5. Controlled Bailout Areas.
- 8.2.6. Local Weather Procedures.
- 8.2.7. Unit Standards.
- 8.2.8. Approved Alternate Missions.
- 8.2.9. Cross-Country Procedures.
- 8.2.10. Search and Rescue and On-Scene Commander Procedures.
- 8.2.11. Bird/Wildlife Aircraft Strike Hazard (BASH) program guidance per DAFI 91-202, and DAFI 91-212.
- 8.2.12. Environmental Restrictions to Flight Operations (winds, sea state, temperature, etc.) applicable to unit operating locations.

8.3. Distribution of Local Supplements. When published, units will forward copies of the local supplement to MAJCOM and appropriate subordinate agencies, who will review and return comments back to the unit(s). **(T-2)** Distribution of local supplements may begin before the review process is complete unless otherwise specified by MAJCOM or appropriate subordinate agency. If a procedure is deemed applicable to all F-22A units, it will be incorporated into the basic AFMAN volume.

CASE A. CUNNINGHAM, Lt Gen, USAF
Deputy Chief of Staff, Operations

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

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AFH 11-203V1, *Weather for Aircrews*, 12 January 2012

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AFI 33-322, *Records Management and Information Governance Program*, 23 March 2020

AFMAN 11-202V2, *Aircrew Standardization and Evaluation Program*, 30 August 2021

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AFMAN 11-202V3_ACCSUP, *Flight Operations*, 8 November 2022

AFMAN 11-214, *Air Operations Rules and Procedures*, 29 November 2022

AFMAN 11-218, *Aircraft Operations and Movement on the Ground*, 5 April 2019

AFMAN 11-246V1, *Air Force Fighter Type Aircraft Demonstrations (A-10, F-16, F-22, F-35)*, 18 March 2022

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AFMAN 11-301V2, *Management and Configuration Requirements for Aircrew Flight Equipment (AFE)*, 13 February 2020

AFMAN 11-404, *Fighter Aircrew Acceleration Training Program*, 27 November 2019

AFPAM 11-205, *Aircrew Quick Reference to Aircraft Cockpit and Formation Flight Signals*, 9 August 2018

AFPD 11-2, *Aircrew Operations*, 31 January 2019

AFTTP 3-1.*Shot Kill*, 18 August 2023

AFTTP 3-1.F-22A, *Tactical Employment F-22A*, 22 September 2023

AFTTP 3-2.5, *Multi-Service Tactics Techniques and Procedures for Brevity Codes*, 7 March 2023

AFTTP 3-3.F-22A, *Combat Aircraft Fundamentals F-22A*, 22 September 2023

AFTTP 3-4, *Airman's Manual*, 26 September 2022

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DAFMAN 90-161, *Publishing Processes and Procedures*, 18 October 2023

DAFI 11-209, *Participation in Aerial Events*, 20 May 2021

DAFI 21-101, *Aircraft and Equipment Maintenance Management*, 20 December 2023

DAFI 21-103, *Equipment Inventory, Status and Utilization Reporting*, 1 November 2022

DAFI 91-202, *The Department of the Air Force (DAF) Mishap Prevention Program*, 20 March 2020

DAFI 91-212, *Bird/Wildlife Aircraft Strike Hazard (BASH) Management Program*, 13 April 2023

DoD FLIP, *Area Planning*, updated cyclically

DoD FLIP, *Chart Supplement*, updated cyclically

DoD *Flight Information Publications (FLIP)*, updated cyclically

F-22A, *Ready Aircrew Program Tasking Memorandum*, updated annually

FAA, *Airman's Information Manual*, updated cyclically

FAA Order JO 7930.107, *Field Condition (FICON) Reporting*, 1 October 2016

HQ ACC, *F-22A Minimum Essential Subsystem List (MESL)*, 9 November 2023

NATO ATP 3.3.4.2., *Air-to-Air Refuelling, Edition D Version 1*, April 2019; at Air-to-Air Refueling Home – Joint Air Power Competence Centre

NATO ATP 3.3.4.2., *US Standards Related Document*, 16 January 2024

TO 1F-22A-1, *Flight Manual—F-22A*, updated periodically

TO 1F-22A-34-1-1, *Nonnuclear Weapons Delivery Flight Manual—F-22A*, updated periodically

