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# KC-135 CREW REDUCTION FEASIBILITY DEMONSTRATION SIMULATION STUDY VOLUME 1: FUNCTION ANALYSIS AND FUNCTION REALLOCATION

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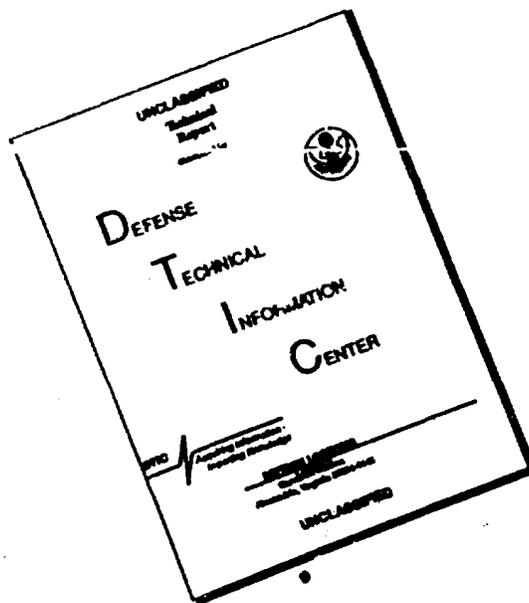
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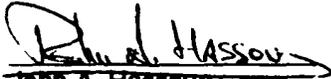
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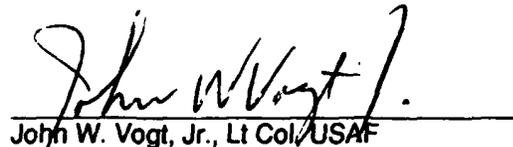
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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A function analysis of the four-person crew KC-135 and function reallocation to a three-person crew were completed in support of the KC-135 Avionics Modernization program. This report is volume one of a three-volume technical report. This effort provided a distribution of functions between automation concepts and the remaining three crewmembers. The function redistribution and automation concepts served as a baseline for a crew station design group to design a cockpit configuration for a three-person crew KC-135 (Vol II). This configuration was then implemented in a simulator at the Crew Station Evaluation Facility (CSEF) for a comprehensive man-in-the-loop simulation evaluation (Vol III). The function analysis and reallocation were the first step towards modifying the KC-135 cockpit and will be instrumental in future KC-135 efforts.

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# BACKGROUND

As the budget deficit continues to grow, government dependent programs are being asked to do more with less. Within the Department of Defense (DOD), the Air Force has scaled back its acquisition activities and has instituted several programs to reduce the size of the force. Part of this personnel reduction effort involved the KC-135. Specifically, can the crew size in the KC-135 be reduced feasibly from four people to three people? HQ SAC/XRH sought to answer this question, and via ASD/SDB requested support from the Crew Station Evaluation Facility (CSEF) in a message (number 90280) dated 11 Oct 90.

The CSEF is an U.S. Air Force simulation facility that belongs to the Aeronautical Systems Division (ASD) of Air Force Systems Command, at Wright-Patterson AFB, Ohio. The CSEF government personnel are assigned by the Crew Systems Division (ASD/ENEC). The facility performs human engineering evaluations in support of a variety of System Program Offices (SPOs).

The KC-135 crew reduction issue has been addressed several times in the past. Geiselhart, Schiffler, and Ivey (1976) conducted a series of flight tests to assess the feasibility of reducing crew size. A dual INS was installed in the test aircraft and workload was prohibitively high with a three man crew in an Emergency War Order (EWO) scenario. Schiffler, Geiselhart and Ivey (1976) reviewed task analysis documents and conducted a series of flight tests. It was concluded that crew workload was too high during various mission segments, hence, maintaining a four man crew was recommended. Barbato, Madero, Sexton, Moss, and Brandt (1980), performed a mockup cockpit design study to determine the avionics control and display criteria needed if the crews were to successfully fly the given mission. The study incorporated reallocated crew functions and used 1980 state-of-the-art systems including a navigation management system, electronic horizontal situation/multipurpose displays and upgraded avionics systems. Results indicated that the subject crews would strongly support a reduced crew size only if the present cockpit hardware was updated and relocated. Madero, Barbato, and Moss (1981) used prior analysis and mockup evaluations to determine desirable and undesirable characteristics of three designs. The results of the mockup evaluations were used to develop a "composite" configuration which was evaluated in a full mission simulation. The simulation validated the acceptability of the composite configuration and verified that the KC-135 mission could successfully be accomplished using a three man crew. In short, results from prior evaluations are mixed. Some researchers found that workload reaches unacceptably high levels when one crew member is eliminated, while others concluded that given the appropriate equipment and design changes KC-135 missions are unaffected by the reduced crew size. The present analysis effort is the first of a three-phase feasibility demonstration. Phase II is system design, and Phase III, simulation, test and evaluation, is a direct result of Phases I and II.

# INTRODUCTION

The primary focus of this analysis phase (Phase I) was to complete a function analysis of the four KC-135 crew positions, and recommend function reallocation including certain automation concepts that can be integrated into a three man crew KC-135 configuration. The function analysis was comprehensive and examined the following: the functions performed during various phases of flight, a breakdown of the functions to the task level, inputs needed to perform each task, equipment needed to perform the task, sensory modality being used for task performance, control inputs and their effects, common errors, task criticality, training required to proficiently perform each task, the time needed to perform each function, and workload associated with each function. The function analysis/reallocation was accomplished in three steps: (1) the construction and validation of task listings for each KC-135 crew position, (2) the performance of function analysis for each crew position, and (3) the reallocation of the navigator's functions among the remaining crewmembers and automation concepts. Crews supporting this effort flew either the KC-135A, E, or R model. Procedural differences do exist between models, but for the purposes of this function analysis, the differences were insignificant.

# STEP 1 - TASK LISTINGS

A current task listing of all KC-135R crew positions was collected to serve as a basis for the entire effort.

## METHOD

The CSEF obtained a listing of each KC-135 crewmember's tasks from the 93 BMW/DO5 at Castle AFB. This task listing was constructed in the fall of 1989 and included tasks for the KC-135 A-, Q-, and R-model aircraft. Two CSEF engineers were sent to Castle AFB from 5 Nov to 9 Nov 90 to interview crewmembers from each crew position in order to update and verify the task listing. Flight crew checklists and T.O. 1C-135(K)R-1 were also used to construct the comprehensive task listing for each crewmember. The working definition of a task employed by the CSEF engineers was: "the uninterruptible crew activities that are required for the successful completion of a function." The CSEF engineers interviewed five pilots/copilots, two navigators, and seven boom operators from the 330 CFIS. The pilots/copilots averaged 2,880 hours (standard deviation=249.0 hours) and 9.4 years flying time in the KC-135. Navigators averaged 1,875 hours (standard deviation=176.8 hours) and 9 years, and boom operators averaged 3,386 hours (standard deviation=933.5 hours) and 11.1 years flying time in the KC-135. While validating the task listings, shown in Appendix A, CSEF engineers also began the boom operator function analysis. A detailed description of the function analysis is provided in the "Function Analysis" section.

### Mission Scenario

For the task listings, function analysis, and function reallocation, a mission scenario was provided to give the interviewers and crewmembers a realistic mission context. The scenario used in this evaluation was developed using inputs from HQ SAC/XRH personnel, ASD/SDB personnel, crew members from Castle Air Force Base (AFB) and Wurtsmith AFB, and the Barbato et al., (1980) document entitled "Tanker Avionics/Aircrew

Complement Evaluation (TAACE), Phase O - Analysis and Mockup, Volume III: **Mission Scenario."**   A written description of the scenario is provided below:

> You are the #2 aircraft in a 2-ship Cell/MITO leaving Mildenhall.  You will be carrying support cargo and a crew chief.  Your mission is to refuel F-4s over the Baltic Sea (assume no radar returns) in confined airspace.  There is one refueling track, and a point parallel rendezvous will be used.  The F-4s arrive late.  After refueling, you head toward Fairford, your intended recovery base.  Due to weather throughout the region, you are directed to recover to Zaragosa.  After planning the divert, the lead navigator's equipment goes out and the #2 navigator must take on the lead navigation responsibilities.  The communication level throughout this mission is EMCON-2.

## RESULTS

The task listings generated served as the basis for the function analysis; they can be found in Appendix A.

# STEP 2 - FUNCTION ANALYSIS

Function analyses for each of the four crewmembers were completed to ensure that all of the functions required in a KC-135 mission would be taken into account and that no crewmember would be overloaded by taking on the residual navigator's tasks.

## METHOD

Two CSEF engineers were sent to Grissom AFB from 26 Nov to 30 Nov 90 to fly in two air refueling missions, and interview crewmembers from each crew position. The CSEF engineers interviewed nine pilots/copilots who averaged 4,430 hours (standard deviation=1182.8 hours) and 17.2 years flying time in the KC-135. Five navigators and four boom operators were interviewed and respectively averaged 2,721 hours (standard deviation=1516.6 hours) and 12.4 years, and 3,372 hours (standard deviation=1307.0 hours) and 13.8 years flight time in the KC-135. All crews were from the 434 AREFW and 72 AREFS. The mission scenario described in the previous method section was employed as a reference for the crewmembers. The definition of each analysis category is given below.

**Task** - The actual task being performed (often a checklist item).

**Modality** - The modality of activity required for the task from the following listing:

        Man  -   Manual
        Vis   -   Visual
        Aud  -   Auditory
        Cog  -   Cognitive
        Voc  -   Vocal

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**Criticality** - Crewmembers were instructed to identify those tasks that were
critical due to effects on mission performance, potential
equipment damage, or personal safety (boom operators only).

**Errors** - Potential errors associated with each task. Crewmembers were
instructed to identify only those errors that had a reasonable
probability of occurrence.

**Information In** - The source of any information that the crewmember needed
to complete the task.

**Error Effects** - Effects of the errors that are likely to occur in the performance of a
task.

**Desired Outcome** - The desired outcome of the task. This item answered the
question "why is this task completed?" (boom operators only).

**Training** - The amount of training (either no training, on-the-job training
(OJT) or formal training) each crewmember would need to perform the various
navigator tasks.

Other parts of the function analysis included a workload assessment and a training
evaluation. These efforts began with interviews of four crewmembers at Rickenbacker
AFB and ended with a workload questionnaire and subsequent data analysis.

Prior to the interviews, the mission was divided into 20 discrete, time-sequenced
"mission events." The mission events are listed in Table 1. Dividing the mission made
workload assessment and function reallocation more manageable. "Mission events" were
either phases of flight (i.e., takeoff), checklists (i.e., preparation for contact) or
major occurrences (i.e., mission planning). The two objectives of this effort were (1)
to collect workload and timeline data for each of the mission events and (2) to finish
collecting training data which were not completed at Grissom AFB. Four crewmembers,
one from each crew position, were interviewed. The crew averaged 3,100 hours
(standard deviation=2447.4 hours) and 12.8 years flying time in the KC-135.

Workload data were collected for each crew position using the 10-point modified
Cooper-Harper scale shown in Figure 1 (Boff, Kaufman & Thomas, eds, 1986). Each
crewmember was given a comprehensive task list for his crew position so he or she
could reference the list to see what tasks were performed for that mission event. Each
crewmember rated the level of workload for each mission event, as a function of his/her
own experience.

Following this effort at Rickenbacker AFB, more workload data were solicited from
personnel of the 330 CFIS at Castle AFB. A questionnaire was administered to document
the workload level of each crew position and mission event. Based upon a recommendation
received at Rickenbacker AFB, the last three mission events were combined and titled
"after landing"; thus, there were now 18 events instead of the original 20. The CSEF
received 18 completed questionnaires from Castle AFB: Ten from pilots/copilots, four
from navigators and four from boom operators. A copy of the questionnaire and ratings
description are provided in Appendix C.

To ascertain potential training requirements, the pilot, copilot and boom operator were
given a navigator task list and asked to indicate the type of training (no training, OJT or
formal training) that would be required before the crewmember could perform

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1. MISSION PLANNING

2. SQUADRON/BASE OPS AND COMBAT CREW DUTIES

3. POWER OFF/WALK AROUND INSPECTION

4. POWER ON INSPECTION

5. STARTING ENGINES AND BEFORE TAXI

6. TAXI

7. BEFORE TAKEOFF

8. TAKEOFF

9. CELL JOIN UP

10. CRUISE #1

11. PREPARATION FOR CONTACT

12. AIR REFUELING

13. POST AIR REFUELING

14. CRUISE #2

15. PLAN DIVERT

16. DESCENT

17. APPROACH AND LANDING

18. AFTER LANDING*

19. TURN OFF EQUIPMENT*

20. MAINTENANCE DEBRIEF, ETC.*

*For timeline development and workload assessment, mission
events 18-20 were combined into 1 event entitled "After Landing"

Table 1. The 20 defined mission events.

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| DIFFICULTY LEVEL | OPERATOR DEMAND LEVEL | RATING |
|---|---|---|
| VERY EASY HIGHLY DESIREABLE | OPERATOR MENTAL EFFORT IS MINIMAL AND DESIRED PERFORMANCE IS EASILY ATTAINABLE | 1 |
| EASY DESIREABLE | OPERATOR MENTAL EFFORT IS LOW AND DESIRED PERFORMANCE IS ATTAINABLE | 2 |
| FAIR MILD DIFFICULTY | ACCEPTABLE OPERATOR MENTAL EFFORT IS REQUIRED TO ATTAIN ADEQUATE SYSTEM PERFORMANCE | 3 |
| MINOR BUT ANNOYING DIFFICULTY | MODERATELY HIGH OPERATOR MENTAL EFFORT IS REQUIRED TO ATTAIN ADEQUATE SYSTEM PERFORMANCE | 4 |
| MODERATELY OBJECTIONABLE DIFFICULTY | HIGH OPERATOR MENTAL EFFORT IS REQUIRED TO ATTAIN ADEQUATE SYSTEM PERFORMANCE | 5 |
| VERY OBJECTIONABLE BUT TOLERABLE DIFFICULTY | MAXIMUM OPERATOR EFFORT IS REQUIRED TO ATTAIN ADEQUATE SYSTEM PERFORMANCE | 6 |
| MAJOR DIFFICULTY | MAXIMUM OPERATOR MENTAL EFFORT IS REQUIRED TO BRING ERRORS TO MODERATE LEVEL | 7 |
| MAJOR DIFFICULTY | MAXIMUM OPERATOR MENTAL EFFORT IS REQUIRED TO AVOID LARGE OR NUMEROUS ERRORS | 8 |
| MAJOR DIFFICULTY | INTENSE OPERATOR MENTAL EFFORT IS REQUIRED TO ACCOMPLISH TASK, BUT FREQUENT OR NUMEROUS ERRORS PERSIST | 9 |
| IMPOSSIBLE | INSTRUCTED TASK CANNOT BE ACCOMPLISHED RELIABLY | 10 |

YES

NO — IS MENTAL WORKLOAD LEVEL ACCEPTABLE

YES

NO — ARE ERRORS SMALL AND INCONSEQUENTIAL

YES

NO — EVEN THOUGH ERRORS MAY BE LARGE OR FREQUENT CAN INSTRUCTED TASK BE ACCOMPLISHED MOST OF THE TIME

OPERATOR DECISIONS

Figure 1. The 10-point modified Cooper-Harper workload scale.

each task. The navigator's opinion of which crewmember would be best suited to perform each navigator task was also solicited, as well as the associated amount of training required. These data were used to make general statements about new training requirements for each crewmember.

## RESULTS

The result of the function analysis was a completed function matrix (example in Appendix B). The matrices served as a common reference point for members of the function reallocation team.

Figure 2 shows each crewmember's workload as a function of mission event. Figure 3 shows the average workload ratings for the pilot, copilot, and navigator as a function of mission event. The boom operator was not considered in this average because most of the navigator functions were not going to be reallocated to the boom anyway. Takeoff, cell join-up, cruise #1, preparation for contact, air refueling, planning a divert, descent, and approach and landing yielded relatively high mean workload ratings. Individual workload graphs were used during the function reallocation to prevent overloading any crew position and are shown in Figures 4-21.

Some experienced crewmembers know how to perform a few of the true navigator functions already, but because experience levels vary from crew to crew, a more structured approach to reallocating navigator functions is required. This structured approach leads to additional training needs. These training needs are addressed below in very generic terms.

Generally, the copilots and boom operators felt their present jobs allowed them to pick up the navigator functions, if necessary, without causing serious workload problems. Many of these functions could be performed proficiently after OJT, while others, such as radar tasks, would require additional formal training. Copilots were given all tasks associated with radar.

## STEP 3 - FUNCTION REALLOCATION

A function reallocation was conducted in an attempt to distribute navigator functions among the remaining crewmembers in such a way that no one crewmember would be overworked. By referencing the function analyses, the navigator tasks that still pertained to a three-man crew could be distributed to the remaining crewmember(s) that could best handle the additional workload.