Prescribed Forms

None

Adopted Forms

DAF Form 679, *Department of the Air Force Publication Compliance Item Waiver Request/Approval*

DAF Form 847, *Recommendation for Change of Publication*

DD Form 1801, *International Flight Plan*

Abbreviations and Acronyms

AB—After Burner

ABOS—Automatic Backup Oxygen System

ACA—Aerospace Control Alert

ACC—Air Combat Command

ACCI—Air Combat Command Instruction

AFE—Aircrew Flight Equipment

AFH—Air Force Handbook

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFTTP—Air Force Tactics, Techniques and Procedures

AFPD—Air Force Policy Directive

AGCAS—Automatic Ground Collision Avoidance System

AGL—Above Ground Level

AGSM—Anti-G Straining Maneuver

AIM—Aeronautical Information Manual

ATC—Air Traffic Control

ATP—Allied Tactical Publication

BASH—Bird/Wildlife Aircraft Strike Hazard

BRNAV—Basic Area Navigation

CBRNE—Chemical, Biological, Radiological, Nuclear, and High Yield Explosive

DAF—Department of the Air Force

DAFI—Department of the Air Force Instruction

DAFMAN—Department of the Air Force Manual

DoD—Department of Defense

DRU—Direct Reporting Unit

EFB—Electronic Flight Bag

e.g.—exempli gratia (for example)

etc.—etcetera

FAA—Federal Aviation Administration

FE—Flight Examiner

FICON—Field Condition

FL—Flight Lead

FLxxx—Flight Level xxx

FLIP—Flight Information Publication

FOA—Field Operating Agency

FOD—Foreign Object Damage

FT—Foot/Feet

G—Gravitational—Load Factor

GPS—Global Positioning System/Inertial Navigation System

GLOC—**G**—Induced Loss of Consciousness

HAF—Headquarters United States Air Force

HAS—Hardened Aircraft Shelter

HUD—Heads-Up Display

IAW—In Accordance With

ICAO—International Civil Aviation Organization

i.e.—id est (that is)

IFF—Identification Friend or Foe

IFR—Instrument Flight Rules

IMC—Instrument Meteorological Conditions

IP—Instructor Pilot

KCAS—Knots Calibrated Airspeed

KIO—Knock-It-Off

KM—Kilometers

LOWAT—Low Altitude Training

LOX—Letter of Qualifications

MAJCOM—Major Command

mm—Millimeter

MNPS—Minimum Navigation Performance Standard

MOPP—Mission Oriented Protective Posture

MSA—Minimum Safe Altitude

MSL—Mean Sea Level

NATO—North Atlantic Treaty Organization

NM—Nautical Miles

NORDO—No Radio

NVD—Night Vision Device

OPR—Office of Primary Responsibility

Ops—Operations

PSI—Pounds per Square Inch

RCR—Runway Condition Reading

RNAV—Area Navigation

RNP—Required Navigation Performance
RVSM—Reduced Vertical Separation Minimum
SARCAP—Search and Rescue Combat Air Patrol
SD—Spatial Disorientation
SFG—Standby Flight Group
Stan/Eval—Standardization and Evaluation
T—Tier—TACAN—Tactical Air Navigation
TERPS—Terminal Procedures
TOLD—Takeoff and Landing Data
TO—Technical Order
USAF—United States Air Force
VFR—Visual Flight Rules
VMC—Visual Meteorological Conditions
WG—Wingman

Office Symbols

ACC/A3—Air Combat Command Director of Operations
ACC/A3TO—Air Combat Command Flight Operations and Training Branch
ACC/A3TV—Air Combat Command Standardization and Evaluation Branch
AF/A34—Air Force Command and Control Division
AFFSA/XOF—Air Force Flight Standards Agency Flight Directives
MAJCOM/A3—Major Command, Director of Operations
OG/CC—Operations Group Commander

Terms

Other References—See AFMAN 11-214, AFMAN 11-2F-22AV1, AFTTP 3-1.F-22A, AFTTP 3-3.F-22A, and AFTTP 3-2.5, *Multi-Service Tactics Techniques and Procedures for Brevity Codes* for further clarification on definitions/terms throughout the publication. If there is a conflict, AFMAN 11-214 will take precedence.