## METHOD

The function reallocation was conducted in a series of round table meetings over a 3-day period. Participants in the working group included CSEF, ASD/SDBA, and SACSO personnel. Three members of this working group were pilots (two of which were KC-135 pilots). Two working group members were navigators (one KC-135 and one B-52). Each participant was provided copies of the function and workload analysis results, a copy of the mission scenario, a list of available technologies for automation, and a list of functions for each crew position. As each function was reallocated, its impact on the recipient of the function was assessed to assure that the crewmember would not become overworked. Each navigator function was either allocated to another crew member,
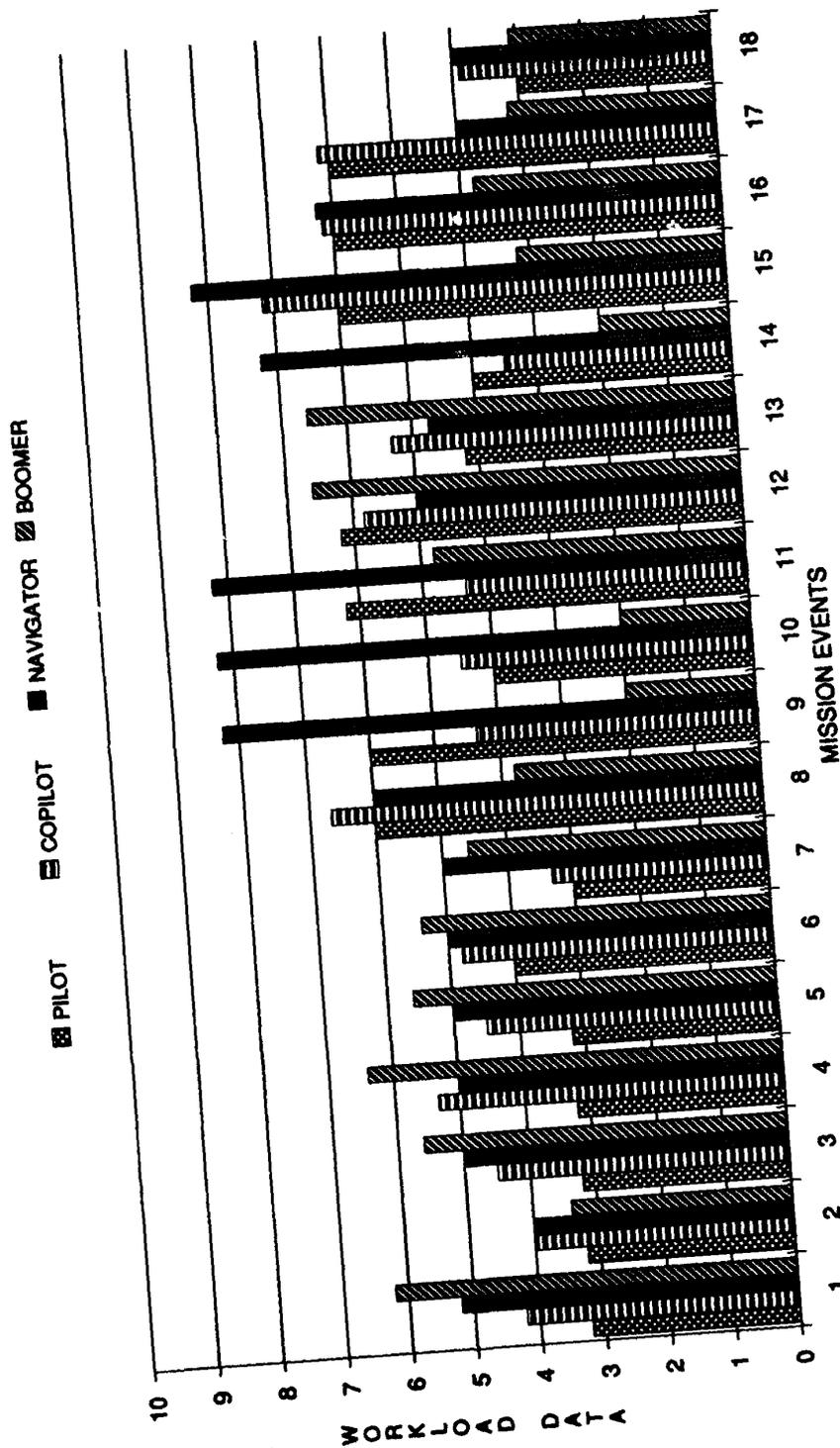
Figure 2. Crew workload as a function of mission event.
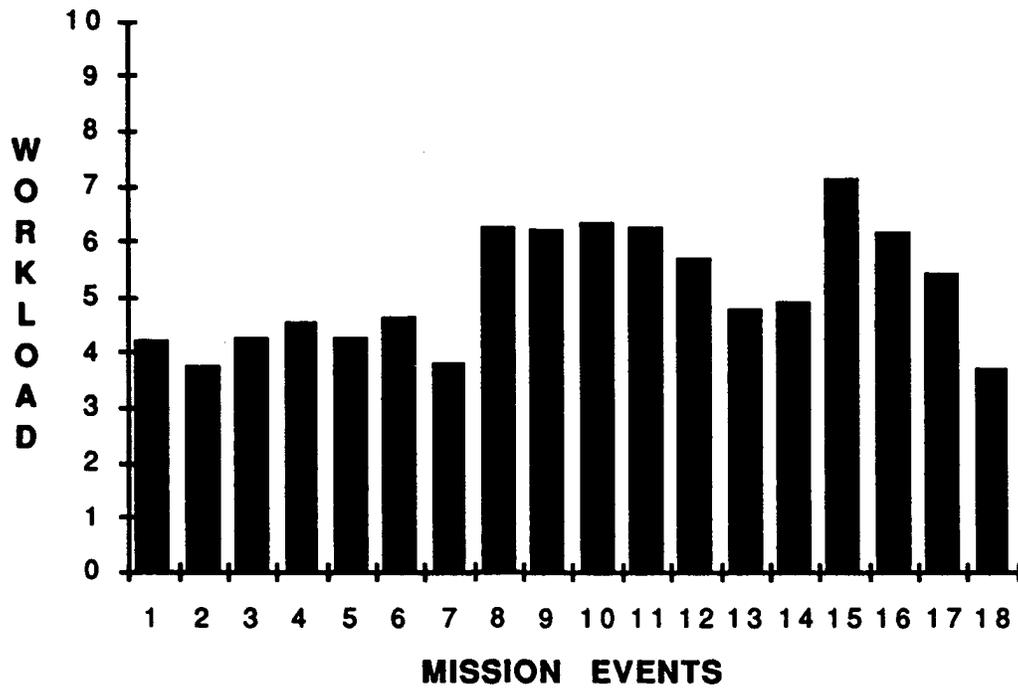
**Figure 3. Mean crew workload as a function of mission event (exclude boom operator).**

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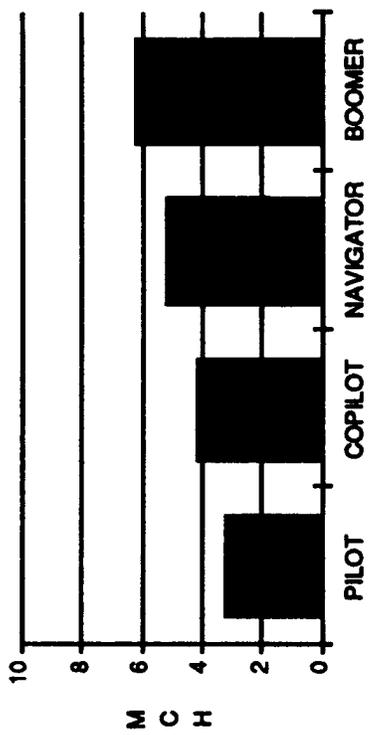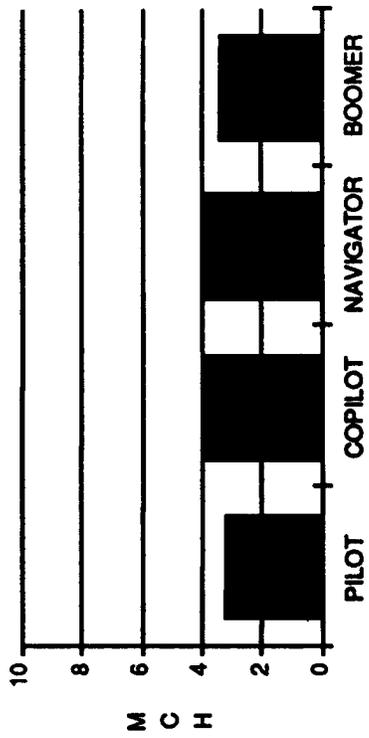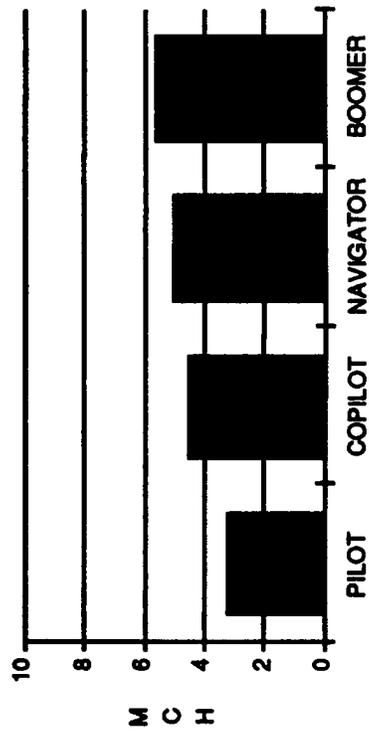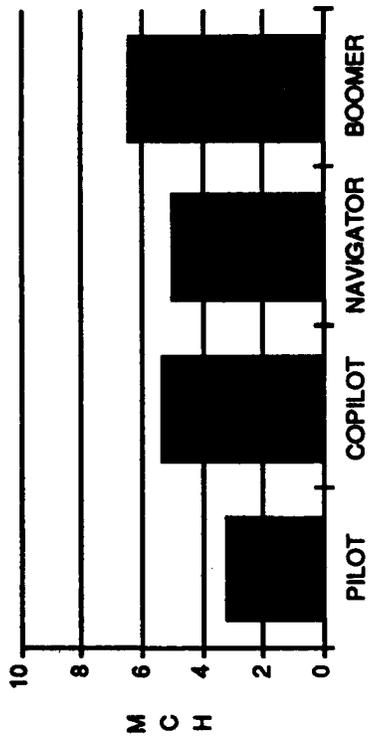
Figures 4-7. Crew workload for each mission event.
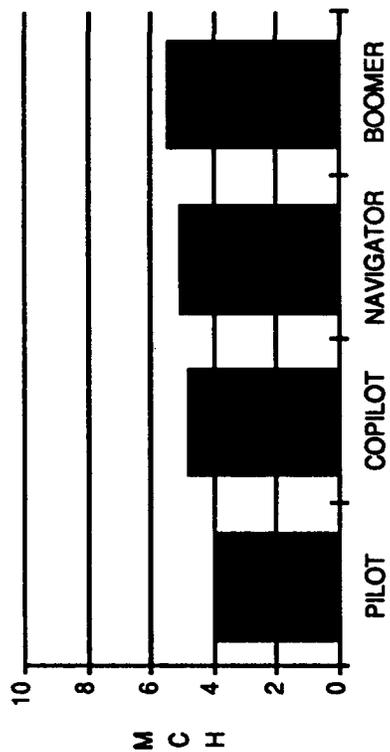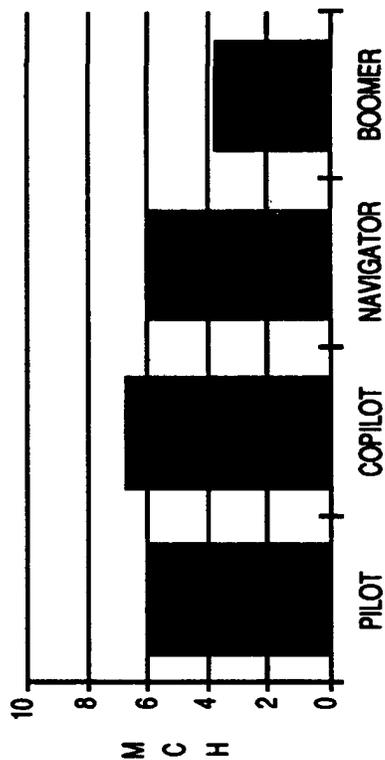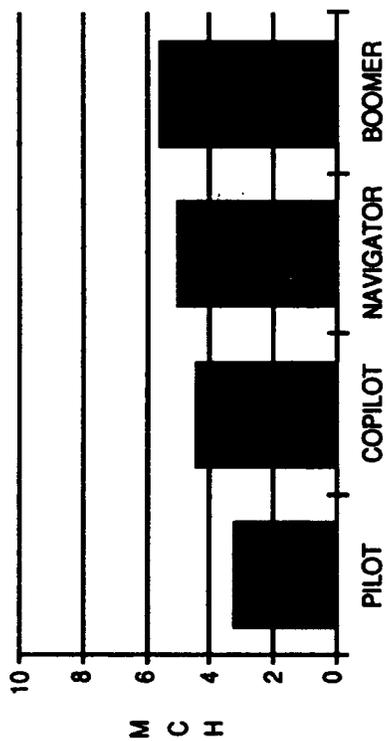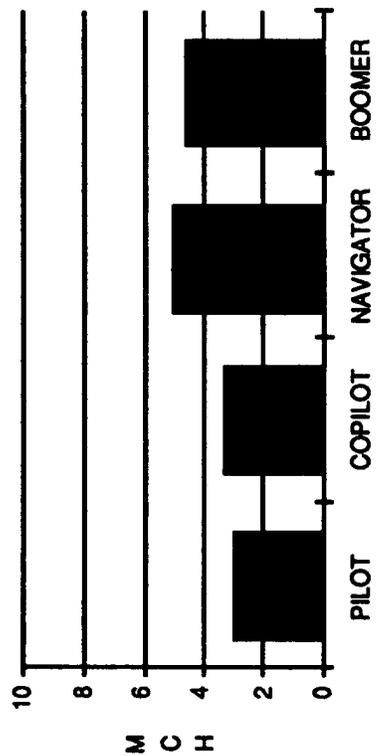
Figures 8-11. Crew workload for each mission event.

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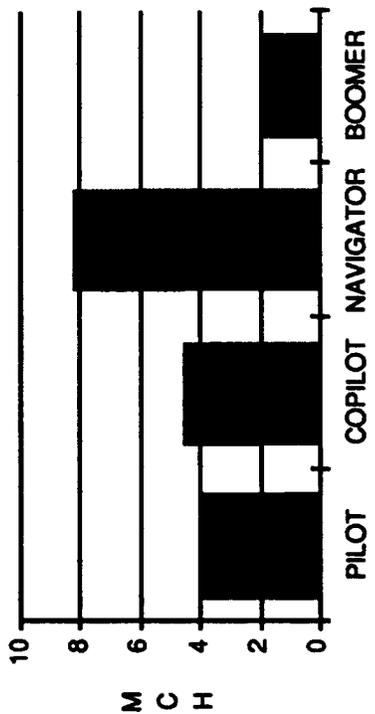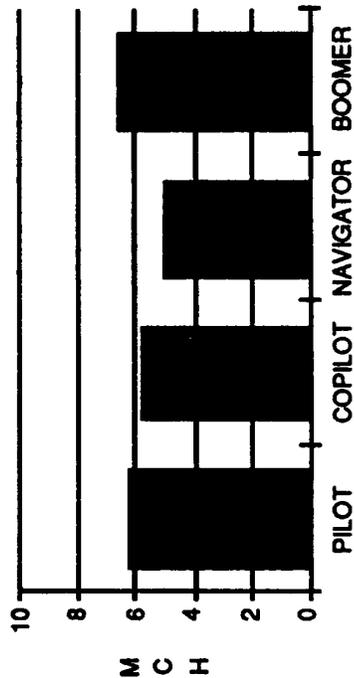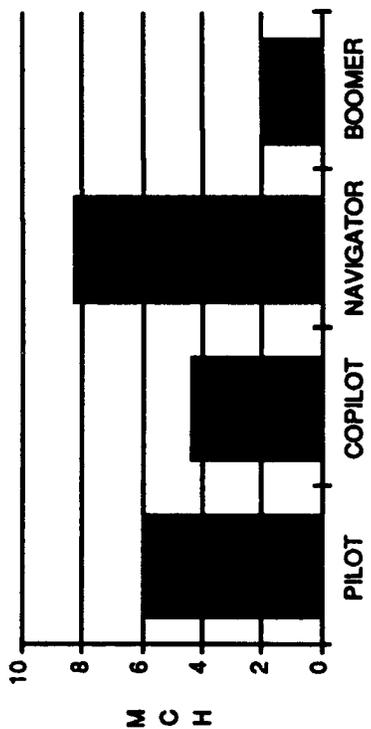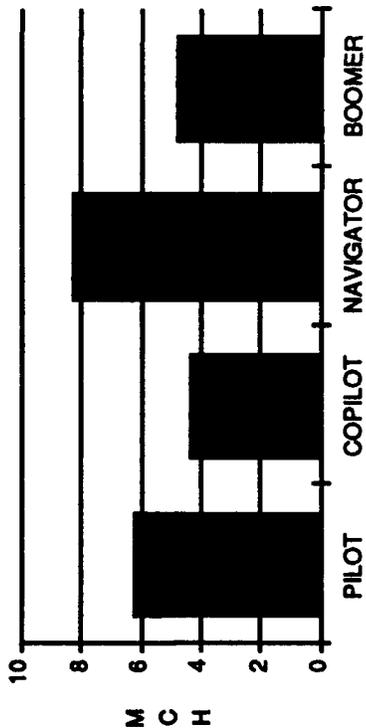
Figures 12-15. Crew workload for each mission event.
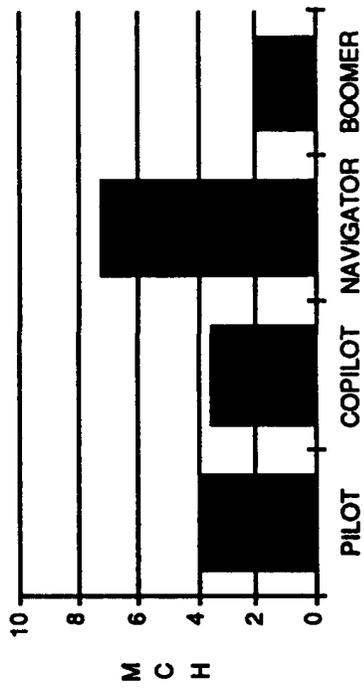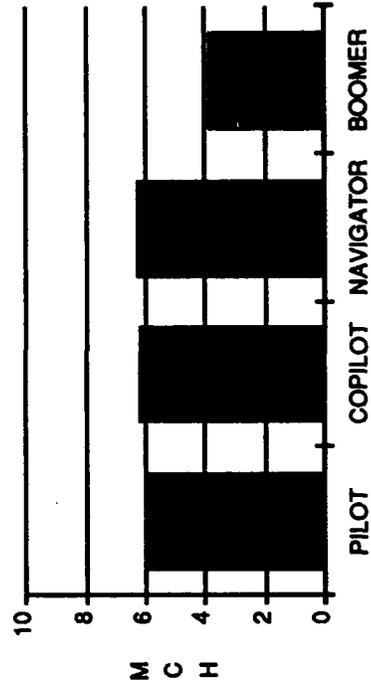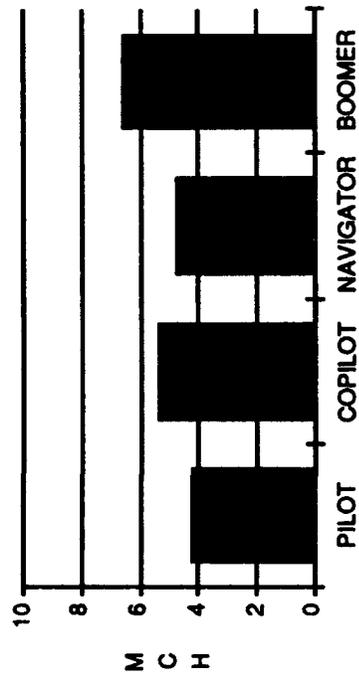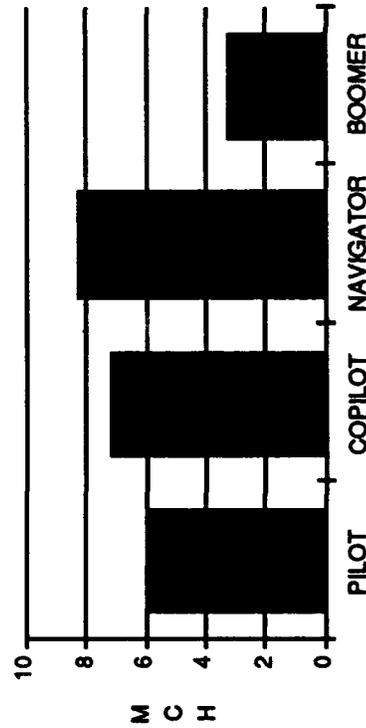
Figures 16-19. Crew workload for each mission event.

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**(20)**

## APPROACH AND LANDING
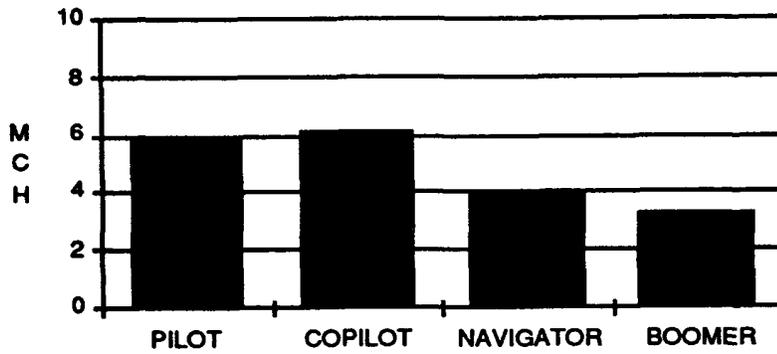


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## AFTER LANDING
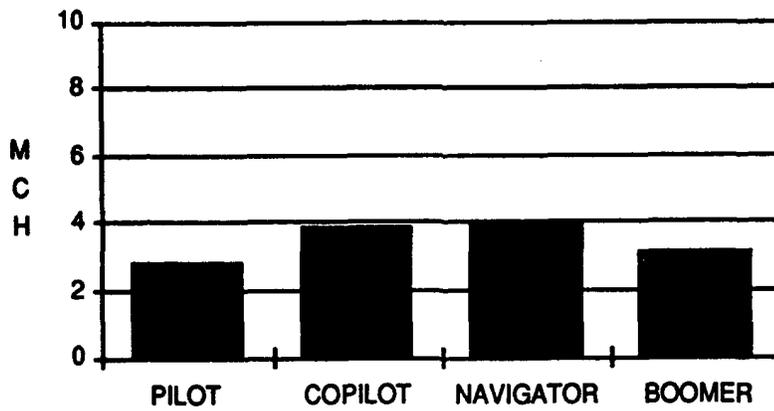


**Figures 20-21. Crew workload for each mission event.**

allocated to a proposed automation concept or deemed as no longer necessary and removed from the list.

## RESULTS

The following results describe the reallocated functions for each crew position by mission event. Those functions allocated to automation concepts are included at the end of this section. The three-crewmember task listings for each crew position can be found in Appendix D. All tasks strictly concerning the navigator (i.e., navigator strap-in, oxygen system tasks, etc.) were deleted from the task listings.

The following section provides a baseline for the reallocated functions. This baseline will undoubtedly be modified as the systems and subsystems are maturing through the design, and test and evaluation phases.

### Mission Planning (Event 1)

Figure 4 shows each crewmember's workload during mission planning. The navigator and boom operator have the highest workload rating during this event. The boom operator has the responsibility of loading cargo onto the aircraft. Cargo loading is a workload intensive period for the boom operator, consequently the navigator's mission planning tasks were reallocated to the pilot and copilot. Most of the navigator's work during this event involved chart and flight plan document preparation.

**Functions Reallocated to the Pilot:**

Complete briefing guide
Complete correlation sheet
Complete scheduling blocks of mission accomplished report (MAR)
Review and study FLT Info Pubs (FLIP) and general planning requirements
Conduct crew flight briefing
Check Form 200 and chart for accuracy

**Functions Reallocated to Copilot:**

Select correct charts
Develop route of flight to meet mission timing
Place special use and space data on chart
Annotate highest terrain and obstructions on chart
Annotate level off point
Annotate ADIZ entry point (if applicable)
Pre-determine radar targets at action points

**Functions Reallocated to Boom Operator:**

None

**Functions Eliminated:**

Plot celestial navigation leg on charts
Place air refueling data on chart
Complete mission paperwork (mission review worksheet, pre-comp sheets)

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Complete Form 200
Fill out known information on in-flight log
Determine where celestial observation will take place

**Justification for eliminating functions:** The charts and mission paperwork were deleted given the assumption of a navigation database and a data transfer system. The mission paperwork and Form 200 will be automated, air refueling data will be automated in the navigation system via the navigation database. Since celestial navigation will not be used, no navigation legs or points for celestial observations need be selected or annotated on the charts.

## Squadron/Base Operations and Combat Crew Duties (Event 2)

Squadron/base operations and combat crew duties typically begin approximately two hours before take-off time. Crew workload is very low (see Figure 5).

**Functions Reallocated to the Pilot:**

Synchronize crewmember's watches (time hack)
Check receiver status
Check aircraft parking spot

**Functions Reallocated to the Copilot:**

Check flight schedule for changes
Check weather for impact on mission timing
Pick up KY-58
Check for departing and landing airfield pages

**Functions reallocated to the Boom Operator:**

Check KIK-18

**Functions Eliminated:**

Review approach plates and enroute charts
Pick up required inflight publications

**Justification:** Since the navigator is no longer a crewmember, and assuming a navigation database is available, his duties of reviewing the mission and picking up inflight publications are no longer necessary.

* If a mission change occurs, such as a fuel load change, then some copilot functions would have to be picked up by the pilot because the copilot would have to recompute take off data, etc.

## Power Off/Walkaround Inspection (Event 3)

Again crew workload is very manageable (see Figure 6). The pilot briefs the crew prior to their boarding the aircraft, and then walks around the aircraft inspecting the exterior surfaces and equipment. The copilot and navigator are seated in their positions ensuring that all switches are correctly set. The boom operator preflights the cargo

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compartment, the boom operator's compartment and performs miscellaneous preflight procedures.

**Functions Reallocated to the Pilot:**

None

**Functions Reallocated to the Copilot:**

Take out navigation publications
Set IFF master switch off
Set mode 4 code switch to A or B (as required)
Set mode enabling switches OUT
Set mode 4 on/out switch ON
Set mode 3/A code selectors to all Os
Check MSU-INS mode selectors off
Check CDU power switch in NORMAL or AUX
Set FSA/CAS power switch off
Set search radar FTC switch OFF
Set IAGC switch off
Set PATT switches as desired
Set bearing switch as desired
Set STC dial full counterclockwise
Set stab switch off
Set gain control full counterclockwise
Set heading select knot to local magnetic variation
Set scan switch OFF
Set test meter switch to "Mag"
Set range switch to 3-30/5
Set function switch OFF
Set radar pressurization control switch to ON
Set pulse width switch (as required)
Set code selector switches (as required)
Set radar intensity control knob fully counterclockwise
Set range control knob fully clockwise

**Functions Reallocated to Boom Operator:**

Check portable oxygen bottle
Check cleanliness, general condition, and stored in normal position
Check for pressure approximating 300 PSI
Check altitude selector knob in NORMAL position
Service portable oxygen bottle (if required)
Replace portable oxygen bottle
Ensure oxygen supply lever OFF

**Functions Eliminated:**

Take out navigation charts and equipment
Ensure celestial tables and air almanacs on-board and current
Set APN 218 Doppler switch to OFF
Check MSU-DNS mode selectors OFF
Set search radar range delay switch OFF

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**Justification:** The navigator's charts, equipment, and celestial references should no longer be necessary. The DNS is assumed deleted.

## Power On Inspection (Event 4)

Workload for each crewmember is shown in Figure 7. The pilot and copilot are seated inspecting switches, radios, flight controls, and display accuracy. The navigator, also seated, checks navigation equipment and inserts waypoint data. The boom operator continues checking the cargo compartment, the boom operator's compartment or finishes miscellaneous tasks.

**Functions Reallocated to the Pilot:**

Perform INS system preflight procedures (pilot or copilot)
Check INS status panel (pilot or copilot)
Set MSU-INS mode selectors to ALIGN (pilot or copilot)
Insert INS present position
Set altimeter to correct barometric pressure (pilot or copilot)
Verify waypoints (pilot or copilot)
Read waypoint data

**Functions Reallocated to the Copilot:**

Perform INS system preflight procedures (pilot or copilot)
Check INS status panel (pilot or copilot)
Set MSU-INS mode selectors to ALIGN (pilot or copilot)
Turn FSA/CAS power switch ON
Insert INS present position (pilot and copilot)
Set IFF mixer switch as desired
Set IFF antenna switch to BOTH
Set RAD-TEST/MON switch to OUT
Set IFF master switch to NORMAL test modes, 1, 2, 3/A and C
Check Mode 4 light outset master switch to STANDBY
Set Mode 1, 2, 3/A and C switches as required
Set Mode 1, 2, and 3A codes as required
Set Audio/Light switch as required
Set RAD-TEST/MON switch as desired
Turn APN-59 function switch to STBY
Set altimeter to correct barometric pressure (pilot or copilot)
Input waypoint data
Verify waypoints (pilot or copilot)

**Functions Reallocated to Boom operator:**

Encode Mode 4
Load KY-58
Request authentication and launch message from command post
Respond with correct authentication

**Functions Eliminated:**

Check N-1 compass latitude correction pointer OFF
Set N-1 compass to correct MAG heading

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Center annunciation pointer
Accomplish GRID check
Perform DNS system preflight procedures
Check Doppler status panel
Set MSU-DNS mode selectors to ALIGN
Turn APN-218 mode selector to LAND
Perform bit test
Turn APN-218 mode selector to OFF
Insert DNS present position
Compare altimeter setting with field elevation
Accomplish DNS interface test
Accomplish INS interface test
Insert TACAN data
Check sextant mount
Check sextant desiccant
Check averager
Check sextant alignment
Observe a celestial precomp
Resolve sextant accuracy
Remove and stow sextant and stool

**Justification:** With new navigation equipment, N-1 compass procedures and the grid check should no longer be necessary. The DNS is assumed deleted. TACAN data should be included in the navigation database. The sextant check is no longer necessary since celestial navigation will not be accomplished.

## Starting Engines and Before Taxi (Event 5)

Crewmember workload during the start engines and before taxi event are shown in Figure 8. Only moderate workload was induced.

**Functions reallocated to the Pilot:**

None

**Functions reallocated to the Copilot:**

Set INS system to NAV mode
Check for at least one generator on line
Set IFF master switch to STANDBY
Turn search radar to STANDBY
Set radar/rendezvous beacon as required
Perform warning and indicator light test
Check receiver status
Ensure taxi clearance received

**Functions reallocated to the Boom operator:**

Turn oxygen system ON

**Functions eliminated:**

Set DNS system to NAV mode

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Monitor engine start
Turn APN-218 Doppler mode selection ON

**Justification:** The DNS is assumed deleted.

## Taxi (Event 6)

Figure 9 shows that crewmember workload was very manageable during Taxi. All navigator functions performed during this event were either eliminated or reallocated to the copilot.

**Functions reallocated to the Pilot:**

None

**Functions reallocated to the Copilot:**

Set search radar function switch to SEARCH
Adjust radar intensity control
Adjust heading mark intensity control
Set scan switch as desired
Set stabilization switch to ON
Fine-tune radar
Check beacon capability
Ensure departure clearance is received
Perform weather scan

**Functions reallocated to the Boom operator:**

None

**Functions eliminated:**

Perform radio procedures

**Justification:** This function was for the navigator only.

## Before Takeoff (Event 7)

At this point in the mission each crewmember is accomplishing last minute tasks before takeoff. Workload is low (see Figure 10).

**Functions reallocated to the Pilot:**

None

**Functions reallocated to the Copilot:**

Set radar/rendezvous beacon (as required)
Set IFF (as required)

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**Functions reallocated to the Boom Operator:**

None

**Functions eliminated:**

None

## Takeoff (Event 8)

Takeoff is a very intense event, and consequently workload is high (see Figure 11) for the pilot and copilot who are flying the aircraft, and for the navigator who is busy trying to skin paint the lead aircraft using radar.

**Functions reallocated to the Pilot:**

Monitor lead aircraft for MITO timing (Pilot and Copilot)

**Functions reallocated to the Copilot:**

Monitor lead aircraft for MITO timing (Pilot and Copilot)
Perform initial climb-out procedures i.e. skin paint lead aircraft

**Functions reallocated to the Boom Operator:**

Record take-off time
Monitor aircraft instruments

**Functions eliminated:**

Ensure positive rate of climb
Ensure gear up
Ensure flaps raised

**Justification:** The pilot and copilot already ensure these tasks are performed.

## Cell Join Up (Event 9)

Figure 12 shows cell join up is a high workload event for the pilot, who is flying, and for the navigator who is communicating on the radio and with the pilot, as well as trying to acquire the lead aircraft on radar. These communication and radar related functions were reallocated to the copilot for two reasons: (1) Copilot workload is low and (2) The radar equipment will be available within the copilot's workspace envelope.

**Functions reallocated to the Pilot:**

Ensure correct altitudes are flown
Ensure correct headings are flown
Perform climb altitude procedures
Perform after takeoff checklist procedures
Monitor interphone and radios (pilot, copilot and, boom operator)

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**Functions reallocated to the Copilot:**

Direct pilot into enroute formation
Use all available equipment to effect join up
Inform pilot of other aircraft's position
Ensure level off in altitude block
Acquire lead aircraft on radar
Make departure call
Monitor departure being flown
Make 2,000' prior to level off call
Make 1,000' prior to level off call
Monitor interphone and radios (pilot, copilot and, boom operator)

**Functions reallocated to the Boom Operator:**

Check IFF mode 4 caution light off
Monitor HF after passing out of home station UHF range during Alpha monitor periods
Monitor interphone and radios (pilot, copilot and, boom operator)

**Functions eliminated:**

Reset altimeter at transition altitude
Ensure oxygen requirements are met
Ensure oxygen is ON and at 100% when aircraft is above 10,000'
Ensure oxygen is readily available above FL250
Record level off time
Monitor interphone and COMM radios from takeoff

**Justification:** The level off time should be recorded by the flight data recording system. The remainder of the functions are performed by each crewmember individually.

## Cruise #1 (Event 10)

This event typically involves celestial navigation which is the primary reason why the navigator's workload rating was above 8 (see Figure 13). For the other crewmembers this is not a workload intensive event.

**Functions reallocated to the Pilot:**

Monitor UHF command post/cell frequency (pilot, copilot, and boom operator)
Monitor UHF air traffic control frequencies (pilot, copilot, and boom operator)
Monitor HF giant talk during alpha monitor period (pilot, copilot, and boom operator)
Update IFF mode 3a as required (pilot and copilot)
Monitor APN 59 radar (pilot and copilot)
Monitor navigation radio aids (pilot and copilot)
Keep aircraft within 10 NM of track
Direct aircraft to avoid thunderstorms by 20 NM at or above FL230 (pilot and copilot)
Compute "alter heading" and ETA to turn
Perform dead reckoning (DR) navigation
Direct aircraft along planned route to coast end point/ADIZ
Accomplish control time to air refueling control point

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Monitor equipment for malfunction (pilot and copilot)
Set IFF as required
Track aircraft position (pilot and copilot)
Perform CELL formation
Perform station keeping duties
Monitor radar for skin paint or beacon

## Functions reallocated to the Copilot:

Complete Comm log
Request and record UHF traffic
Accomplish HF contact
Record HF traffic
Monitor UHF command post/CELL frequency (pilot, copilot and, boom operator)
Monitor UHF air traffic control frequencies (pilot, copilot and, boom operator)
Monitor HF giant talk during Alpha monitor period (pilot, copilot and, boom operator)
Update IFF mode 3A as required (pilot and copilot)
Monitor APN 59 radar (pilot and copilot)
Monitor navigation radio aids (pilot and copilot)
Direct aircraft to avoid thunderstorms by 20 NM at or above FL230 (pilot and copilot)
Set equipment as required for specific navigation leg
Take coast out fixes
Complete log work on form 200
Monitor equipment for malfunction (pilot and copilot)
Perform over water navigation
Update and monitor INS as required
Set IFF as required (pilot and copilot)
Track aircraft position (pilot and copilot)
Use all navigation aids to monitor position within 20 NM of track
Update ETAs to pilot as necessary for HF position report

## Functions reallocated to the Boom Operator:

Monitor UHF command post/CELL frequency (pilot, copilot, and boom operator)
Monitor UHF air traffic control frequencies (pilot, copilot, and boom operator)
Monitor HF giant talk during Alpha monitor period (as applicable) (pilot, copilot, and boom operator)

## Functions eliminated:

Update DNS position
Update INS position
Accomplish in-flight log entry requirements
Record aircraft position and time at all planned turn points
Record aircraft position at least once every 30 minutes
Prepare for celestial navigation
Ensure celestial navigation clearance is obtained          .
Start celestial navigation

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Record accurate start position and time
Accomplish celestial pre-comps (SACF 289)
Resolve MPP/FIX
Set APN-218 to SEA

**Justification:** The DNS is assumed deleted, as is the need for celestial navigation. Update of the INS will be automatic via the navigation computer or by copilot radar fixing. In-flight log entries will be accomplished by the flight data recording system.

## Preparation for Contact (Event 11)

All crewmembers experienced high workload during this event. The navigator ensured rendezvous times were met, performed orbit holding procedures, and performed the rendezvous. The pilot accomplished the preparation for contact checklist, and the boom operator prepared for air refueling. Although not shown in Figure 14, Copilot workload can be very high during preparation for contact. Copilots typically communicate with air traffic controllers and begin determining the amount of fuel to offload, from where the fuel will be off-loaded and the number of pumps to use during the off-load. For newer copilots, accomplishing all of the necessary functions prior to contact with the receiver is impossible. So there is concern about reallocating navigator functions to the copilot.

### Functions reallocated to the Pilot:

Set equipment as required for rendezvous (pilot and copilot)
Perform station keeping duties (pilot and copilot)
Set assigned radio frequencies (pilot and copilot)
Monitor radios (pilot and copilot)
Establish radio contact with receiver as required
Obtain receivers information as required
Relay tanker information as required
Establish offset
Accomplish Automatic Direction Finder (ADF) Check if applicable
Monitor echelon position
Place beacon to STBY as required (pilot and copilot)
Initiate overrun procedures (pilot and copilot)
Set equipment as required for contact (pilot and copilot)
Ensure rendezvous time is met
Perform orbit holding procedures

### Functions reallocated to the Copilot:

Set equipment as required for rendezvous (pilot and copilot)
Perform station keeping duties (pilot and copilot)
Set assigned radio frequencies (pilot and copilot)
Monitor altitude (pilot and copilot)
Ensure ATC clearance to air refuel received
Accomplish positive beacon ID (if applicable)
Start timing
Place beacon to STBY as required (pilot and copilot)
Initiate overrun procedures if applicable (pilot and copilot)
Set equipment as required for contact (pilot and copilot)

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**Functions reallocated to the Boom Operator:**

None

**Functions eliminated:**

Conduct point parallel rendezvous
Instruct pilot to turn at turn range and give a time to turn

**Justification:** Point parallel rendezvous and turn range information should be accomplished via commands from the navigation system.

## Air Refueling (Event 12)

Figure 15 clearly shows that workload is high for the entire crew. Because the KC-135 and receivers are in such close proximity during air refueling, the pilot really has to concentrate and maintain airspeed, altitude, and attitude to avoid a mishap. The copilot performs the fuel transfer functions and monitors the aircraft's center-of-gravity, which is crucial. The boom operator performs contact procedures, and the navigator performs peripheral air refueling functions such as recording the amount of fuel transferred and the number of contacts made, as well as monitoring radios. The navigator becomes much more involved if refueling occurs in an anchor area because navigating in an anchor area is more difficult and using radar to skinpaint the receiver is necessary.

**Functions reallocated to the Pilot:**

Monitor CELL formation (pilot and copilot)
Tune radar for optimum picture (pilot or copilot)
Alter aircraft as necessary to maintain course within 10NM of cleared course
Monitor and update navigation systems (pilot and copilot)
Monitor interphone and radios (pilot and copilot)
Monitor altitude (pilot and copilot)

**Functions reallocated to the Copilot:**

Record air refueling data
Record number of contacts
Record amount of fuel transferred
Monitor CELL formation (pilot and copilot)
Tune radar for optimum picture (pilot or copilot)
Keep pilot advised of position
Maintain ATC clearance requirements
Monitor and update navigation systems
Monitor interphone and radios (pilot and copilot)
Set APN-69 to OPERATE
Monitor altitude

**Functions reallocated to the Boom Operator:**

None

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**Functions eliminated:**

Configure radar to skinpaint receiver at bottom of air refueling block

**Justification:** "Configure radar to skinpaint receiver at bottom of air refueling block" is a breakaway procedure. Having to do this during air refueling would cause excessive workload. Therefore, the receiver should ensure lateral clearance immediately after disconnect so no skinpaint would be necessary.

## Post Air Refueling (Event 13)

Following air refueling, each crewmember completes the post air refueling checklist. The boom operator has the highest workload (Figure 16) as he retracts, stows and latches the boom, closes the sighting door and ensures the ruddervators are locked.

**Functions reallocated to the Pilot:**

Monitor radios (pilot and copilot)

**Functions reallocated to the Copilot:**

Set radar/rendezvous beacon to OFF (if required)
Monitor radios (pilot and copilot)

**Functions reallocated to the Boom Operator:**

Open fuel tank circuit breakers as required

**Functions eliminated:**

None

## Cruise #2 (Event 14)

Figure 17 shows that only the navigator's workload was high during cruise; however, assuming celestial navigation becomes obsolete, workload would be drastically reduced. In fact, all navigation functions are eliminated during this phase except "assume CELL lead navigation responsibilities," which the pilot or copilot would do.