Pilot Reported Braking Action (Braking Action)—Control/braking assessment criteria as determined by the FAA on non-Air Force airfields.

AGCAS “paddle-off”—Action of depressing the vertical bar at the base of the flight control stick. Commonly known as the paddle switch.

Attachment 2

BRIEFING GUIDES

A2.1. General and Specific Briefing Guides. Guides are meant to highlight flight briefing considerations and provides a reference for coordination and mission briefings.

A2.2. General Briefing Guide. See specific briefing guides below for details for the type of mission being flown.

Table A2.1. Briefing Guide.

MISSION DATA 1. Time Hack and Briefing Classification 2. Emergency Procedure/Threat of the Day 3. Mission Objective(s) 4. Mission Overview 5. Mission Data Card a. Mission Commander/Deputy Lead b. Joker/Bingo Fuel c. Takeoff and Landing Data (as required: short/wet/icy runway, heavy gross weights, external fuel tank configurations, high-density altitude and non-standard cable configurations) d. AGCAS Settings e. Working Area 6. Weather/Sunrise/Sunset/Moon Illumination 7. Notice to Airmen (NOTAMs)/Bird Strike Potential 8. Personal Equipment 9. Flight Crew Information File (FCIF)/Pubs/Maps GROUND PROCEDURES 1. Intelligence Update 2. Step 3. Pre-Flight a. Aircraft b. Armament 4. Start/Check-In 5. Arming/Taxi/Marshaling 6. Spare Procedures 7. FOD Hazard Areas TAKEOFF 1. Runway Lineup 2. Takeoff/Takeoff Interval 3. Abort	RECOVERY 1. Rejoin 2. Battle Damage Check 3. Type Recovery 4. Flight Break-Up 5. Pattern and Landing 6. After Landing/De-Arm 7. Emergency/Alternate Airfields SPECIAL SUBJECTS (as applicable) 1. General Roles and Responsibilities (FE, IP, Flight Lead, Wingman) 2. Formation Specific Responsibilities and Priorities 3. Flight Member Mission Priorities 4. Task/Sensor Prioritization 5. Deconfliction Contracts 6. Fallout/Late Rejoin 7. Chase Procedures 8. IFF/IFFI/Mode 5 Procedures 9. Radar/Visual Search Responsibilities/Midair Collision Avoidance 10. Sensor/Visual Search Responsibilities 11. Departure/Enroute/Recovery a. High Density Traffic Areas b. Mid-Air Collision Avoidance from Other Military Aircraft, From Civilian Aircraft 12. Dissimilar Formations 13. Carriage/Jettison Limitations 14. Terrain Avoidance/Use of Controlled Flight into Terrain Prevention Systems a. Departure/Enroute/Recovery b. Altitude Warning Settings 15. Bird Strike Procedures/Use of Visor(s)
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4. Jettison Procedures 5. Low Altitude Ejection 6. Landing Immediately After Takeoff DEPARTURE/ENROUTE 1. Routing 2. Trail Departure 3. Join-Up/Formation 4. Systems/Ops Checks AIRSPACE 1. Area 2. Times 3. Restrictions, (Electronic Attack/Electronic Protection, (EA/EP)/Chaff/Flare/Supersonic), Bailout (Controlled/Uncontrolled) 4. MSA	16. Hazards Associated with Human Factors (e.g., Channelized Attention, Task Saturation/Prioritization, and Complacency) 17. G-Awareness a. G-Suit connection/G-tolerance/G-Awareness Turn b. Use of Anti-G Straining Maneuver 18. Visual Illusions/Perceptions 19. Spatial Disorientation/Unusual Attitudes 20. Lost Wingman 21. Radio Inoperative 22. SAR/On-Scene Commander 23. Recall Procedures 24. Special Interest Items 25. Pilot currencies for events to be flown TRAINING RULES/SPECIAL OPERATING INSTRUCTIONS/ALTERNATE MISSION (refer to appropriate mission briefing guide) 1. Operational Risk Management 2. Assessment, hazards to this flight a. Factors mitigating risk b. When to reassess 3. Tactical Portion of Mission
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Table A2.2. Mission Debriefing.

GENERAL 1. Ground Ops 2. Takeoff 3. Join-up/ Departure/ Enroute 4. Recovery/ Landing/ After Landing 5. Special Interest Items/Training rules/ROE 6. Radio Procedures 7. Flight Discipline/ Effectiveness	MISSION ACCOMPLISHMENT/ANALYSIS 1. Mission Reconstruction 2. Debrief Focus Point(s) 3. Portable Memory Device Assessment 4. Anti-G Straining Maneuver Effectiveness 5. Objectives Analysis 6. Debrief Focus Points/ Root Cause/ Instructional Fixes (as applicable) COMMENTS/QUESTIONS
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Table A2.3. Instrument/Advanced Handling.

AIRWORK 1. Airspace Restrictions 2. Area Orientation 3. Instructor Responsibilities 4. Maneuvers	SPECIAL SUBJECTS 1. "G" Awareness 2. Fuel Awareness/AB /Consumption Rates 3. Special Subjects and Maneuvering Limitations a. Airspeed and "G" limits
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APPROACHES 1. Frequencies 2. Holding 3. Penetration 4. Missed Approach/Climb Out	b. Recognition/Prevention/Recovery from Out of Control c. Maneuvering at Heavyweight/ High Angles of Attack/ Asymmetrical Configuration d. Effects of “CG” throughout the flight e. Low Altitude Time to Ground Impact (1) Wings Level (2) Overbank/Under G 4. Hazards Associated with Human Factors (e.g., Channelized Attention, Task Saturation/Prioritization, and Complacency)
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Table A2.4. Air Refueling.

GENERAL 1. Tanker Callsign(s)/Receiver Assignments 2. Refueling Track(s) a. Altitude b. Airspeed c. Airspace Restrictions 3. Air refueling initial point(s), contact point(s), contact time(s) 4. Radio Frequencies BUDDY PROCEDURES 1. Departure 2. Join-Up ENROUTE 1. Route of Flight 2. Formation 3. Ops Checks RENDEZVOUS 1. Type Rendezvous 2. Holding Procedures/Formation 3. Ground Radar Assistance 4. Tanker Identification – Tactical air navigation (TACAN)/Radar/IFFI/Visual 5. Radar Procedures/Techniques 6. Wingman/Deputy Lead Responsibilities 7. Receiver Formation/Join-Up Procedures 8. Rendezvous Overrun REFUELING 1. Checklist Procedures	4. Techniques 5. Radio Silent Procedures a. Emissions control (EMCON) b. Visual Signals 6. Fuel Off-Load 7. Bingo Fuel (Abort Points/Abort Bases) 8. Drop-Off Procedures 9. Wake Turbulence REFORM AND EXIT 1. Formation 2. Clearance EMERGENCY PROCEDURES 1. Breakaway Procedures 2. Systems Malfunctions 3. Damaged Receptacle IMC/NIGHT CONSIDERATIONS 1. Lost Wingman Procedures 2. Aircraft Lighting 3. NVG Procedures SPECIAL SUBJECTS 1. Fuel Awareness/AB Use/Consumption Rates 2. Flight Path Deconfliction/Other Receiver Considerations 3. Hazards Associated with Human Factors (e.g., Channelized Attention, Task Saturation/Prioritization, and Complacency)
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2. Radio Calls 3. Refueling Order	
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Table A2.5. Adversary Coordination.