**Functions reallocated to the Pilot:**

Assume CELL lead navigation responsibilities (pilot or copilot)

**Functions reallocated to the Copilot:**

Assume CELL lead navigation responsibilities (pilot or copilot)

**Functions reallocated to the Boom Operator:**

None

**Functions eliminated:**

    Terminate celestial/over water navigation
    Accomplish final DR position and announce ETA to coast in
    Accomplish coast in fix
    Terminate celestial navigation clearance
    Check N1 and J4 compass heading

    **Justification:** Actual navigation functions will be accomplished by the navigation system. No celestial navigation will be used.

## Plan Divert (Event 15)

    Planning a divert is workload (see Figure 18) intensive for the navigator because a new route of flight, distance traveled and time required must be determined. Workload is high for the copilot who must compute the fuel required for the divert. As aircraft commander, the pilot must oversee these activities to ensure a logical and safe route of flight given the amount of fuel available.

**Functions reallocated to the Pilot:**

    None

**Functions reallocated to the Copilot:**

    Compute distance and time

**Functions reallocated to the Boom Operator:**

    None

**Functions eliminated:**

    Prepare chart

    **Justification:** Chart work should be unnecessary because the alternate routes of flight should be in the navigation system. The copilot will have to type in an alpha-numeric identifier of the diversion base and the system should provide the best route of flight as well as time and fuel required.

## Descent (Event 16)

    Figure 19 depicts the workload for each crewmember during descent. The pilot generally just flies the descent, while the copilot accomplishes the descent checklist. The navigator reviews the penetration, approach, highest terrain, emergency airfields and so on.

**Functions reallocated to the Pilot:**

    Review penetration and approach (pilot or copilot)
    Review highest terrain (pilot or copilot)
    Review emergency airfields (pilot or copilot)
    Review special use airspace (pilot or copilot)

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Monitor aircrew terminal information service (ATIS) (pilot or copilot)
Ensure approach clearance received (pilot or copilot)
Make "2,000' prior to assigned altitude" call (pilot or copilot)
Make "1,000' prior to assigned altitude" call (pilot or copilot)

## Functions reallocated to the Copilot:

Review penetration and approach (pilot and copilot)
Review highest terrain (pilot and copilot)
Review emergency airfields (pilot or copilot)
Review special use airspace (pilot or copilot)
Monitor aircrew terminal information service (ATIS) (pilot or copilot)
Ensure approach clearance received (pilot or copilot)
Make "2,000' prior to assigned altitude" call (pilot or copilot)
Make "1,000' prior to assigned altitude" call (pilot or copilot)
Monitor weather reports

## Functions reallocated to the Boom Operator:

Set altimeters
Contact command post

## Functions eliminated:

None

## Approach and Landing (Event 17)

Approach and landing is a very critical phase of flight, hence as Figure 20 shows pilot
and copilot workload is high. Most of the reallocated navigator functions went to the
boom operator, with a few going to the pilot and copilot.

## Functions reallocated to the Pilot:

Scan for traffic (pilot, copilot, and boom operator)
Perform go around as required
Monitor landing roll out/ground speed (pilot and copilot)

## Functions reallocated to the Copilot:

Ensure altitude restrictions are met
Monitor approach
Monitor radios (copilot and boom operator)
Monitor timing as required
Scan for traffic (pilot, copilot, and boom operator)
Ensure missed approach procedures are accomplished
Make required altitude calls
Monitor landing roll out/ground speed (pilot and copilot)

## Functions reallocated to the Boom Operator:

Monitor radios (copilot and boom operator)
Scan for traffic (pilot, copilot, and boom operator)

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Check flap setting
Check gear position down
Check pilot approach speed (as required)
Check fuel panel
Advise pilots of any hazards noted
Record time

## Functions eliminated:

Perform instrument approaches
Perform airborne radar directed approach (if required)
Configure radar
Direct descent as published (as required)

**Justification:** Instrument approaches should be included in the navigation database and displayed (at least) to the copilot. An airborne radar approach display should be available to the copilot for him to direct the pilot in airborne radar approaches.

## After Landing (Event 18)

Figure 21 clearly shows that crew workload during the after landing phase was low.

## Functions reallocated to the Pilot:

Turn INS MSU switch OFF after parked (pilot and copilot)
Assist in aircraft offload (as required) (pilot, copilot, and boom operator)
Offload flight equipment (pilot, copilot, and boom operator)
Assist in off-loading passengers/personnel (pilot, copilot, and boom operator)
Relay INS accuracy check information

## Functions reallocated to the Copilot:

Set mode 4 code switch (as required)
Set mode 4 on/out switch OUT
Set IFF master switch OFF
Set gain control CCW
Set intensity control CCW
Set heading marker control CW
Set scan switch OFF
Set stab switch OFF
Set function switch OFF
Set APN-69 control panel OFF (if required)
Select way point for INS accuracy check
Press hold key
Record latitude and longitude coordinates
Press hold key
Load pure present position
Load airplane actual position
Set data selector to DIST/TIME
Press WY PT CHG key
Press 1 and 2 keys in sequence
Record distance from left-hand data display
Press clear key

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Turn INS MSU switch OFF after parker (pilot and copilot)
Set IFF/SIF (as required)
Set mode 2 code (as required)
Set FSA/CAS power OFF
Assist in aircraft offload as required (pilot, copilot, and boom operator)
Offload flight equipment (pilot, copilot, and boom operator)
Assist in offload of passengers/personnel (pilot, copilot, and boom operator)

## Functions reallocated to the Boom Operator:

Monitor radios
Record flight time
Zeroize code in KIK-18 and KY-58
Assist in aircraft offload as required (pilot, copilot, and boom operator)
Offload flight equipment (pilot, copilot, and boom operator)
Assist in offload of passengers/personnel (pilot, copilot, and boom operator)
Enter navigation systems maintenance discrepancies into Form 781
Turn in comm kit, KIK-18, KY-58 and FLIP publications

## Functions eliminated:

Turn APN-218 system OFF
Turn DNS MSU switch OFF
Calculate nav accuracy
Complete SAC Form 157
Turn in navigation mission paperwork

**Justification:** The DNS is assumed deleted. Navigation accuracy should be calculated by the data transfer system. Mission paperwork will be completed by the flight data recording system and the data transfer system.

## Functions Reallocated to Automation Concepts (All Mission Events)

### Navigation Functions:

Navigate by Dead reckoning
Update navigation systems (INS, radar, compasses, etc.)
Update estimated time of arrivals (ETAs) for pilot HF reports
Perform orbit holding procedures via commands to the pilot (orbital pattern
    displayed)
Computation of distance, time, fuel, and route of flight for waypoints and
    divert airfields
Mission paperwork (Form 200, Inflight Log, etc.)
Record significant mission events (waypoints, refuelings, 30-min updates,
    etc.)
Provide station keeping information and commands

### Air Refueling Functions:

Calculate air refueling control time (ARCT) to air refueling control point (ARCP)
Command true airspeed (TAS) to make timing for ARCP or waypoints (ADIZ)
Command track to make timing for ARCP or waypoints (ADIZ) within
    designated corridor

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Conduct rendezvous (point parallel, etc.)

Perform orbit holding procedures via commands to the pilot (orbital pattern displayed)

Compute turn range and offset, time to turn, and range with copilot input of receiver airspeed, track, and altitude

Mapping of anchor point and refueling track on pilot's display for air refuelings using anchor points

Track receiver aircraft on radar

## Departure/Approach Functions:

Commands for navigation to initial approach fix (IAF) when entered into the flight mission computer (FMC)

Provide approach and standard instrument departure (SID) information and commands

Provide ability for airborne radar approach

# CONCLUSION

The objectives of this effort were to complete a function analysis of the four KC-135 crew positions and to recommend function reallocations and automation concepts that can be integrated into a three-man crew KC-135 cockpit configuration. The effort began at Castle AFB where task listings for each crew position were validated. The function/task lists were then refined iteratively at Grissom AFB and Rickenbacker AFB. At the same time, data were collected concerning inputs, equipment, sensory modality, workload, control activations and task errors . Eighteen mission events were selected spanning from mission planning to after landing. Additional workload data were collected for each of these 18 events. Using the function analysis and the workload data, KC-135 crewmembers and CSEF engineers spent three days reallocating all navigator functions among the remaining crewmembers or automation concepts. The results of the function reallocation and requirements of certain automation concepts will be used by the CSEF cockpit design team during development of a three-man crew KC-135 cockpit configuration.

Throughout this effort, concern was expressed about removing the navigator from the KC-135; from the loss of "another set of eyes in the cockpit," to the increased training of the three remaining crewmembers. Replacing the navigator will be an automated system and a copilot whose primary role will be navigation. In essence the copilot is being replaced by a navigator who can fly the aircraft. The boom operator will have to take a more active role in the positive control of the aircraft and its systems. No longer will both pilots have the sole task of piloting the aircraft. Both must have the ability and training to share the navigation role, possibly switching roles while in flight. The little "free" time that a four-man KC-135 crew had will grow smaller, while overall reliance on automated systems, particularly navigation systems, will have to increase.

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# DISCUSSION

A three-man crew KC-135 should be capable of maintaining the flexibility and capability of the four-man crew KC-135, but only at a price of more automated and integrated systems, an overall increase in flight crew workload and increased aircrew training.

## SYSTEM AUTOMATION

The systems most in need of automation involve the navigation functions and mission planning/execution paperwork. A system integrating these two functions would be the best solution since they are, to a great extent, concerned with the same information. The function of navigation should be automated, as much as possible, so pilots will only have to monitor the system and respond to its command indications. However, the aircrew's ability to input information or select navigation information sources should not be abridged. The system should be mechanized to allow for fixtaking and navigation source selection to assure aircrew control of navigation under degraded modes of operation. An automated system for mission planning/execution paperwork feeding directly into the aircraft's navigation system and mission computer could reduce some of the workload associated with crew reduction, while increasing the flexibility of the link between mission planning and execution.

## CREW WORKLOAD

The workload of a three-man crew will be higher than that of a four-man crew, without extensive redesign of the cockpit and flight controls. Since the scope of this effort included minimum impact on the existing KC-135 cockpit while maintaining the system's capabilities, the function reallocation team attempted to maintain the crew workload at a "manageable" level. Requiring the same functions be completed in the same amount of time by a reduced number of crewmembers cannot escape an increase in overall crew workload without automating several navigator functions.

## AIRCREW TRAINING

Aircrew training will have to be increased to account for the additional crew duties levied upon the remaining crewmembers. All crewmembers should be trained on the new systems that will be implemented, as well as in navigation theory and practice.

# RECOMMENDATIONS

The following are the CSEF's recommendations for the aircraft systems that would meet the requirements of the functions allocated to the automation concepts. These recommendations have been structured for use by the CSEF cockpit design team in their effort to develop a three-crewmember KC-135 conceptual cockpit design for simulation purposes.

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## PILOT/COPILOT

Throughout the function reallocation the pilot was defined as the pilot actually flying the aircraft at any given time. The copilot was defined as the non-flying pilot. Thus, both pilots should be able to take on either role at any given time. Navigation tasks are considered the responsibility of the copilot. Several control panels (IFF, radar, etc.) will need to be moved, duplicated, or made accessible through the control/display units (CDUs) to provide access to both pilots.

## SWITCH/DISPLAY RELOCATIONS

Switches and displays found on the navigator's station that will require activation or monitoring in a new mechanization should be moved to a position accessible to one or both of the pilots (navigation systems power switches, warning lights, etc.).

## SECRET DOCUMENTATION

Secret documentation should be positioned in a place accessible to all crewmembers.

## DOPPLER NAVIGATION SYSTEM

The Doppler navigation system should be removed.

## CELESTIAL NAVIGATION

Celestial navigation should no longer be a requirement.

## FLIGHT DATA RECORDING SYSTEM

A flight data recording system should be installed to take the place of the navigator's log.

## DUAL INERTIAL NAVIGATION SYSTEMS (INS)

Dual Inertial Navigation Systems were considered necessary for system navigation accuracy.

## GLOBAL POSITIONING SYSTEM (GPS)

The aircraft should be equipped with receivers for the GPS.

## NAVIGATION DATABASE

The aircraft should have a navigation database onboard, either totally indigenous or merely a host system for a data transfer system. This navigation database should, as a minimum, include the three-, four- and five-letter identifiers and corresponding information of all navaids, refueling tracks, anchor areas, and airfields near the route of flight (location, elevation, frequencies, runway lengths, etc.) as well as waypoint information. Other useful information include: Location and pertinent information on restricted airspace (area, dates, times, altitudes, etc.), standard instrument departure/approach information (turnpoints, IAFs, frequencies, MDAs, etc.), and

preplanned radar fix information (location, elevation) that could be loaded via the data transfer system.

## DATA TRANSFER SYSTEM (DTS)

The DTS should include automated flight plans, takeoff and landing data, navigation information (Form 200), fuel information, and weight and balance information that can be transfered to the aircraft navigation database. Information updates (Notes To Airmen (NOTAMs), Flight Information Publications (FLIPs), Crew Information Files (CIFs)) should automatically update information on navaids, airfields, restricted airspace, and other database entries.

## NAVIGATION SYSTEM

The navigation system should be capable of integrating all navigation information (navaids, INS, GPS, radar) for a navigation solution. Updating should be virtually instantaneous so the aircraft corrects for track automatically when in autopilot modes or gives commands for return to track in manual modes. Weather avoidance modes should allow the copilot to either enter the new waypoints via a CDU or by a cursor, and have a correct to track option. Navigation charts should only be needed as a backup or reference information. The copilot should be able to select the navigation input(s) (INS 1, INS 2, GPS, radar) in case of degraded modes or malfunction.

## RADAR SYSTEM

The copilot should control the radar system. Since either pilot can take this role, the controls for the radar system should either be centrally located for access by both pilots, or each pilot should have his own radar controls. The radar system should have ground map, skin paint, beacon, and weather modes. As a minimum, the beacon mode should allow the copilot to designate a receiver for tracking purposes; this ability should prove useful in the skinpaint mode as well. Color radar displays should seriously be considered to reduce cognitive processing time.

## CONTROLS AND DISPLAYS

Each pilot should have his own control/display unit. The four CRT displays should be capable of displaying any format in either an original or a repeater mode. Navigation displays should be able to display waypoints, desired track, actual aircraft location, navaid information and radar information (weather, skin paint, beacon, or ground map). A station keeping display should give the pilot the information needed to maintain aircraft control and station when in a cell an d during cell join up. Each display should have a complete set of controls for brightness and contrast, as well as gain, range, antenna tilt, and cursor controls for those displays that will be used with the radar.

## TRAINING

### Secret Documentation

All crewmembers should be trained in the handling, decoding, and usage of classified material so that any crewmember can receive classified messages as they are received.

## Data Transfer System

All crewmembers should be trained in the use of the DTS as it applies to their crew position. Pilots should be trained in the navigation, and fuel aspects of the DTS, while boom operators should be trained in the weight and balance and cargo loading aspects of the DTS. All crewmembers should be trained in the DTS as it applies to NOTAMs, FLIPs, CIFs, etc.

## Navigation System

Pilots will need to be trained in navigation theory and the specific navigation systems on the aircraft. Boom operators, as a minimum, should be trained in the aircraft's navigation systems as a precaution against incapacitation of a pilot.

## Radar System

Pilots will need to be trained in radar theory and actual radar system performance. Again, boom operators should be trained in the aircraft's radar systems as a precaution against incapacitation of a pilot.

# REFERENCES

## Primary

Barbato, G. J., et al., (1980). Tanker avionics/aircrew complement evaluation (TAACE), Phase 0 - analysis and mockup, volume III: mission scenario. AFWAL-TR-80-3030. Wright-Patterson AFB, Ohio.

Boeing Military Airplane Company. (1984). Flight manual - USAF series KC-135R aircraft. T.O. 1C-135(k) R-1.

Boff, K.R., Kauffman, L. & Thomas, J.P. eds. (1986). Handbook of perception and human performance, volume II. New York: Wiley and Sons.

Geiselhart, R., Schiffler, R.J. & Ivey, L.J. (1976). A study of task loading using a three-man crew on a KC-135 aircraft. ASD-TR-76-19. Wright-Patterson AFB, Ohio.

Madero, R.P., Barbato, G.J. & Moss, R.W. (1981). Tanker avionics/aircrew complement evaluation (TAACE), Phase I - simulation evaluation, volume I. AFWAL-TR-80-3127. Wright-Patterson AFB, Ohio.

## Secondary

Barbato, G. J. et al., (1980). Tanker avionics/aircrew complement evaluation (TAACE), Phase 0 - analysis and mockup, volume II: summary of data. AFWAL-TR-80-3030. Wright-Patterson AFB, Ohio.

Geiselhart, R., Koeteeuw, R.I. Capt. & Schiffler, R.J. (1976). A study of task loading using a four-man crew on a KC-135 aircraft (giant boom). ASD-TR-76-33. Wright-Patterson AFB, Ohio.

Madero, R.P., Barbato, G.J. & Moss, R.W. (1981). Tanker avionics/aircrew complement evaluation (TAACE), Phase I - simulation evaluation, volume II. AFWAL-TR-80-3127. Wright-Patterson AFB, Ohio.

Meister, D. (1985). Behavioral analysis and measurement methods. New York: Wiley and Sons.

Schiffler, R.J., Geiselhart, R. & Griffen, J.C. (1978). A study of crew task loading on the C-141A aircraft. ASD-TR-78-1. Wright-Patterson AFB, Ohio.

Schiffler, R.J., Geiselhart, R. & Ivey, L.J. (1976). Crew composition study for an advanced tanker/cargo aircraft (ATCA). ASD-TR-76-20. Wright-Patterson AFB, Ohio.

US Air Force Academy, Human factors engineering: applications and evaluation - BS374 course handbook.

# APPENDIX A

## FOUR MAN CREW TASK LISTS

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## MISSION PLANNING

### PILOT FUNCTIONS

Complete mission paper work
Discuss mission requirements with wing intelligence and communications officers
Attend pretakeoff brief

### COPILOT FUNCTIONS

Complete offload plan
Get Form 365 data from Boom
Print out Form 200
Discuss mission requirements with wing intelligence and communication officers
Attend pretakeoff brief
Input coordinates, airspeeds, altitudes, control times, gross weight, fuel load, receiver type and offload amounts

### NAV FUNCTIONS

Prepare Navigation Charts
Select Correct charts
Develop route of flight to meet mission timing
Plot Celestial Navigation Leg on charts
Place Special Use Airspace data on charts
Place Air Refueling data on charts
Place Emergency Airfields on charts
Annotate Highest terrain and obstructions on chart
Annotate Level Off Point
Annotate ADIZ Entry Point (if applicable)
Complete Mission Paperwork (mission review worksheet, pre-comp sheet)
Complete Form 200
Complete navigator briefing guide
Complete Correlation Sheet
Complete Scheduling blocks of Mission Accomplished Report (MAR)
Review and study Flight Information Publication (FLIP) and General Planning (GP) requirements
Conduct Crew Flight Briefing
Discuss mission requirements with Wing intelligence and communications officers
Study Mission Charts
Check Form 200 and chart for accuracy
Fill out known information on in-flight log
Determine Where Celestial observations will take place
Predetermine Radar targets at action points
Attend Pretakeoff Brief

### BOOMER FUNCTIONS

Plan Cargo Loading
Check Cargo Unit Dimensions
Check For hazardous materials
Determine Weights of Cargo Units
Determine CG Location of Large Cargo Loads
Compute Contact Area Pressures
Determine Shoring Requirements
Determine Load Plan of Cargo
Complete Forms 83, 83A and 84
Determine load and aircraft CG Location
Coordinate and Order Flight Meals
Perform aircraft exterior preparation for cargo loading
Check Tail Support Strut Installed
Check Chock position
Check Ground Wire installed
Check Cargo Loading Area clear
Check Fire Extinguisher available
Perform Aircraft Interior Preparation for Cargo Loading
Check Tiedown Equipment
Check Shoring
Open Cargo Door
Check Cargo Door Sill protected
Stow Seats
Position Shoring
Check Manifest and Waybills
Check Mounted Cargo secured to Carrier
Brief Load Team Members
Position Loading Vehicle
Load Cargo
Secure Cargo
Stow Loose equipment

### BOOMER FUNCTIONS (continued)

Perform Flight Crew Planning
Complete DD Form 365-4 weight and balance information with computer or by hand calculation
Complete Other mission planning paperwork: AF-781, AF-791, AFTO-
Perform Boom Operator portion of mission briefing
Brief Offload Type
Brief Offload Amount
Brief Air Refueling Control Times
Brief Receiver Type
Brief Receiver Callsigns

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# SQUADRON/BASE OPS AND COMBAT CREW DUTIES

## PILOT FUNCTIONS

Check weather
Check Notems
Compute take-off data
Conduct MITO/Cell briefing
File mission paper work (Flight plan, weight and balance, etc.)
Check aircraft and mission status
Brief planned flight demonstration maneuvers
Brief touch and go procedures
Brief deployment requirements if applicable
Brief cell procedures
Brief MITO procedures
Complete local mission planning/ briefing certificate if applicable
Complete flight plan

## COPILOT FUNCTIONS

Read Crew Information File
Go to Life Support
Pick up Publications, Quick Dons, helmet, and mask
Attend Weather Briefing
Update Takeoff data as required

## NAV FUNCTIONS

Perform Squadron Preflight Activities
Check Flight Schedule for changes
Review FCIF (if applicable)
Perform Base Operations Duties
Attend Weather Briefing
Check weather for impact on mission timing
Review approach plates and enroute charts
Check Flight Notices to Airmen (NOTAMS)
Synchronize Crewmembers' watches (Time Hack)
Check Aircraft parking spot
Check receiver status
Attend Crew Briefing and Cell briefing (if required)
Pick-up Helmet and Oxygen Mask from life support
Perform combat crew duties
Pick up required in-flight publications
Check for departing and landing airfield pages
Pick up classified information
Check KIK-18
Pick up KY-58

## BOOMER FUNCTIONS

Check Crew Information File
Coordinate Life Support equipment
Attend Weather Briefing
Pick up flight meals

# POWER OFF/WALKAROUND

## PILOT FUNCTIONS

Perform walkaround inspection
Check Interphone and oxygen system
Complete crew report
Test and check interior lights
Read AF Form 781
Notify crew of type of fuel on board
Verify APU with generator loaded
Notify crew of engine start time
Brief AF Form 781 data
Review AF Form 781 data, as required
Complete mission and weather briefing
Announce start engines time
Provide additional instruction, as required
State which APU has generator
Inspect and close nose compartment
Check for presence of Foreign Object Damage (FOD)
Check nose gear strut position
Check nose gear pin removed
Ensure scanners are connected to nose gear doors
Check manual downlatch valve cover closed
Check right wheel well
Check right gear system Hydraulic accumulator pressure
Check wheel well
Set manual retracting valve handle to FLIGHT
Check single point refueling receptacle
Ensure landing gear door downlocks are removed
Ensure landing gear pins are removed
Check right wing
Check general condition of engines
Check fire bottle discharge indication
Check fire bottle pressure gage
Check wheel well general condition
Ensure door downlocks removed
Ensure landing gear safety pins removed
Check left wing
Check general condition of engines
Check fire bottle discharge
Check fire bottle pressure
Inspect aircraft main fuselage ext
Ensure pilot covers are removed
Check aircraft/ramp general condition
Ensure pins, downlocks and ground valve removed

## COPILOT FUNCTIONS

Attend Crew Assembly
Perform Interior Inspection (Power off)
Check FDRGA Circuit Breakers
Check Instructor Oxygen Panel
Check Regulator OFF, Diluter lev at at 100%
Bleed, pressure dom
Check Portable Oxygen Bottle
Set Altitude Selector Knob to NORM
Check pressure above 50 psi
Check Hydraulic Press. Switch OFF
Check Engine Starter Switch OFF (R)
Check PRC switches ON, guard closed
Check Emergency Hydraulic crossover valve lever in NORMAL
Check Pressurization/Air conditioning panel
Check Cabin Pressure Test Valve handle position
Set Master Switch OFF
Set Cabin Manual Pressure Control OFF
Set Cabin Pressure Controller as required
Set Cabin Pressure Rate Of Change knob as desired
Check Air Conditioning Crossover switch OPEN
Set Cabin Temperature Control as desired
Check Air Conditioning Master switch to RAM AIR
Check Alternate Pressurization switches OFF and guards closed
Check Overhead Panel
Check radns in preset mode
Set manuals to initial planned frequency
Check UHF Comm 1
Check UHF Comm 2
Check VHF (if applicable)
Check all switches OFF
Check Flight Director Mode selector switch in GYRO
Check IDG Switches NORMAL (R)
Check Fire Switches IN
Check Inboard Spoiler Switch in CUTOFF
Check Landing Gear Handle DOWN, in Detent
Check Fuel Panel
Check all Fuel Valves CLOSED
Check all switches OFF
Set CDU Select Panel
Check Power Switch in NORM
Check CDU Select Switch in DNS
Check Radar Intensity Switch Full counter clockwise
Check Throttle CUTOFF
Check Rudder Power Switch OFF
Check Trim Servo Switch in NORMAL
Check Anti-Icing J-4 Panel
Check Anti-Ice, Pilot Heat, and
Check Battery voltage if applicable
Set Windows Heat OFF (as applicable)
Ensure J-4 Compass Mode Selector switch in MAG
Perform APU Start Procedures if required
Perform External Power applications procedures (if applicable)
Set External Power Switch to TRIP (if applicable)
Check all Warning Flags (as applicable)
Set Battery Power Switch to EMERGENCY (if applicable)
Check EGT Lights if applicable
Check Battery voltage if applicable
Activate Alarm Bell (momentarily)
Perform APU Start Procedures if required
Set External Power Switch to CLOSE if applicable
Check T-R voltage
Set Battery Power Switch to NORMAL (if applicable)

## NAV FUNCTIONS

Attend Crew Assembly
Perform Interior Inspection (power off)
Check Portable Oxygen Bottle
Check Cleanliness, general condition, and stored in normal position
Check For pressure approximating 300 PSI
Check Altitude Selector Knob in NORMAL position
Service Portable Oxygen Bottle (if required)
Replace Portable Oxygen Bottle
Hook up helmet to oxygen
Prepare Navigator station for preflight
Take out chairs and equipment
Take out Navigation Publications
Ensure Celestial Tables and Air Almanacs on board and current
Perform IFF Control Panel preflight
Set Master Switch OFF
Set Mode 4 Code Switch to A or B (as required)
Set Mode Enabling Switches OUT
Set Mode 4 On/Out Switch ON
Set Mode 3/A Code Selectors to all 0s
Check MSU-INS and MSU-DNS Mode selectors OFF
Check CDU Power Switch in NORMAL or AUX
Set APN-218 Doppler Switch to OFF
Set Search Radar Control Panel
Set FTC Switch OFF
Set IAGC Switch OFF
Set PATT switches as desired
Set Bearing Switch as desired
Set STC Dial full counterclockwise
Set Stab Switch OFF
Set Gain Control full counterclockwise
Set Heading Select Knob to local magnetic variation
Set Scan Switch OFF
Set Test Meter Switch to "MAG"
Set Range Switch to 3-30%
Set Function Switch OFF
Set Radar Pressurization Control switch to ON
Set Radar/Rendezvous Control Panel
Set Master Power Switch OFF
Set Pulse Width Switch (as required)
Set Code Selector Switches (as required)
Set Electronic Cabinet Cooling switch to ON
Set Search Radar Indications
Set Range Delay Switch OFF
Set Intensity Control Knob fully counterclockwise
Set Range Control Knob fully clockwise
Set Interphone Panel
Set Interphone Panel Switches as desired
Set FSACAS Control Panel (if applicable)
Set FSACAS Power Switch OFF
Check Oxygen System
Turn Oxygen Supply Lever ON
Don Flight Helmet and Oxygen Mask
Check Helmet and Mask connections
Place Oxygen Regulator-Diluter lever to 100 percent
Test Oxygen Mask for leaks
Place Emergency Oxygen Toggle lever to EMERGENCY
Place Regulator-Diluter Lever to NORMAL
Place Emergency Toggle Lever to center position
Place Oxygen Supply Lever OFF
Place Oxygen Regulator-Diluter lever to 100 percent
Test Helmet Transmit/Receive capability
Take off helmet
Don headset
Test transmit/receive capability
Complete Crew Report
Place Interphone Rotary Switch to CALL position
Acknowledge Crew Position (verbally)

## BOOMER FUNCTIONS

Attend Crew Assembly
Start APU
Check Crew Equipment Stowed
Walkthrough Aircraft to Determine Preflight Schedule
Check Circuit breakers
Remove And store Nose Gear Ground/Downlock And Release
Check Portable Oxygen Bottle
Check Interphone Panel settings
Check Interphone
Perform Oxygen System check
Perform Boom Operator's forward station preflight
Perform Crew Report
Perform Sextant Check (if required)
Position Navigator's Sighting Stool
Check Sextant Mount
Install and Check Alignment of Sextant
Check Timer
Perform Instantaneous Shoot (as required)
Remove And store Sextant and Stool
Perform Cargo Compartment Preflight
Check Cargo Compartment A/C interior switch in MANUAL
Check Passenger Station Oxygen Panel
Check Gaseous Oxygen System Quantity Gage
Check Gaseous Oxygen System Valves
Perform Boom Operator's compartment preflight procedures
Check Air Outlet Doors and Defrost Slide
Open Sighting Door
Check Interphone Panel
Check Oxygen Regulator
Check BO Oxygen Regulator
Check Emergency Override Switch
Check Boom Limit Switches
Check Indicator Lights
Set Telescope-at-Disconnect Switch
Check Circuit breakers
Set A/R Boom Operator's Control Panel Master Switch ON
Check Boom fully retracted
Perform Signal Coil Test
Set Underbody and Underwing Lights ON
Check Nozzle Light and Tail Mounted Floodlight (Night A/R
Close Sighting Door open
Close Sighting Door Lever
Set Ruddevator Trim Control at ZERO
Perform Miscellaneous Preflight Procedures
Verify DD Form 365-4 data
Conduct Ground Safety Locks Check
Inform Pilot of Actual Takeoff Weight and Center of Gravity
Ensure Cargo and loose equipment Secure
Perform APU Accumulator Check
Close Cargo Door and Emergency Exit Hatches (if required
Check External Power Switch Trip
Perform Passenger Loading
Check Seats and Safety Belts
Position Life Support Equipment
Check Passenger Information Cards
Remove Floor obstru.stres
Install Boom Operator/Compartment Entry Panels
Open Cargo Door
Position Passenger Loading Stand
Brief Passengers
Direct Personnel to Seats and verify Manifest
Check Cargo Manifest
Secure Baggage and loose Equipment

## PILOT FUNCTIONS

Check battery charging current
Check battery charging level
Pressurize hydraulic system
Check pressure switches ON
Set right system auxiliary pump switch to AUTO
Set left system auxiliary pump switch to RESERVE BRAKE
Set left system Auxiliary pump switch to AUTO
Check antiskid system
Check parking brake OFF
Check Test panel indicator BLANK
Set antiskid test switch to FWD
Set antiskid test switch to AFT
Ensure test panel indicators are BLANK
Check hydraulic pressure in normal range
Check speed brakes
Set inboard spoiler switch to NORMAL
Set speed brake lever to 60 degrees
Set yoke to full left
Set yoke to full right
Set yoke to center
Set inboard spoiler switch to CUTOFF
Set outboard switch to cutoff
Set speed brake level to zero degrees
Return inboard and outboard spoiler switches to NORMAL
Check ailerons and glare shield clearance
Move yoke left
Move yoke right
Move yoke center
Check aileron trim
Check elevators
Check trim indication
Move yoke forward
Move yoke aft
Move yoke center
Check electric trim
Check manual trim
Actuate stab trim control switch NOSE DOWN then NOSE UP
Set stab trim control switch to CUTOUT
Set Stab trim control switch to NORMAL
Check rudder
Check rudder power switch OFF
Push rudder full LEFT
Push rudder full RIGHT, then release
Set rudder power switch to ON
Check rudder pressure
Check rudder trim
Check Engine Failure Assist System (FSAS)
Set EFAS switch to TEST, then ON
Check engine system
Check yaw damper system
Check HF radio
Set SYD switch to TEST, then ON
Check DISENG light comes on and goes out within 35 seconds
Check radios
Check ILS receivers
Check VOR
Check TACAN
Check COMM 1 UHF
Check COMM 2 UHF (ground radio)
Check HF radio
Set-up HAVE QUICK radios
Determine HQ I or II availability
Load Word of Day (WOD) or load Multiple WODs (MWOD)
Set Time of Day (TOD)
Practice WOD/MWOD
Check operation of altimeters
Check flight director heading mode

Check instruments
Check all dials and gauges
Check Attitude Director Indicator (ADI)
Check INS gyro
Set clock
Set oil lamp selector switch to TEST
Set oil lamp selector switch to M
Check fuel quantity readings
Check Rotation Go Around (RGA) mode Check flap and speed brake warning horn
Check Autopilot
Check autopilot turn knob in detent position
Set autopilot engage switches ON, as required
Set autopilot turn knob LEFT then RIGHT
Rotate autopilot pitch knob NOSE UP, then NOSE DOWN
Depress pilot's disengage button
Set autopilot engage switches ON, as required
Activate stab trim switch
Press test switch, if applicable
Press valid/invalid test indicator, if applicable
Check flight controls for freedom of movement
Set trim for take-off
Move flight director mode selector to gyro
Adjust seats, pedals, belts and harnesses
Ensure fuel panel set for take-off
Perform CELL check
Perform ground radio check
Inform CELL lead ready to start engines
Check APU accumulator pressures
Set taxi pump to OFF
Review takeoff and emergency procedures
Perform FSA/CAS alignment and insertion procedures

## POWER ON INSPECTION

Close Generator Breaker Switches
Set Remaining Switches ON as required
Set VOR to ON
Set TACAN to ON
Set VHF Radio ON
Set UHF Radio ON
Set HF Radio ON
Set Autopilot ON
Set RGA Power Switches ON
Set Instrument Power Gyro
Ensure Required publications are available
Ensure presence of Aircraft Flight Manuals
Ensure Parachute preflight completed
Check Interphone and oxygen
Ensure Crew report complete
FSAS preflight procedures
Ensure FSA/CAS POWER Switch ON
Accomplish IFMP Interface Test
Check FUEL Key
Press FUEL Key
Press Data Key
Press Malfunction Data Key
Verify Airplane Type
Verify Engine Type
Verify Brakes and Anti-Skid type
Check ICDU STATUS Displays
Check System Status Display
Steer ICDU Display to Bus Status 2/3
Check Bus Status Display
Check WT and Balance info on ICDU for FSAS
Obtain Crew Report
Set interior lights
Check wheel wells clear
Ensure System Pressure Switches ON
Check anti-skid
Check Fuel Quantity reading
Check Hydraulic System Pressure
Check Hydraulic System quantity
Check Pump Supply Guards CLOSED
Press to Test all gages
Record actual readings on Form 14, 365-4 and flight log
Hydraulic Pressure checks
Check L/R Systems & Pilot's reserve
Pressure gages in Normal range
Turn on autopilot yaw damper switch
Check Gear Warning Light extinguished
Complete control & trim check
Check Fuel Dump Actuator
Check Boom retracted
Set Fuel Dump Switch to FUEL DUMP
Set Fuel Dump Switch to OFF
Ensure Wheel Well Doors clear
Receive Report from each crewmember
Check INS/DNS CDU Test Switch (if applicable)
Check INS/DNS NAV INOP Light Illuminated
Check Fuel Dump Actuator
Set Fuel Dump Switch to FUEL DUMP
Check Flap lever in 50 degree detent
Accomplish DNS Interface Test if desired
Depress Copilot's autopilot Disengage button
Set Fuel Dump Switch to OFF
Set Stabilizer Trim as required
Set Flap Lever to 40 degree detent
Move Flap Lever through 30 degree to 20 degree detent
Set Flap Lever to 50 degree detent
Set Flap Lever to 30 degree detent
Set Flap Lever to 0 degree detent
Set Flap Lever to 0 degree detent

## COPILOT FUNCTIONS

Perform Interior Inspection (Power On)
Set FD Master Power Switches ON
Ensure FD 109 Power Off Lights ON
prior to placing switches ON
Set FD 109 Master Power Switches to ON
Ensure FD 109 Power Off Lights out after placing switches ON
Perform APR Panel Checks (As applicable)
Set Master Refuel Switch to ON
Press to test all indicator lights not illuminated
Set Manifold Valves Switch to FLIGHT
Check Main AFR/FR Valve Switch CLOSED
Check Tank Level Control Switches CLOSED
Check Scavenge Switch OFF
Check Reverse Refuel Pump Switch OFF
Check Slipway Door Switches CLOSED
Check Signal Amplifier Power Switch in NORMAL
Check Manual Toggle Latch Switch in RELEASE
Set Master Refuel Switch to OFF
Check Engine Bleed Valves OPEN
Perform Bleed Air Leak Detection test
Press Bleed Air Leak Detection test switch
Check at LEAK DET, OVER PRESS and OVER TEMP Lights ON
Release Test Switch
Ensure Lights go out after releasing test switch

## NAV FUNCTIONS

Set Navigation Lights
Set Flash-Steady Switch to FLASH
Set all Fuel Boost Pump Switches to ON
Set Bright-Dim Switch to BRIGHT
Set #2 Tank-To-Engine-Manifold Valve Switch to OPEN
Set A/R Line Valve Switch to OPEN
Report ACDS Lights ON/OFF if applicable
Perform Interior Inspection (power on)
Set Control Panel Switches (As Required)
Perform N-1 Compass Preflight
Check Latitude Correction Pointer OFF
Set Compass to correct MAG heading
Center Annunciation Pointer
Accomplish Grid Check (if required)
Perform INS/DNS System Preflight procedures
Check INS-Doppler Status Panel
Set MSU-INS and MSU-DNS Mode selectors to ALIGN
Turn on FSA/CAS power switch
Perform APN-218 Doppler Checks
Turn Mode Selector to LAND
Perform Bit Test
Turn Mode Selector to OFF
Insert INS and DNS
Set IFF Miter Switch as desired
Set IFF Antenna Switch to BOTH
Set RAD - TEST/MON Switch to OUT
Set IFF Master Switch to NORMAL test modes 1, 2, 3/A and C
Encode Mode 4
Check Mode 4 light out
Set Master Switch to STANDBY
Set Mode 1, 2, 3/A, and C switches as required
Set Mode 1, 2, and 3/A Codes as required
Set Audio/Light Switch (as required)
Set RAD - TEST/MON Switch (as desired)
Turn APN-59 Function Switch to STBY
Perform Altimeter Preflight procedure
Set Altimeter to correct Barometric Pressure
Compare Altimeter setting with field elevation
Accomplish INS Interface Test
Insert Waypoint Data
Insert TACAN Data
Verify waypoints
Perform Launch Authentication procedures
Load KY-58
Request Authentication and Launch message from command post
Respond With correct Authentication
Install sextant stool and sextant
Check sextant mount
Check sextant desiccant
Check sextant
Check averager
Check sextant alignment
Observe a celestial body
Perform celestial precomp
Resolve sextant accuracy
Remove and stow sextant and stool
Turn FSA/CAS Power Switch ON
Fit Life Preserver Unit (LPU)

## BOOMER FUNCTIONS

Continue with power off list if required

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## STARTING ENGINES AND BEFORE TAXI