MISSION DATA 1. Time Hack and Classification of Briefing 2. Call signs, Number and Type Aircraft 3. Scenario/area of responsibility discussion 4. Objectives: Blue, Command and Control, Intel/Space, Red, Cyber, Other 5. Weather/NOTAMS 6. Mission Overview GROUND PROCEDURES 1. Taxi/Marshall/Arming deconfliction and timing 2. Check-in time/Freq 3. Minimum numbers 4. How much delay is available TAKEOFF AND DEPARTURE 1. Times 2. Military assumes responsibility for separation of aircraft (MARSA) options 3. Departure Routing 4. Weather Check 5. Late entries AREA 1. Airspace times 2. Restrictions a. Altitude b. Supersonic c. Chaff/Flare d. Noise Sensitive 3. Points/Marshall and Cap Limit Lines 4. Average terrain (Controlled/Uncontrolled bailout altitudes) 5. Ground references 6. Emergency airfields RECOVERY 1. Order/MARSA 2. Dissimilar formations	COORDINATION LADDER 1. Special Instructions/Setups 2. Red-air replications 3. Regeneration criteria FIGHT ADMINISTRATION 1. Desired Setup Range (if applicable) 2. Fight's On/Knock-it-off per engagement or Continuous Vulnerability window 3. Vulnerability window times (if applicable) 4. Timeout/Kill criteria a. Range Training Officer (RTO)/Non-RTO b. Probability of Kill Option (IAW AFTTP 3-1. <i>Shot Kill</i>) c. Timeout, Timeout Tally and Kill Passage, acknowledgement, relays and repeats d. Kill removal procedures 5. Terminate (reasons and procedures) 6. Knock-it-off (reasons and procedures) TRAINING RULES 1. IAW AFMAN 11-214 2. Highlights a. Maneuvering limits (limited/unlimited) b. Bubble c. Blocks d. LOWAT transition altitude (if applicable) e. Floor CONTINGENCIES 1. Weather 2. Airborne Warning and Control System (AWACS)/ Control and Reporting Center (CRC) control fallout 3. Aircraft fallout (minimum numbers) 4. Alternate missions DEBRIEF 1. Time/Location 2. Required information
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ABNORMAL PROCEDURES 1. EPs (Like/dissimilar aircraft) 2. Cruise/Gear/Final Approach Airspeeds 3. NORDO 4. Lost Wingman 5. SAR combat air patrol (SARCAP)	QUESTIONS
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Table A2.6. Tactical Intercepts.

GENERAL 1. Area Information a. Threats / CAP Points b. Target Locations c. Bullseye location and cuts of critical points d. Radar and Communication blind zones e. Safe Areas/forward edge of the battle area/Ground Threats f. Friendly Surface to Air Missile Locations 2. Threat Type and Simulation 3. ID Criteria 4. Communications a. Requirements (other than AFTTP 3-1) b. Type/Level of Control c. Frequencies d. IFF squawk and procedures 5. Training Rules a. Blocks b. Floor/Transition altitude FLIGHT/ELEMENT TACTICS 1. Fill-ins a. Contrail altitude b. Winds aloft c. Ordnance d. Reload criteria for training e. ID criteria and method(s) f. EMCON procedures 2. Avionics Set-up a. Radar Elevation b. Waypoints/Route c. IFF d. IFDL e. RW/EW Scan Schedules/Search Volumes 3. CAP	4. Intercept Phase a. Formation/Altitude/Airspeed b. Detection c. ID Criteria d. Search Responsibilities (Radar/Visual) e. Targeting Plan f. Tactic (1) Execution (2) Formation (3) Low Observable Considerations 5. Engagement Phase a. Shot doctrine and mechanics b. MAR Penetration Decision c. Recommits d. Egress Formation/Responsibilities 6. Contingencies a. Avionics Malfunction(s) b. Electronic Warfare Fail/Degrade EXCM c. IFF and Min-risk Routing d. Low Fuel/Ordnance e. Rendezvous point 7. Live Missile/Hot Gun Safety Procedures 8. Additional Considerations a. Threat Reaction b. Code words c. Electromagnetic Interference (EMI)/ EP/ EA Effects
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a. Formation/Altitude/Airspeed b. Search Responsibilities c. Commit (1) Criteria/Range (2) Procedures (3) Low Observable Considerations	
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Table A2.7. Offensive Counter Air - Escort.

Enroute to Rendezvous/Post-mission NAVIGATION 1. Formation 2. Route of Flight 3. Control Agency Call sign/Frequency RENDEZVOUS 1. Protected Force Call sign 2. Altitude 3. Airspeed 4. Number of Aircraft ESCORT PROCEDURES 1. Striker Ingress a. Route(s) b. Formation c. Altitude d. Airspeed e. Primary/Secondary target locations and time over targets f. Tactics/EMCON 2. Type Formation 3. Tactics 4. Low Observable Considerations	4. Commit a. Criteria/Range b. Procedures 5. Escort Route 6. Contracts a. Targeting Strikers b. Lean/Spin procedures 7. Egress a. Tactics b. Formation 8. Contingencies a. Avionics Malfunction b. Electronic Warfare Fail/Degrade c. EXCM d. IFF and Min-risk Routing e. Low Fuel/Ordnance f. Rendezvous point 9. Additional Considerations a. EMI/EP/EA Effects
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Table A2.8. Aerial Gunnery Tow Coordination. Aerial gunnery target tow considerations and provides a reference for coordination of an air-to-air, 20mm gun target tow safety briefing.