### PILOT FUNCTIONS

Start APU if required
Fasten belts and harnesses
Turn oxygen to 100 percent
Set battery switch to EMERGENCY
Set hydraulic pressure switches
Flip external power switch as required
Set parking brakes
Check hydraulic pressure
Set starter switch to START *
Start 1 engine *
Set throttle to START at 25 percent N2 RPM*
Monitor engine instruments *
Set throttle to IDLE at 50 percent N2 RPM*
Set starter switch to OFF *
Turn on starter selector switch (last engine only)
Check overhead panel caution lights
Shutdown APU as required
Ensure external power and chocks removed
Set battery switch to NORMAL
Turn on engine anti-ice as required
Reset altimeters
Check INS NAV INOP and DNS NAV INOP lights
Ensure taxi report complete

* Repeated for each engine

### COPILOT FUNCTIONS

Fasten seat belts and harness
Set oxygen to 100%
Set External Power Switch to CLOSE
Set Air Conditioning Master switch
Set Throttle to Cross Start RPM if required
Check Overhead Panel Caution Lights out
Set Generator Circuit Breaker Switches to CLOSE if required
Set Beacon and Navigation Light Switches to BOTH ON and STEADY
Set Copilot's Instrument Power Switch to START
Set Pitot and Q-inlet Heat Switches to ON
Set Engine Anti-ice as required
Perform Taxi Report Procedures
Set Air Conditioning Master Switch as required
Set altimeter to STANDBY
Confirm INS NAV INOP & DNS NAV INOP as required

### NAV FUNCTIONS

Perform Starting Engines And Before Taxi checklist procedures
Turn Oxygen System ON
Set INS/DNS System to NAV Mode
Don Gloves
Monitor engine start
Perform Aircraft Electrical Power check
Check For at least One Generator on line
Perform IFF Control Panel preflight
Set IFF Master Switch to STANDBY
Turn APN-218 Doppler Mode Selection ON
Turn search radar to STBY
Set Radar/Rendezvous Beacon as required
Perform Warning and Indicator Light Test
Report over Interphone "Ready to Taxi"
Check receiver status
Ensure Taxi Clearance received

### BOOMER FUNCTIONS

Perform Before Starting Engines procedures
Start APU (if required)
Remove Entrance Ladder
Close And latch Entry Door
Stow Entrance Ladder
Check Emergency Exit Hatches
Turn On Boom Operator's Compartment Window Heat Switch
Check Air Refueling Line Valve OPEN
Cycle APU Generator Switch

# TAXI

## PILOT FUNCTIONS

Check hydraulic pressure, brakes and steering
Check flight controls
Check flight instruments
Check speed brakes to ZERO
Set flaps
Advance power momentarily to begin taxi
Release parking brakes
Position airplane as required
Check powered rudder system
Check system and rudder power hydraulic pressure gauges
Push rudder pedal full LEFT
Push rudder pedal full RIGHT and hold
Push rudder pedal full LEFT and hold
Set EFAS and SYD switches to ON
Set EFAS switch to ON
Set yaw damper switch to ON
Review takeoff data
Ensure trim ready for takeoff
Check rudder trim at ZERO
Check aileron trim at ZERO
Check stab trim
Set and recheck NAV aids
Set flight director and climb selector switch to RGA mode
Set APU start-stop switches to STOP if required
Obtain last chance inspection
Check radar to STBY
Set parking brakes
Clear SOF for last chance inspection report
Check EFAS/SYD annunciators
Check annunciators
Check APU doors open and lights turned out
Close windows
Turn on window heat
Adjust throttle friction
Obtain MITO approval
Change radios to MITO discrete frequency
Obtain radio check on MITO frequency
Set power for MITO
Release parking brakes when directed by lead
Scan for traffic
Maintain spacing
Accomplish additional radio checks as required
Accomplish takeoff report

## COPILOT FUNCTIONS

Check hydraulic pressure, brakes and steering
Obtain taxi clearance
Check/set Anti-Ice Equipment as required
Set Anti-Icing ON
Set Anti-Icing OFF unless needed for takeoff
Set Flaps as required
Check Overhead Panel
Ensure Bus Tie, Generator breaker and generator control lights off
Check Main T-R Units for normal operation
Check Air Conditioning and AC ammeters for balanced load
Check Pressurization Panel for proper switch settings
Check Circuit Open, IDG Failure and DISC system lights out if applicable
Discuss Take-Off Data
Set Stabilizer Trim for Takeoff
Obtain Weather data
Recompute Takeoff data if required
Obtain ATC clearance
Review and set N1 RPM Indices
Set NAV aids for departure
Set FLT Director Mode & Climb Selector switches to RGA Max Mode
Check Door Warning/OVHD Panel Caution Light, as applicable
Close window and set Window heat switch as required
Accomplish Crew Take-off Report
Scan for traffic

## NAV FUNCTIONS

Perform Search Radar Turn On Procedures
Set Function Switch to SEARCH
Adjust Intensity Control
Adjust heading mark intensity control
Set Scan Switch as desired
Set Stab Switch to UP
Fine-tune Radar
Check beacon capability
Perform Radio Procedures (As Required)
Ensure Departure Clearance is received
Ensure Flight Safety Check by (SOF) is accomplished
Ensure MITO/Cell Radio Check is accomplished
Fasten Seat Belt and Shoulder Harness
Perform safety check
Prepare For Takeoff
Report ready for takeoff

## BOOMER FUNCTIONS

Notify Passengers and Extra crewmembers prepare for takeoff
Check Cargo Door Closed and Locked
Complete TAXI Report
Monitor Electrical Control Panel

## BEFORE TAKEOFF

### PILOT FUNCTIONS

Accomplish before takeoff checklist
Ensure fuel panel set for take off
Ensure landing lights on
Rotate beacons as appropriate
Move starter switches to ignition
Turn radar on
Scan for traffic

### COPILOT FUNCTIONS

Set lights as required
Call for pilot to move starter switches
    to IGNITION
Scan for traffic

### NAV FUNCTIONS

Perform Before Takeoff Checklist Procedures
Set Radar/Rendezvous Beacon (as required)
Set IFF (as required)

### BOOMER FUNCTIONS

Check Passenger and extra Crewmember
    status
Check Fuel distribution
Check Circuit breakers
Set Oxygen Panel ON, 100%
Fasten And lock Safety Belts and Harness
Complete Takeoff Report

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## TAKEOFF

### PILOT FUNCTIONS

Advance power as required
Release parking brake as directed
Maintain left hand on nose wheel
   steering as required
Taxi into position and align aircraft
   with centerline
Assure flight idle
Maintain full pressure on yoke
Maintain spacing/timing as required
Direct copilot to set take-off thrust
Maintain directional control and
   wings level
Check airspeed at 90 knots
Maintain full forward until ground
   minimum control speed is reached
Acknowledge S1 interphone call as
   required
Activate Rotation Go Around (RGA)
   within 10 knots of rotation speed
Pull back on yoke until takeoff attitude is
   reached
Call for gear up
Follow command bars as required until
   2000 feet above ground
Push forward on yoke
Call for flaps up
Check hydraulic pressure in low range
Look for lead aircraft visually or on radar

### COPILOT FUNCTIONS

Turn Radar Intensity Switch clockwise
Hold yoke full forward
Check for FLT Idle on all four engines
Announce FLT Idle on all four engines
Set Takeoff thrust
Call 90 knots
Call S1
Call pickle
Call rotate
Call climb speed
Raise Gear
Move flaps up

### NAV FUNCTIONS

Perform Takeoff Duties
Monitor lead aircraft for MITO timing
Record Takeoff Time
Monitor Aircraft instruments
Perform Initial Climbout procedures
Ensure positive rate of climb
Ensure Gear Up
Ensure flaps raised

### BOOMER FUNCTIONS

Monitor Takeoff (Overhead Control Panel)

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## CELL JOIN UP

### PILOT FUNCTIONS

Perform joinup procedures as required
Maintain cell position as required
Call for climb power and after takeoff climb check
Ensure landing gear up
Ensure flaps up
Call for engine anti-ice on/off
Set starter switches as required
Set altimeter to 29.92 and radio altimeter MDA Index to 2000 feet
Ensure oxygen on, 100 percent
Ensure fuel panel is set
Ensure RGA switches off
Level off
Pull power back
Set level flight attitude
Trim aircraft
Engage autopilot
Maintain formation position
Change position as required
Perform cell communications as required
Terminate formation if necessary

### COPILOT FUNCTIONS

Turn off Starter Switches (as required)
Turn on Engine Anti-Ice (as required)
Check Cabin Pressurization
Set Fuel Panel as required
Turn off RGA Power Switches
Turn off landing light at 10,000 Ft.
Set radio altimeters to 2000 Ft.
Direct crew to set 29.97 Altimeter setting passing FL180

### NAV FUNCTIONS

Perform Cell Joinup
Direct Pilot Into Enroute Formation
Use All available equipment to effect Join Up
Inform Pilot of other Aircraft's position
Ensure Level Off In Altitude Block
Acquire lead aircraft on radar
Make departure call
Monitor Departure Being Flown
Ensure Correct Headings are flown
Ensure Correct Altitudes are flown
Perform Climb Altitude Procedures
Perform After Takeoff Checklist Procedures
Check IFF Mode 4 Caution Light off
Reset Altimeter at Transition Altitude
Ensure Oxygen Requirements Are Met
Ensure Oxygen Is ON and at 100% when aircraft is above 10,000 ft.
Ensure Oxygen is readily available above FL250
Don Helmet above FL430
Make 2,000' prior to Level Off Call
Make 1,000' prior to Level Off Call
Record Level Off Time
Monitor Interphone And Radios
Monitor Interphone and COMM radios from takeoff
Monitor HF after passing out of home station UHF range during alpha monitor periods

### BOOMER FUNCTIONS

Turn Off Wheel Well Lights
Set Air Conditioning Master Switch to CONDITION AIR
Install Sextant Stool (If Required)
Install Sextant
Check Cargo Compartment
Turn On Nacelle Illumination
Set Boom Nozzle Light (as required)
Set Boom Marker Lights (as required)

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# CRUISE #1

## PILOT FUNCTIONS

Maintain cell position
Perform turbine engine monitoring system (TEMS) test

## COPILOT FUNCTIONS

Check hydraulics
Check electrical system
Monitor fuel system
Monitor O2 system
Monitor engine instruments
Give control of HF Radio to NAV

## NAV FUNCTIONS

Perform General Cruise/Navigation
Complete Comm Log
Request And record UHF Traffic
Accomplish HF Contact
Record HF Traffic
Monitor Radios And Interphone
Monitor UHF Command Post/Cell frequency
Monitor UHF Air Traffic Control frequencies
Monitor HF giant talk during alpha monitor period as applicable
Update IFF Mode 3A as required
Monitor Interphone as required
Monitor And Update Navigation Equipment as required
Update INS/DNS position
Monitor APN 59 Radar
Monitor Navigation Radio aids
Perform station keeping duties
Keep Aircraft within 10 NM of track
Direct Aircraft to avoid thunderstorms by 10 NM below FL230
Direct Aircraft to avoid thunderstorms by 20 NM at or below FL230
Accomplish In-flight log entry requirements
Record Aircraft position and time at all planned turn points
Record Aircraft position at least once every 30 minutes

## NAV FUNCTIONS(Cont.)

Perform Celestial Navigation
Prepare For Celestial Navigation
Ensure Celestial Navigation clearance is obtained if required
Set Equipment as required for specific navigation leg
Start Celestial Navigation
Take coast out fixes
Record Accurate Start Position and Time
Compute "Alter Heading" and ETA to turn
Perform Dead Reckoning (DR) Navigation
Accomplish Celestial Pre-comps (SACF 289)
Resolve MPP/FIX
Complete Log work on Form 200
Direct Aircraft along planned route to coast end point/ADIZ
Accomplish Celestial control time to air refueling control point
Monitor Navigation equipment for malfunction
Perform Overwater Navigation
Update INS/DNS as required
Set IFF as required
Set APN-218 to SEA
Track Aircraft Position
Use All navigation aids to monitor position within 20 NM of track
Update ETAs to Pilot as necessary for HF position report
Monitor Interphone and Radio
Perform Cell Formation
Perform Station Keeping Duties
Monitor Radar for Skin Paint or Beacon
Keep Pilot informed (verbally) on Aircraft position

## BOOMER FUNCTIONS

Provide Crew Support (as required)
Take Celestial Observations
Collect Azimuths and Elevations From navigator
Dial in Azimuth and Elevation
Give Elevations to Navigator

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# PREPARATION FOR CONTACT

## PILOT FUNCTIONS

Accomplish preparation for contact checklist
Check altimeter
Reset altimeter
Confirm altimeter setting
Ensure proper air refueling frequency
Disconnect autopilot elevator/pitch axis
Accurate stabilizer trim
Check stabilizer trim
Reengage autopilot elevator/pitch axis
Check autopilot stabilizer trim follow up
Set Air-to-Air TACAN
Establish air refueling echelon formation
Initiate 1/2 mile checklist
Check oxygen as required
Confirm oxygen setting correct
Set autopilot HDG SEL/VOR LOC switches to OFF

## COPILOT FUNCTIONS

Obtain permission to delay at the ARCP until revised ARCI
Obtain block altitude
Request permission to conduct AR
Declare MARSA (Military Assumes responsibility for separation of aircraft)
Compute Max Continuous Thrust setting
Post Max Continuous Thrust setting
Compute turn range and off-set
Set Max Continuous thrust setting on N1 Bug
Compute turn range and off-set
Request end Air Refueling request from receiver

## NAV FUNCTIONS

Ensure RZ Timing is met
Adjust TAS to make timing
Adjust Track to make timing
Perform Orbit Holding Procedures
Compute Orbit Headings
Set Equipment As Required For Rendezvous
Perform station keeping duties
Monitor/Set Miscellaneous Equipment As required
Set Assigned Radio frequencies
Monitor Radios
Set Altimeter as required
Monitor Altitude
Establish Radio Contact With Receiver as required
Obtain Receivers information as required
Relay Tanker Information as required
Compute Turn Range And Offset
Determine Turn Range from chart using TAS closure and drift inbound
Determine Offset required from chart using TAS and drift inbound
Set Oxygen Regulator As Required
Set Oxygen Regulator to ON
Set regulator-diluter Lever to 100%
Perform Rendezvous
Ensure ATC clearance to air refuel received
Conduct Point Parallel Rendezvous
Establish Offset
Accomplish Automatic Direction Finder (ADF) check if applicable
Accomplish Positive Beacon ID (If applicable)
Start Timing
Instruct Pilot to turn at turn range
Monitor echelon position
Place Beacon to STBY as required
Initiate Overrun Procedures (If applicable)
Perform Precontact
Set Equipment As Required
Set Rendezvous Beacon Control to STBY

## BOOMER FUNCTIONS

Perform Air Refueling Preparation Procedures
Set Forward Oxygen Panel OFF, 100%
Inform Passengers and ext a Crewmembers
Set Refueling Oxygen Panel (If applicable)
Monitor Command Radios
Set Sighting Door Lever OPEN
Check Signal Coil
Set Telescope-At-Disconnect (as required)
Ensure Extension and Elevation Limit switches active
Set Emergency Override Switch (as required)
Set Receiver Director Light Rheostats
Turn On A/R Floodlight (as required)
Set Ruddevator Trim Control to Zero (as required)
Perform Boom Lowering Procedures
Extend Boom
Check Boom Controls
Obtain Radio Contact
Brief Receiver for Contact (as Required)
Set External Lights (as required)
Provide Visual commands to Receiver (As required)
Maintain Required communications with receivers
Maintain proper boom alignment

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## AIR REFUELING

### PILOT FUNCTIONS

Monitor receiver/observer position
Advance power as required
Maintain cell position

### COPILOT FUNCTIONS

Set altimeter to 29.92 or as briefed
Set Radios as required
Set Air to Air TACAN if required
Check oxygen
Dump Fuel if required
Set Lights as required
Set Position Lights to STEADY and DIM
Set Rendezvous Beacon Lights as required
Complete Fuel quantity check
Set No Smoking/Seat Belt lights ON as applicable
Set Autopilot VOR/LOC and Heading select switches off
Set TACAN as required
Set Fuel Panel for A/R
Set one A/R Pump Switch to ON
Set Beacon Lights to BOTH ON and Position Lights to BRIGHT

### NAV FUNCTIONS

Perform General Air Refueling
Record Air Refueling Data
Record Number of contacts
Record Amount of fuel transferred
Monitor Cell Formation (If Required)
Tune Radar for optimum picture
Keep Pilot advised of position
Maintain ATC Clearance Requirements
Alter Aircraft as necessary to maintain course within 10 NM of cleared course
Monitor And update NAV systems
Monitor Interphone and Radios
Monitor UHF Radios
Monitor HF Radio
Monitor Interphone
Perform Breakaway Procedures (If necessary)
Configure Radar to skinpaint Receiver at bottom of air refueling block
Set APN-69 to OPERATE
Monitor Altitude

### BOOMER FUNCTIONS

Perform Contact Procedure
Monitor Boom Position Indicators
Monitor Receiver position
Perform Disconnect or Breakaway procedures
Recycle System for subsequent contacts

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## POST AIR REFUELING

### PILOT FUNCTIONS

Initiate post air refueling checklist
Assure fuel panel reconfigured for cruise
Assure radios reset
Set altimeter to 29.92 and check oxygen 100 percent if required
Reestablish cell position
Maintain cell position

### COPILOT FUNCTIONS

Complete post air refueling check
Re-engage Autopilot as required
Provide Post A/R Report to Receiver/Cell
Set No Smoking/Seat Belt Lights as required
Record Fuel quantity
Establish Cruise Configuration
Set Position and Rendezvous beacon lights as required
Set Altimeter to 29.92 (as required)
Turn off oxygen (as required)

### NAV FUNCTIONS

Accomplish Post Air Refueling Checklist procedures
Set Radar/Rendezvous Beacon to OFF
Monitor Radios
Set Altimeters (if necessary)
Check Oxygen
Open fuel tank circuit breakers as required

### BOOMER FUNCTIONS

Perform Post Air Refueling procedures
Set Ruddevator Trim Control to "0" (as required)
Retract, Stow, and Latch Boom
Close Sighting Door with Sighting Door Lever
Check Ruddevators locked Switch
Set External Lights (as required)
Set Refueling Station Oxygen Panel
Inform Pilot BOOM STOWED
Return to Forward Cabin
Set Forward Station Oxygen Panel ON, 100%

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## CRUISE #2

### PILOT FUNCTIONS

Engage autopilot
Maintain formation position
Change position as required
Perform cell communications as
   required
Terminate formation if necessary

### COPILOT FUNCTIONS

Notify ATC A/R terminated
Pass reciever's requested route of flight
Make position reports when out of radar
   range
Obtain phone patch on HF radio to update
   weather
Establish VHF contact prior to coast-in

### NAV FUNCTIONS

Terminate Celestial/over water navigation
Accomplish Final DR position and announce
   ETA to coast end
Accomplish coast end fix
Terminate Celestial Navigation clearance
Check N1 and J4 compass heading
Assume Cell lead navigation responsibilities

### BOOMER FUNCTIONS

Provide crew support (as required)

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## PLAN DIVERT

### PILOT FUNCTIONS

Obtain destination weather
Direct navigator to determine range
Direct copilot to determine if we have
fuel capability to reach destination
Direct crewmember to look up
instrument flight rule supplement
Direct copilot to obtain proper
clearances
Coordinate plan with #1 aircraft
Obtain destination weather/monitor air
route traffic control center

### COPILOT FUNCTIONS

Compute fuel required for divert
Obtain ATC clearance

### NAV FUNCTIONS

Replan divert
Prepare chart
Compute distance, time, and fuel

### BOOMER FUNCTIONS

Provide crew support as required

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## DESCENT

### PILOT FUNCTIONS

Direct cell breakup

Call for descent checklist

Review weather

Review approach procedures

Direct navigator to advise destination base of aircraft status

Brief the approach

Confirm N1 RPM index set

Set specific altitude into radio altimeter

Insure navigation aides are set

Set starter switches to ignition

Direct anti-ice equipment use as required

Check switches and pressure of left, right, reserve brake, and powered rudder systems