GENERAL 1. Ground/Takeoff/Departure 2. Rendezvous 3. Airspace Data 4. GCI Support 5. Target Launch/Chase EMPLOYMENT 1. Shooter Order 2. Type Pattern	11. Armament Safety Check 12. Scoring 13. Subsequent Set-Ups 14. Target Drop Procedures 15. Recovery Order ABORMAL PROCEDURES 1. Erratic Target a. During Deployment b. During Employment
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3. Tow Altitude Block(s)/Flight Parameters 4. Intercept Phase/Pattern Set-Up 5. Arming Procedures 6. Timing 7. Tow Maneuvering Parameters 8. Shooter/Firing Plan 9. Radio Procedures 10. Termination a. Timing b. Minimum Altitude c. Joker/Bingo Fuel d. Winchester e. Fouls	2. Target Drag-Off 3. Recovery with Target/Cable 4. NORDO a. During Engagement b. Target Drop c. Visual Signals d. Recovery
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Table A2.9. Aerial Gunnery. Aerial gunnery employment.

GENERAL 1. Formation 2. Area Information a. Controlling Agency b. Airspace Restrictions c. Frequencies 3. Switch Positions 4. Arming Procedures 5. Intercept/Set-Up 6. Shooter Sequence 7. Position Changes 8. Chase Procedures 9. Timing EMPLOYMENT 1. Firing Parameters a. Minimum Range b. Overtake c. Angle-Off d. Error Analysis 2. Contingencies a. Avionics Malfunctions b. Gun Malfunctions c. Range Estimation without Radar 3. Safety Considerations a. Target Fixation b. Debris Avoidance c. Fouls	TRAINING RULES/SPECIAL OPERATING INSTRUCTIONS/ALTERNATE MISSION 1. Type Mission (refer to appropriate mission briefing guide) 2. Mission Objectives SPECIAL SUBJECTS 1. Minimum Altitudes 2. "G" Awareness 3. Fuel Awareness/Ops Checks/AB Use/Consumption Rates 4. Maneuvering Limitations a. Airspeed/"G" limits/Stress b. Recognition/Prevention/Recovery from Out of Control 5. Hazards Associated with Human Factors (e.g., Channelized Attention, Task Saturation/Prioritization, and Complacency)
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Table A2.10. Low-Level Navigation.

GENERAL	EMERGENCIES
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1. Route/Clearance/Restrictions 2. Flight Responsibilities a. Navigation b. Radar/Visual Search 3. Entry/Spacing /Holding/Initial Altitude (MSA) ROUTE PROCEDURES 1. Fence Checks 2. Tactical Formation/Turns 3. Low Level Navigation a. Dead Reckoning/Use of Navigation Aids/Equipment (i.e., GINS) b. Sensor Procedures/Techniques c. Visual Procedures/Techniques d. Updates/Calibrations e. Time/Fuel Control f. Terrain Following/Avoidance/Wingman Considerations g. Leg Altitudes/Obstacle Avoidance (MSL/AGL) h. Use of Altitude Warning Features 4. Threat Reactions a. Radar Warning/Electronic Warfare/Expendable Countermeasures b. Engagement Criteria c. Flight Path Deconfliction d. Termination	1. Aircraft Malfunctions 2. Route Abort Procedures (RAA/MSA)/ATC Frequencies TRAINING RULES/SPECIAL OPERATING INSTRUCTIONS/ALTERNATE MISSION 1. Type mission (refer to appropriate mission briefing guide) 2. Mission objectives SPECIAL SUBJECTS 1. Airspace Restrictions 2. Fallout/Late Rejoin 3. "G" Awareness/Ops Checks 4. Fuel Awareness/AB Use/Consumption Rates 5. Flight Path Deconfliction 6. Maneuvering Limitations a. Airspeed and "G" limits b. Recognition/Prevention/Recovery from Out of Control 7. Time to Ground Impact a. Wings Level b. Overbank/Under "G" 8. Night Considerations 9. Hazards Associated with Human Factors (i.e., Channelized Attention, Task Saturation/Prioritization, and Complacency)
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Table A2.11. Aerospace Control Alert. This ACA guide is all-inclusive and is designed to incorporate all the applicable items from the General Briefing Guide.