Accuate brakes and check for gauge fluctuation

Reduce power to initiate descent

Ensure proper course, altitude, and airspeed

Set appropriate altimeter setting

Confirm descent checklist complete

### COPILOT FUNCTIONS

Make entries in landing data card

Back up NAV for ADIZ penetration time and coordinates

Accomplish descent checklist

Review descent and approach procedures

Set N1 RPM Index

Set Radio Altimeters

Set and select Nav Aids

Set Anti-icing Equipment

Check Electric and Hydraulic Systems

Set Cabin Pressure Controller at 500 ft above field pressure altitude

Set Altimeters

Turn Landing Lights on

### NAV FUNCTIONS

Prepare For Descent

Navigate To IAF

Monitor #1 aircraft

Review Penetration and Approach

Review highest terrain

Review emergency airfields

Review special use airspace

Authenticate mission change

Monitor weather reports

Monitor Aircrew Terminal Information service (ATIS)

Set Altimeters

Fasten Safety Belt and Shoulder Harness

Ensure Approach Clearance received

Contact Command Post

Perform Descent Altitude Procedures

Make "2,000' Prior to Assigned Altitude" Call

Make "1,000' Prior to Assigned Altitude" Call

Monitor Cell breakup

### BOOMER FUNCTIONS

Calculate Landing Center of Gravity

Stow Sextant Stool and Sextant

Check Circuit Breakers

Set Cargo Compartment Temperature

Notify Passengers and Crewmembers

Walkthrough to Boom Pod

Perform Boom Latched Check

Walkthrough to Forward Cabin

Fasten and Lock Safety Belt and Shoulder harness

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## APPROACH AND LANDING

### PILOT FUNCTIONS

Call for before landing checklist
Ensure speed brakes set to ZERO
Ensure autopilot disengaged
Direct copilot to lower flaps as required
Set EFAS/SYD switches on
Ensure proper navigation aides selected and set
Scan for traffic
Direct copilot to lower landing gear
Confirm landing gear down and locked
Check anti-skid system
Direct additional flaps as required for landing
Ensure fuel panel set for landing
Ensure flaps set for landing
Raise speed brakes
Apply wheel brakes as required
Ensure 4 engines in ground idle
Maintain aircraft directional control
Taxi clear of the runway

### COPILOT FUNCTIONS

Review Approach Procedure
Ensure Speed Brakes are set to zero
Set RGA Power & Speed Deviation switches ON
Ensure flaps set as desired
Check Rudder Hydraulic pressure
Set and Select Nav Aids
Monitor Altitude, Airspeed, Sink Rate, ground speed, wind sheer, A/C altitude
Scan for traffic
Set fuel panel for landing
Set Flaps for landing
Confirm A/C on center line for landing
Call VDP
Call out MDA/DH
Call missed approach point if necessary
Advise pilot when engines decelerate to ground idle during landing rollout
Check Anti-Skid after gear lowered
Check Rudder Pressure in hydraulic set

### NAV FUNCTIONS

Perform Instrument Approaches
Perform Airborne Directed Radar Approach (if required)
Relay Ground Speed and Drift Information
Ensure Altitude Restrictions are met
Configure Radar
Direct Descent as published as required
Monitor Approach
Monitor Radios
Monitor timing as required
Perform Safety Checks
Scan For Traffic
Check Flap setting
Check Gear position down
Check Pilot Approach Speed (as required)
Check Fuel Panel
Announce Approach for Decision Height or MDA
Call Missed Approach Point as required
Perform Go Around as required
Ensure Missed Approach Procedures Are Accomplished
Advise Pilots of any hazards noted
Make Required Altitude calls
Record Time
Monitor landing roll out/ground speed

### BOOMER FUNCTIONS

Monitor electrical control panel
Monitor fuel panel

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# AFTER LANDING

## PILOT FUNCTIONS
Call for after landing checklist
Set starter switches as required
Direct copilot set engine anti-ice as required
Take time hack
Set speed brakes to ZERO
Taxi airplane to assigned parking location as required
Shut down inboard or outboard throttles
Confirm APU if required
Ensure flight director mode selector switch in gyro
Direct copilot to request progressive taxi instructions
Direct engine shut down checklist
Set parking brake
Ensure INS accuracy check complete
Direct engine anti-ice to OFF (if not previously accomplished)
Set starter switches to OFF (if not previously accomplished)
Set battery power switch to EMERGENCY
Turn throttles off
Ensure APU start accumulator pressures are checked
Turn oxygen off
Ensure all electrical switches off or closed
Turn off window heat switches
Turn off instrument power gyro switches
Turn off boost pump and fuel valve switches
Turn off RGA power switches
Turn off FD #1 and #2 master power switches
Turn off radios and yaw damper
Turn off hydraulic pressure switches
Turn off lights
Ensure chocks installed and check brakes
Release parking brake
Stop APU as required
Set battery power switch as required
Perform walk-around inspection as required
Ensure aircraft security
Coordinate aircraft servicing

Ensure communication kit and classified documents secured
Complete AF Form 781
Relay crew and aircraft status to home base
Locate secure location for secrets
Complete remaining paperwork
Complete SAC Form 828 as required

## COPILOT FUNCTIONS
Set Starter Switches as required
Set lights as required
Set Engine Anti-ice as required
Set pitot, Q-inlet, and window switches to OFF
Set Flaps to UP
Set speed brakes to Zero
Set Cabin Manual Pressure Control to FULL DECREASE
Set Air Conditioning Master switch to RAM AIR
Set Pilots' Radar intensity to full counter clockwise
Set HF Radio to OFF
Set Lights as required
Ensure INS Accuracy Check complete
Turn off Auto Pilot
Zeroize Ciphony Control Panel if required
Set Manifold Valve Switch to WING REFUEL
Set Engine Anti-ice to OFF (if not previously accomplished)
Set engine starter switches to off (if not previously accomplished)
Apply External Power as required
Set Air Conditioning Master switch to RAM AIR
Set External Power Switch to TRIP if required

## NAV FUNCTIONS
Monitor radios
Turn Equipment Off
Set Mode 4 Code Switch (as required)
Set Mode 4 On/Out Switch OUT
Set IFF Master Switch OFF

Turn APN-218 System OFF
Turn DNS MSU Switch OFF
Set Search Radar Control Panel
Set Gain Control CCW
Set Intensity Control CCW
Set Heading Marker Control CW
Set Scan Switch OFF
Set Stab Switch OFF
Set Function Switch OFF
Set APN-69 Control Panel OFF (if required)
Set Oxygen System
Set Supply Lever OFF
Set Diluter Lever 100%
Ensure Oxygen pressure bleeds to Zero
Perform INS Accuracy Check Procedures
Select Way Point
Press Hold Key
Record Latitude and Longitude Coordinates
Press Hold Key
Load Pure Present Position
Load Airplane Actual Position
Set Data Selector to DIST/TIME
Press WY PT CHG Key
Press 1 and 2 Keys in sequence
Record Distance from left-hand data display
Press Clear Key
Record Nav Time of last flight
Calculate nav accuracy
Turn INS MSU Switch OFF after parked
Set IFF/SIF As Required
Set Mode 2 Code (as required)
Set FSA/CAS power OFF
Zeroize Code in KIK-18 and KY-58
Assist in Aircraft Offload As Required
Offload Flight Equipment
Offload Passengers/Personnel
Enter Navigation systems maintenance discrepancies into Form 781
Perform maintenance debriefing
Relay INS accuracy check information
Turn in comm kit, KIK-18, KY-58 and FLIP publications
Complete mandatory aircrew requirements
Complete SAC Form 157 (if applicable)
Turn in all navigation mission paperwork required
Turn in helmet and mask to life support
Perform crew mission debriefing

## BOOMER FUNCTIONS
Perform After Landing Procedures
Set Oxygen OFF, 100%
Install Nose Gear Ground Down Lock And Release Handle
Check APU Start Accumulator Pressure Gages
Set Cargo Compartment Temperature Control Switch to Manual
Check APU Start Accumulator Pressure Gages
Perform Aircraft Checks
Set Interphone
Open Entry Door
Open Grill
Install Entrance Ladder
Close Grill
Set Boom Compartment Switches
Perform APU Shutdown (if required)
Complete Form 781
Unload Passengers and Cargo
Open Cargo Door
Install Tail Stand
Ensure Passenger Loading Stand in position
Unload Baggage
Unload cargo
Check Tail Support Strut Installed
Check Position of Chocks
Check External Power available
Check Ground Wire Installed
Check Cargo Loading Area clear
Check Fire Extinguisher available
Check Cargo Door Sill protected
Stow Seats
Remove Tiedown Devices
Position Shoring
Stow Aircraft Equipment
Perform Maintenance Debriefing
Complete Form 76
Complete Form 781
Complete Form 791

# APPENDIX B

# FUNCTION ANALYSIS MATRICES FOR EACH CREW POSITION

# PILOT'S TASK LIST

| TASK | INFORMATION IN | MODALITY | ERRORS | ERROR EFFECTS |
|---|---|---|---|---|
| **Preparation for Flight** | | | | |
| Check weather | TV, Supervisor Of Flying (SOF), and Weather | Man,Vis,Aud | | |
| Check Notams | | Vis,Cog | | |
| Compute take-off data | Crew Coordination,SOF, and weather | Man,Vis,Cog | | |
| Conduct MITO/Cell briefing | Squadron Handout | Voc,Aud | | |
| File mission paper work | | Man,Vis | | |
| Check Aircraft and mission status | SOF | Voc,Aud | | |
| Brief planned flight demonstration maneuvers | Crew Coordination | Voc,Aud | | |
| Brief touch and go procedures | Crew Coordination | Voc,Aud | | |
| Brief deployment requirements | Intelligence,Operations | Voc,Aud | | |
| Brief Cell Procedures | Briefing Guide | Voc,Aud | | |
| Brief MITO Procedures | Briefing Guide | Voc,Aud | | |
| Complete local mission planning/briefing certificate | Crew Coordination and Briefing Guide | Voc,Aud | | |
| Complete flight plan | Crew Coordination | Man,Vis,Aud,Cog | | |
| **Preflight** | | | | |
| Perform exterior inspection | | Man,Vis | | |
| Check interphone and oxygen system | | Voc,Aud | | |
| Complete crew report | | Man,Vis | | |
| Test and check interior lights | | Man,Vis | | |
| Read AF Form 781 | | Man,Vis,Voc,Aud | | |
| Notify crew of type of fuel on board | Fuel Sheet from Maintenance | Vis | | |
| Verify APU with generator installed | | Voc,Aud | | |
| Notify crew of engine start time | | Voc | | |
| Brief AF Form 781 data | | Man,Vis | | |
| Review AF Form 781 data, as required | | Vis | | |
| Complete mission and weather briefing | | Voc | | |
| Announce start engines time | | Voc,Aud | | |
| Provide additional instructions | | Voc | | |
| State which APU has generator | | Man,Vis | | |
| Inspect and close nose compartment | | Vis | | |
| Check for presence of Foreign Object Damage (FOD) | | | | |
| Check nose wheel well | | Vis | | |
| Check nose gear condition | | Vis | | |
| Ensure nose gear pin removed | | Man,Vis | Not sufficiently checked | Structural damage to aircraft |
| Ensure actuators are connected to nose gear doors | | Man,Vis | Not sufficiently checked | Structural damage to aircraft |

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| Task | Method | Deficiency | Consequence |
|---|---|---|---|
| Check manual refueling valve cover closed | Vis | | |
| Check right Wheel well | Vis | | |
| Check right system Hydraulic accumulator pressure | Vis | | |
| Check wheel well | Vis | | |
| Set manual refueling valve handle to FLIGHT | Man,Vis | | |
| Check single point refueling receptacle | Man,Vis | | |
| Check single point refueling panel | Vis | | |
| Ensure landing gear door downlocks are removed | Vis | Not sufficiently checked | Structural damage to aircraft |
| | | Not sufficiently checked | Structural damage to aircraft |
| Ensure landing gear pins are removed | Vis | | |
| Check right wing | Vis | | |
| Check general condition of engines | Vis | | |
| Check fire bottle discharge indicators | Vis | | |
| Check fire bottle pressure gage | Vis | | |
| Check aft fuselage and tail assembly | Vis | | |
| Check general condition of fuselage/empennage | Vis | | |
| Check general condition of boom | Vis | | |
| Check top surface of wings | Vis | | |
| Ensure APU Doors Closed | Vis | | |
| Check Left Wheel Well | Vis | | |
| Check left system hydraulic accumulator pressure | Vis | | |
| Check reserve brake accumulator pressure | Vis | | |
| Check wheel well/gear general condition | Vis | | |
| Ensure gear door downlocks removed | Vis | Not sufficiently checked | Structural damage to aircraft |
| Ensure landing gear safety pins removed | Vis | Not sufficiently checked | Structural damage to aircraft |
| Check left wing | Vis | | |
| Check general condition of engines | Vis | | |
| Check fire bottle discharge | Vis | | |
| Check fire bottle pressure | Vis | | |
| Inspect aircraft main fuselage area | Vis | | |
| Ensure pitot covers are removed | Vis | | |
| Check aircraft/ramp general condition | Vis | | |
| Ensure pins, downlocks and ground wires removed | Vis | | |
| Check battery charging level | Man,Vis | | |
| Pressurize hydraulic system | | | |
| Check pressure switches ON | Man,Vis,Aud | | |
| Set right system auxiliary pump switch to AUTO | Man,Vis,Aud | | |
| Set left system auxiliary pump switch to RESERVE BRAKE | Man,Vis,Aud | | |

| Action | Method | Cue | Remarks |
|---|---|---|---|
| Set left system Auxiliary pump switch to AUTO | | Man,Vis,Aud | |
| Check antiskid system | | Man,Vis | |
| Check parking brake OFF | | Man,Vis | |
| Check Test panel indicators BLANK | | Man,Vis | |
| Set antiskid test switch to FWD | | Man,Vis | |
| Set antiskid test switch to AFT | | Man,Vis | |
| Ensure test panel indicators are BLANK | | Man,Vis | |
| Check hydraulic pressure in normal range | | Vis | |
| Check speed brakes | | Man,Vis | |
| Set inboard spoiler switch to NORMAL | | Man,Vis | |
| Set speed brake lever to 60 degrees | Crew Coordination | Man,Vis,Aud | |
| Set yoke to full left | Crew Coordination | Man,Vis,Aud | |
| Set yoke to full right | Crew Coordination | Man,Vis,Aud | |
| Set yoke to center | Crew Coordination | Man,Vis,Aud | |
| Set inboard spoiler switch to CUTOFF | Crew Coordination | Man,Vis,Aud | |
| Set outboard switch to CUTOFF | Crew Coordination | Man,Vis,Aud | |
| Set speed brake level to zero degrees | Crew Coordination | Man,Vis,Aud | |
| Return inboard and outboard spoiler switches to NORMAL | Crew Coordination | Man,Vis,Aud | |
| Check ailerons and glare shield clearance | Crew Coordination | Man,Vis | |
| Move yoke left | Crew Coordination | Man,Vis,Aud | |
| Move yoke right | Crew Coordination | Man,Vis,Aud | |
| Move yoke center | Crew Coordination | Man,Vis,Aud | |
| Check aileron trim | | Man,Vis | |
| Check elevators | | Man,Vis | |
| Check trim indication | | Vis | |
| Move yoke forward | Crew Coordination | Man,Vis | |
| Move yoke aft | Crew Coordination | Man,Vis | |
| Move yoke center | Crew Coordination | Man,Vis | |
| Check electric trim | Crew Coordination | Man,Vis | |
| Check manual trim | Crew Coordination | Man,Vis | |
| Actuate stab trim control switch NOSE DOWN then NOSE UP | Crew Coordination | Man,Vis | |
| Set stab trim control switch to CUTOUT | Crew Coordination | Man,Vis | |
| Set Stab trim control switch to NORMAL | Crew Coordination | Man,Vis | |
| Check rudder | | | |
| Check rudder power switch OFF | Crew Coordination | Man,Vis | |
| Push rudder full LEFT | Crew Coordination | Man,Vis | Not sufficiently checked in windy conditions — Mission delay |
| Push rudder full RIGHT, then release | Crew Coordination | Man,Vis | Not sufficiently checked — Mission delay |
| Set rudder power switch to ON | Crew Coordination | Man,Vis | |
| Check rudder pressure | Crew Coordination | Man,Vis | |
| Check rudder trim | Crew Coordination | Man,Vis | |
| Check Engine Failure Assist System (FSAS) | | Man,Vis | |
| Set EFAS switch to TEST, then ON | | Man,Vis | |
| Check engine system | | Man,Vis | |

| Task | Crew Coordination | Method |
|---|---|---|
| Check yaw damper system | | Man,Vis |
| Set SYD switch to TEST, then ON | | Man,Vis |
| Check DISENG light comes on and goes out | | Vis |
| Check radios | | |
| Check ILS receivers | Crew Coordination | Man,Vis,Aud |
| Check VOR | Crew Coordination | Man,Vis,Aud |
| Check TACAN | Crew Coordination | Man,Vis,Aud |
| Check COMM 1 UHF | Crew Coordination | Voc |
| Check COMM 2 UHF (ground radio) | Crew Coordination | Voc |
| Check VHF radio | Crew Coordination | Man,Vis,Voc,Aud |
| Check HF radio | Crew Coordination | Man,Vis,Voc,Aud |
| Check operation of altimeters | | Man,Vis,Voc,Aud |
| Check flight director heading mode | | Man,Vis |
| Check instruments | | |
| Check all dials and gauges | | Vis |
| Check Attitude Director Indicator (ADI) | | Man,Vis |
| Check INS gyro | | Man,Vis |
| Set clock | | Man,Vis |
| Set oil temp selector switch to TEST | | Man,Vis |
| Set oil temp selector switch to M | | Man,Vis |
| Check fuel quantity readings | | Vis |
| Check Rotation Go Around (RGA) mode | Crew Coordination | Man,Vis |
| Check flap and speed brake warning horn | Crew Coordination | Man,Vis,Aud |
| Check Autopilot | | |
| Check autopilot turn knob in detent position | | Man,Vis |
| Set autopilot engage switches ON | | Man,Vis |
| Rotate autopilot turn knob LEFT then RIGHT | | Man,Vis |
| Rotate pitch knob NOSE UP, then NOSE DOWN | | Man,Vis |
| Depress pilot's disengage button | | Man,Vis |
| Set autopilot engage switches ON | | Man,Vis |
| Activate stab trim switch | | Man,Vis |
| Press autopilot test switch | | Man,Vis |
| Press valid/invalid test indicator | | Man,Vis |
| Check flight controls for freedom of movement | | Man,Vis |
| Move flight director mode selector to gyro | | Man,Vis |
| Adjust seats, pedals, belts and harnesses | | Man,Vis |
| Ensure fuel panel set for take-off | Crew Coordination | Vis |
| Perform CELL check | Crew Coordination | Man,Vis,Voc |
| Perform Comm 2 radio check | | Man,Vis,Voc |
| Inform CELL lead ready to start engines | | Man,Vis,Voc,Aud |
| Check APU accumulator pressures | | Vis |
| Set aux pumps | | |
| Set left aux pump switch to OFF | | Man,Vis |