MISSION DATA 1. Time Hack and Classification of Briefing 2. Mission Data Card a. Call signs b. Aircraft/Location/Status c. Takeoff/Landing Data (worst case, as required: short/wet/icy runway, heavy gross weights, external fuel tank configurations, high-density altitude and non-standard cable configurations) d. Joker/Bingo Fuel 3. Actual/Forecast Weather a. Home base	IN-FLIGHT PROCEDURES 1. Formation 2. Airspeeds 3. Weapons Safe Checks 4. Sensor Search Responsibilities 5. Degraded Fire Control System 6. Transfer of Lead Procedures 7. Ops Checks 8. EMCON Procedures 9. Region MSA 10. Visual ID Procedures a. Authority Required to Close b. Formation/Tactics
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b. Alternates c. Individual Weather Category/Mandatory Status 4. NOTAMs 5. FCIF/Pubs/Maps 6. Personal Equipment 7. Alert Packet a. Authenticators/Duress Code b. Security Procedures 8. Airfield Status a. Actual versus Max Allowable Tailwind b. Barriers c. Navigation Aids d. Hazards to Taxi/RCR GROUND PROCEDURES 1. Aircraft/Armament Preflight 2. Cockpit Set-Up 3. Engine Run/Hot Preflight 4. Crew Chief Briefing a. Act only on pilot's instructions b. Ground emergency procedures c. Hand signals d. Aircraft danger areas 5. Quick Check Procedures LAUNCH PROCEDURES 1. Notification/ Frequency/Authentication Requirement 2. Status a. Airborne Order b. Battle Stations c. Runway Alert d. Scramble 3. Taxi 4. Takeoff/Runway Lineup/Interval/Formation a. Day VMC/IMC b. Night VMC/IMC 5. Join-up/Trail Formation/Power Settings/Airspeeds	c. Range/Altitude Separation Requirements on Target Prior Permission to Close With/Without Visual Contact d. Sensor Lock-On Requirements e. Maximum Closure Speed f. Minimum Airspeed g. Loss of Contact Procedures h. Breakaway Procedures i. Restrictions 11. Aircraft in Distress a. Minimum Closure Distance b. Visual Signals - Day/Night c. Escort Procedures d. Recovery/Landing Visual Signals e. Dissimilar Formation Procedures 12. Jettison Procedures 13. Lost Wingman 14. SARCAP 15. Emergency Airfields SPECIAL SUBJECTS 1. Emergency of the Day 2. Fuel Awareness 3. Maneuvering Limitations 4. Recognition/Prevention/Recovery from Loss of Control 5. Spatial Disorientation 6. Recall Procedures 7. Rules of Engagement 8. Hazards Associated with Human Factors (e.g., Channelized Attention, Task Saturation/Prioritization, and Complacency) 9. Special Interest Items 10. Operational Risk Management a. Assessment, hazards to this flight b. Factors mitigating risk c. When to reassess
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Table A2.12. Night Vision Device.

WEATHER/ILLUMINATION 1. Civil/Nautical Twilight 2. Moon Rise/Set Times/ Phase/ Elevation/ Azimuth	TARGET AREA 1. Holding Procedures (NVD Differences) 2. NVD Lost Wingman 3. A/G Deliveries/Pattern Procedures
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3. Ceiling/Visibility 4. Illumination/Electro optical tactical decision aid 5. Obscurants to Visibility NVD PREFLIGHT 1. Check Adjustments/Helmet Fit and Security 2. Batteries 3. Resolution/Focus 4. NVD Compatible Flashlight COCKPIT PREFLIGHT 1. Cockpit Setup 2. Cockpit Lighting (Leaks) 3. Cockpit Familiarization 4. Check Focus and Stow for Taxi BEFORE TAKEOFF 1. Don NVDs/Check and Adjust/Disconnect 2. Stow for Takeoff AIRBORNE 1. Exterior Lights 2. Donning and Doffing Procedures 3. NVD Scan Pattern a. Forward Scan b. Narrow Field of View c. Peripheral Vision d. Scan Techniques 4. Join-up and Enroute Considerations a. Rejoin/Closure b. Intraflight Datalink (IFDL)/ air-to-air TACAN c. G-Awareness Considerations (1) Lighting (2) Deconfliction/Separation MISSION 1. Route Study/Scene Interpretation a. NVD Predictions/Albedo b. Terrain/Shadowing/Visual Illusions/Visible Horizon c. City/Cultural Lighting (1) Direction/Orientation of Lighting (2) Aggressive Formation Maneuvering (3) Terrain Avoidance	a. Minimum Altitudes b. Flight Member Responsibilities c. Moth Effect d. Deconfliction e. External Lighting/Deconfliction Procedures 4. AB, Flares, and IR Detection Considerations 5. Threat ID and Reaction 6. Egress RTB - NVD off for landing NVD SAFETY 1. NVD Lost Sight 2. NVD Lost Wingman 3. Depth Perception 4. Visual Illusions 5. NVD Failure 6. Battery Failure/Swap Out 7. Overconfidence in NVD Capabilities 8. Transition to/from NVD and degraded acuity operations 9. Entering Weather/Transition to Instruments 10. Correct Lighting of Primary/Secondary Flight Instruments 11. Disorientation/Misorientation/Vertigo 12. Deconfliction contracts 13. Transference 14. Target Fixation 15. Lack of dive dues 16. Fatigue 17. Aircraft EP and NVD battle damage check considerations 18. Ejection/Goggles Off 19. Laser Eye Protection Use 20. NVD Foreign Object Damage Considerations (Batteries, Equipment, Filters, etc.)
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(4) Map Reading	
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Table A2.13. Ground Crew Briefing.

GENERAL 1. Act only on pilot's instructions 2. Ground emergency procedures 3. Hand signals 4. Aircraft danger areas	
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Table A2.14. Offensive Counterair – Attack Operations / Air to Surface.

GENERAL 1. Intelligence, Threat Scenario 2. Operating Area, Description, Boundaries 3. FENCE Checks 4. Enroute Formation(s), Look Out Responsibilities, Low-Level/LOWAT Brief 5. Low Observable Considerations 6. A/G Ordnance/Weapons Data a. Type, Fusing b. Weapons Settings c. Live Ordnance Procedures, Minimum Altitudes d. Fuse Arming, Safe Escape, Safe Separation e. Frag Avoidance (if required) 7. Control Agencies a. Call signs b. Frequencies c. Authentication, Authority 8. Coordination a. Attack Package Times, Support b. Data Gathering, Transmission c. Airspace Restrictions d. Mission Number e. Friendly Forces f. Play Time 9. Ingress a. Formation b. Route of Flight c. Control Agency Call sign/Frequency 10. Threats a. Type b. Numbers c. Threat reactions 11. Low Observable considerations	AIR-TO-AIR TACTICS 1. Detection 2. Identification (ID) Criteria 3. Search Responsibilities (Sensor/Visual) 4. Targeting Plan 5. Tactic a. Execution b. Formation 6. Engagement a. Shot doctrine and mechanics b. Base/Minimum Abort Range (MAR) Crossing Decisions c. Recommits EGRESS a. Tactics b. Formation c. Rendezvous point CONTINGENCIES 1. One/Two/Three-Ship Options 2. Code Words, Comm Out Signals 3. Weather / Back-Up Deliveries 4. Reattack 5. Jettison Procedures/Parameters 6. Hung/Unexpended Ordnance Procedures 7. Wounded Bird, Escort Procedures 8. Low Fuel/Ordnance 9. Degraded Avionics / Systems a. Radar / data link b. RW c. EXCM d. IFF, Min-risk Routing
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ATTACK 1. Target type(s) 2. Weaponeering required 3. Weapon / Fuze Settings 4. DPI Sort 5. Release Criteria 6. Attack Contingency a. Degraded weapon state (INS) b. Reattack (formation/procedures) 7. Egress Flow	
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