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| | | |
|---|---|---|
| Set right aux pump switch to OFF | | Man,Vis |
| Review takeoff and emergency procedures | Crew Coordination | Man,Vis,Vac,Aud |
| Perform FSA/CAS alignment and insertion | Weather, Flight Plan, and crew coordination | Man,Vis |
| procedures | | |
| **Starting Engines and Before Taxi** | | |
| | | |
| Start APU if required | | Man,Vis |
| Fasten belts and harnesses | | Man,Vis |
| Turn oxygen to 100 percent | | Man,Vis |
| Set battery switch to EMERGENCY | | Man,Vis |
| Set hydraulic pressure switches | | Man,Vis |
| Activate external power switch as required | | Man,Vis |
| Set parking brakes | | Man,Vis |
| Check hydraulic pressure | | Man,Vis |
| Set starter switch to START * | Ground Coordination | Man,Vis,Vac,Aud |
| Start 1 engine * | Crew Coordination | Man,Vis,Vac,Aud |
| Set throttle to START at 25 percent N2 RPM | Crew Coordination | Man,Vis |
| Monitor engine instruments * | | Vis |
| Set throttle to IDLE at 50% N2 RPM* | Crew Coordination | Man,Vis |
| Set starter switch to OFF * | | Man,Vis |
| (*Repeat for each engine) | | |
| Set starter selector switch to OFF | | Man,Vis |
| (last engine only) | | |
| Check overhead panel caution lights | | Vis |
| Shutdown APU as required | | Man,Vis |
| Ensure external power and chocks removed | Ground Coordination | Vac,Aud |
| Set battery switch to NORMAL | | Man,Vis |
| Turn on engine anti-ice as required | Crew Coordination | Man,Vis,Vac,Aud |
| Reset altimeters | Crew Coordination | Man,Vis,Vac,Aud |
| Check INS and DNS NAV INOP lights | Ground Coordination | Vac,Aud |
| Ensure taxi report complete | Crew Coordination | Vac,Aud |
| | | |
| **Taxi** | | |
| | | |
| Check hydraulic pressure, brakes and | Crew Coodination | Man,Vis |
| steering | | |
| Check flight controls | Crew Coordination | Man,Vis |
| Check flight instruments | | Man,Vis |
| Check speed brakes to ZERO | Crew Coordination | Vis |
| Set flaps | Crew Coordination | Man,Vis |
| Advance power momentarily to begin taxi | Crew Coordination | Man,Vis |
| Release parking brakes | Crew Coordination | Man |
| Position airplane as required | | Man,Vis |
| Check powered rudder system | | |

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| Task | Coordination | Medium | Error | Consequence |
|---|---|---|---|---|
| Check system and rudder power hydraulic pressure gauges | | Vis | | |
| Push rudder pedal full LEFT | | Man,Vis | | |
| Push rudder pedal full RIGHT and hold | | Man,Vis | | |
| Push rudder pedal full LEFT and hold | | Man,Vis | | |
| Set EFAS and SYD switches to ON | | Man,Vis | | |
| Set EFAS switch to ON | | Man,Vis | | |
| Set yaw damper switch to ON | | Man,Vis | | |
| Review takeoff data | | Man,Vis | | |
| Ensure trim ready for takeoff | | Vis | | |
| Check rudder trim at ZERO | | Vis | | |
| Check aileron trim at ZERO | | Vis | | |
| Check stab trim | | Vis | | |
| Set and recheck NAV aids | | Man,Vis | | |
| Set flight director and climb selector switch to RQA mode | | Man,Vis | | |
| Set APU start-stop switches to STOP | | Man,Vis | Omission | Damage APU |
| Obtain last chance inspection | | Voc,Aud | | |
| Check radar to STBY | | Man,Vis | | |
| Set parking brakes | | Man,Vis | | |
| Clear SOF for last chance inspection report | | Man,Voc,Aud | | |
| Check EFAS/SYD annunciators | | Vis | | |
| Check annunciators | | Vis | | |
| Check APU doors open and lights turned out | | Vis | | |
| Close windows | | Man,Vis | | |
| Adjust throttle friction | | Man,Vis | | |
| Obtain MITO approval | | Voc,Aud | | |
| Change radios to MITO discrete frequency | Coordinate between aircraft | Man,Voc,Aud | Enter incorrect frequency | Mishap |
| Obtain radio check on MITO frequency | Coordinate between aircraft | Man,Vis,Aud | | |
| Set power for MITO | | Man,Vis | | |
| Release parking brakes when directed by lead | Coordinate between aircraft | Man,Vis,Aud | | |
| Maintain spacing | | Man,Vis | | |
| Accomplish additional radio checks | Crew Coordination | Man,Vis | | |
| Accomplish takeoff report | Crew Coordination | Man,Vis | | |
| Ensure fuel panel set for take off | Crew Coordination | Vis | | |
| Move starter switches to ignition | | Man,Vis | | |
| Turn radar on | | Man,Vis | | |
| **Takeoff** | | | | |
| Advance power as required | | Man,Vis | | |
| Release parking brake as directed | | Man,Vis | | |
| Taxi into position and align aircraft with centerline | | Man,Vis | | |

| Task | Coordination Type | Codes | Note | Error |
|---|---|---|---|---|
| Assure flight idle | Crew Coordination | Man,Vis | | |
| Maintain spacing/timing as required | Crew Coordination | Man,Vis | | |
| Direct copilot to set take-off thrust | Crew Coordination | Man,Vis,Voc | | |
| Maintain directional control and wings level | Crew Coordination | Man,Vis | | |
| Check airspeed at 90 knots | Crew Coordination | Vis,Voc | | |
| Acknowledge S1 interphone call as required | Crew Coordination | Vis,Voc,Cog | | |
| Activate Rotation Go Around (RGA) within 10 knots of rotation speed | Crew Coordination | Man,Vis | | |
| Pull back on yoke until takeoff attitude is reached | | Man,Vis,Cog,Aud | Important to maintain pitch attitude | Stall |
| Call for gear up | Crew Coordination | Voc,Vis,Man | | |
| Follow command bars as required until reaching 2,000 feet above ground | | Man,Vis | | |
| Push forward on yoke | | Man | | |
| Call for flaps up | Crew Coordination | Voc | Improper setting | Wrong speed would effect MITO |
| Check hydraulic pressure in low range | | Vis | | |
| Look for lead aircraft visually or on radar | | Vis | | |
| Perform joinup procedures as required | Coordination between aircraft | Man,Vis,Aud,Voc | | |
| Maintain cell position as required | Coordination between aircraft | Man,Vis | | |
| Call for climb power and after takeoff climb check | Crew Coordination | Voc | | |
| Ensure landing gear up | | Vis | | |
| Ensure flaps up | | Vis | | |
| Call for engine anti-ice on/off | | Man,Vis | | |
| Set starter switches as required | | Man,Vis | | |
| Set altimeter to 29.92 and radio altimeter MDA index to 2,000 feet | | Man,Vis | Omission | Mishap |
| Ensure oxygen on 100 percent | | Vis | | |
| Ensure fuel panel is set | Crew Coordination | Voc,Aud | | |
| Ensure RGA switches off | | Man,Vis | | |
| **Level Off** | | | | |
| Pull power back | | Voc,Vis,Man | | |
| Set level flight attitude | | Man,Vis | | |
| Trim aircraft | | Man,Vis | | |
| Engage autopilot | Crew Coordination | Man,Vis,Voc | | |
| Maintain formation position | Crew Coordination | Man,Vis,Voc,Aud | | |
| Change position as required | Coordination between aircraft | Man,Vis,Voc,Aud | | |
| Perform cell communications as required | Coordination between aircraft | Vis,Voc | | |
| Terminate formation if necessary | Coordination between aircraft | Vis,Voc,Aud,Man | | |
| Oversee fuel panel management | Crew Coordination | Vis,Voc | Insufficient crew coordination | |
| Maintain cell position | Coordination between aircraft | Man,Vis,Voc,Aud | | |
| Perform Turbine Engine Monitoring System (TEMS) test | Crew Coordination | Man,Vis,Voc,Aud | | |

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| Task | Coordination | Codes | Notes |
|---|---|---|---|
| Accomplish preparation for contact checklist | | | |
| Check altimeter | Crew Coordination | Vis | |
| Reset altimeter | Crew Coordination | Man,Vis | |
| Confirm altimeter setting | Coordinate with receiver | Man,Vis,Voc,Aud | |
| Ensure proper air refueling frequency | Crew Coordination | Man,Vis,Voc,Aud | |
| Disconnect autopilot elevator/pitch axis | | Man,Vis | |
| Accuate stabilizer trim | | Man,Vis | |
| Check stabilizer trim | | Vis | |
| Reengage autopilot elevator/pitch axis | | Man,Vis | |
| Check autopilot stabilizer | | Man,Vis | |
| trim follow-up | | | |
| Set Air-to-Air TACAN | | Man,Vis | |
| Establish air refueling echelon | | Vis,Voc,Aud | Missed rendezvous |
| formation | | | |
| Initiate 1/2 mile checklist | Crew Coordination | Voc | |
| Check oxygen as required | | Vis | |
| Confirm oxygen setting correct | | Vis | |
| Set autopilot HDG SEL/VOR LOC switches | | Man,Vis | |
| to OFF | | | |
| Monitor receiver/observer position | | Vis | |
| Initiate post air refueling checklist | | Voc | |
| Assure fuel panel reconfigured for cruise | | Man,Vis,Aud | |
| Assure radios reset | | Vis | |
| Set altimeter to 29.92 | | Man,Vis | |
| Check oxygen 100 percent if required | | Man,Vis | |
| Reestablish cell position | | Man,Vis,Aud,Voc | |
| Maintain cell position | | Man,Vis | Insufficient monitoring — Mishap |
| Obtain destination weather | | Man,Vis,Aud,Voc | |
| Direct navigator to determine range | Crew Coordination | Voc | |
| Direct copilot to determine fuel | Crew Coordination | Voc | |
| capability | | | |
| Direct crewmember to look up instrument | Crew Coordination | Voc | |
| flight rule supplement | | | |
| Direct copilot to obtain proper clearances | Crew Coordination | Voc | |
| Coordinate plan with #1 aircraft | Coordinate with #1 aircraft | Man,Voc,Aud | |
| Direct cell break up | Coordinate with other aircraft | Man,Voc,Aud | |
| Obtain destination weather/monitor air | Crew Coordination | Man,Voc,Aud | |
| route traffic control center | | | |
| Call for descent checklist | Crew Coordination | Voc | |
| Review weather | Crew Coordination | Man,Vis,Voc,Cog | |
| Review approach procedures | Crew Coordination | Man,Vis,Voc,Cog | |
| Direct navigator to advise destination | Crew Coordination | Man,Voc,Aud | |
| base of aircraft status | | | |
| Brief the approach | Crew Coordination | Man,Voc | |
| Confirm N1 RPM index set | | Man,Vis,Voc | |

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| | Crew Coordination | | Improper altimeter setting | Mishap |
|---|---|---|---|---|
| Set specific altitude into radio altimeter | | Man,Vis | | |
| Insure navigation aids are set | Crew Coordination | Man,Vis,Voc,Aud | | |
| Set starter switches to ignition | | Man,Vis | | |
| Direct anti-ice equipment use as required | Crew Coordination | Man,Vis,Voc | | |
| Check switches and pressure of left, right | Crew Coordination | Man,Vis,Voc,Aud | | |
| reserve brake and powered rudder system | | | | |
| Accuate brakes and check for | Crew Coordination | Man,Vis,Voc,Aud | | |
| gauge fluctuation | | Man, Vis | | |
| **Descent** | | | | |
| Reduce power to initiate descent | Crew Coordination | Man,Vis,Cog | | |
| Ensure proper course, altitude and airspeed | Crew Coordination | Vis | | |
| Set appropriate altimeter setting | Crew Coordination | Man,Vis,Voc,Aud | | |
| Confirm descent checklist complete | Crew Coordination | Voc,Aud | | |
| Call for before landing checklist | Crew Coordination | Voc | | |
| Ensure speed brakes set to ZERO | | Man,Vis | | |
| Ensure autopilot disengaged | | Man,Vis | | |
| Direct copilot to lower flaps | Crew Coordination | Voc | | |
| Set EFAS/SYD switches on | | Man,Vis | | |
| Ensure proper navigation aides selected | | Vis | | |
| and set | | | | |
| Direct copilot to lower landing gear | Crew Coordination | Voc | | |
| Confirm landing gear down and locked | | Vis | | |
| Check anti-skid system | | Vis | | |
| Direct additional flaps as required for | | Vis,Voc | | |
| landing | | | | |
| Ensure fuel panel set for landing | | Vis | | |
| Ensure flaps set for landing | | Vis | | |
| Raise speed brakes | | Man,Vis | | |
| Apply wheel brakes as required | | Man,Vis | | |
| Maintain aircraft directional control | | Man,Vis | | |
| Taxi clear of the runway | | Man,Vis | | |
| **After Landing** | | | | |
| Call for after landing checklist | Crew Coordination | Voc | | |
| Set starter switches as required | Crew Coordination | Man,Vis | | |
| Direct copilot to set engine anti-ice | Crew Coordination | Man,Vis,Voc | | |
| Take time hack | Crew Coordination | Man,Vis | | |
| Set speed brakes to ZERO | Crew Coordination | Man,Vis | | |
| Taxi airplane to assigned parking location | Crew Coordination | Man,Vis | | |
| Shut down inboard or outboard throttles | Crew Coordination | Man,Vis | | |
| Ensure flight director mode selector | Crew Coordination | Man,Vis | | |
| switch to GYRO | | | | |

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| Task | Coordination | Modality |
|---|---|---|
| Direct copilot to request progressive taxi instructions | Crew Coordination | Man,Vis,Voc |
| Direct engine shut down checklist | Crew Coordination | Voc |
| Set parking brake | Crew Coordination | Man,Vis |
| Ensure INS accuracy check complete | Crew Coordination | Man,Vis,Aud,Voc |
| Direct engine anti-ice to OFF (if not previously accomplished) | Crew Coordination | Man,Vis,Voc |
| Set starter switches to OFF (if not previously accomplished) | Crew Coordination | Man,Vis |
| Set battery power switch to EMERGENCY | Crew Coordination | Man,Vis |
| Turn throttles off | Crew Coordination | Man,Vis |
| Ensure APU starter accumulator pressure are checked | Crew Coordination | Vis |
| Turn oxygen off/down | Crew Coordination | Man,Vis |
| Ensure all electrical switches off or closed | Crew Coordination | Man,Vis |
| Turn off window heat switches | Crew Coordination | Man,Vis |
| Turn off instrument power gyro switches | Crew Coordination | Man,Vis |
| Turn off boost pump & fuel valve switches | Crew Coordination | Man,Vis |
| Turn off RGA power switches | Crew Coordination | Man,Vis |
| Turn off FD #1 & #2 master power switches | Crew Coordination | Man,Vis |
| Turn off radios and yaw damper | Crew Coordination | Man,Vis |
| Turn off hydraulic pressure switches | Crew Coordination | Man,Vis |
| Turn off lights | Crew Coordination | Man,Vis |
| Ensure chocks installed and check brakes | Ground Coordination | Man,Vis |
| Release parking brake | Crew Coordination | Man,Vis |
| Set battery power switch as required | Crew Coordination | Man,Vis |
| Perform walk-around inspection as required | Crew Coordination | Man,Vis |
| Ensure aircraft security | Crew Coordination | Man,Vis,Cog |
| Coordinate aircraft servicing | Coordinate with maintenance | Voc,Aud |
| Complete AF Form 781 | Crew Coordination | Man,Vis,Aud,Vis,Cog |
| Relay crew and aircraft status to home base | Coordinate with home base | Man,Vis,Aud,Vis,Cog |
| Locate secure location for secrets | | Aud,Voc,Man,Cog |
| Complete remaining paperwork | | Man,Vis |

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# COPILOT'S TASK LIST

| TASK | INFORMATION IN | MODALITY | ERRORS | ERROR EFFECTS |
|---|---|---|---|---|
| **Preparation for Flight** | | | * Fuel load critical for all takeoff tasks | |
| Get Form 200 data from navigator | Navigator | Man,Vis,Aud,Voc | Reciprocal headings, math errors possible input errors more likely | Bad takeoff data |
| Get Form 365 data from boom operator | Boom operator | Man,Vis,Aud,Voc | | |
| Compute takeoff data (SAC Form 71) | Computer | Man,Vis | Wrong flap setting | Problem if pushing A/C limits |
| Record fuel Data on SAC Form 200 | Weather | Man,Vis | | |
| Complete copilots chart | | Man,Vis | Mistake in fuel load | Could impact mission and safety |
| Update takeoff data as required | | Man,Vis,Cog | Erroneous takeoff data | Could impact safety |
| (weather and runway changes) | | | | |
| **Preflight** | | | | |
| Check Thrust Settings and Critical field length | | Vis | Errors in takeoff data | Could impact safety |
| Read Crew Information File | | Vis | | |
| Pick up quick dons, helmet, mask, and publications | | Man,Vis | | |
| Go to Base Operations | | | | |
| Attend weather brief | Weather | Vis,Aud | | |
| Check aircraft readiness | | Voc,Aud | | |
| Recheck takeoff data | Weather | Man,Vis,Aud,Cog | | |
| Load Baggage | | Man,Vis | | |
| Pre-position Quickdon, helmet, Pubs, and checklists | | Vis | | |
| **Power Off Inspection** | | | | |
| Check FD/RGA Circuit Breakers | | Vis | | |
| Check Instructor Oxygen Panel | | Vis | | |
| Check Regulator OFF, Diluter Lever at 100% | | Vis | | |
| Bleed pressure down | | Man,Vis | | |
| Check Portable Oxygen Bottles | | Vis | | |
| Set Altitude Selector Knob to NORM | | Man,Vis | | |
| Check pressure above 50 psi | | Vis | | |
| Check hydraulic pressure switch OFF | | Vis | Switch error possible | Could result in personnel injury |
| Check engine starter switch OFF | | Vis | | |
| Check PMC switches ON, guard closed | | Vis | | |
| Check Emergency Hydraulic | | Vis | | |
| crossover Valve Lever in NORMAL | | | | |
| Check pressurization/air conditioning panel | | Vis | | |
| Check Cabin Pressure Test Valve Handle Position | | Man,Vis | | |
| Set Cabin Manual Pressure Control OFF | | Man,Vis | Switch error possible | Takeoff and climbout with improper pressure results in distraction later in flight |
| Set Cabin Pressure Controller as required | | Man,Vis | | |

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| | | |
|---|---|---|
| Set cabin pressure rate of change knob as desired | Man,Vis | |
| Check air conditioning crossover switch OPEN | Vis | |
| Set Cabin Temperature Control as desired | Man,Vis | |
| Set air conditioning master switch to RAM AIR | Man,Vis | |
| Check Alternate Pressurization | Vis | |
| switches OFF and Guards Closed | Vis | |
| Check Overhead Panel | Vis | |
| Check radios in preset mode | Vis | |
| Set manuals to initial planned frequency | Man,Vis | |
| Check UHF Comm 1 | Vis | |
| Check UHF Comm 2 | Vis | |
| Check VHF (if applicable) | Vis | |
| Check all switches OFF | Vis | |
| Check Flight Director Mode selector | Vis | |
| switch in GYRO | | |
| Check IDG switches NORMAL | Vis | |
| Check Fire Switches IN | Vis | |
| Check inboard spoiler switch in CUTOFF | Vis | |
| Check landing gear handle DOWN, in detent | Man,Vis | Omission, Equipment damage possible |
| Check all Fuel Valves CLOSED | Vis | |
| Set CDU Select Panel | | |
| Check Power Switch in NORM | Vis | |
| Check CDU Select Switch in DNS | Vis | |
| Check Radar intensity Switch Full | Man,Vis | |
| counter clockwise | | |
| Check Throttles CUTOFF | Man,Vis | |
| Check Rudder Power Switch OFF | Vis | |
| Check Trim Serve Switch in NORMAL | Vis | |
| Check Anti-Icing/J-4 Panel | Vis | |
| Check anti-ice, pilot heat & set window heat OFF | Man,Vis | |
| Ensure J-4 compass mode selector switch in MAG | Vis | |
| Perform External Power applications procedures | | |
| Set External Power Switch to TRIP | Man,Vis | |
| Check all Warning Flags (as applicable) | Vis | |
| Set battery power switch to EMERGENCY | Man,Vis | |
| Check EGT Lights if applicable | Vis | |
| Check Battery voltage if applicable | Vis | |
| Activate Alarm Bell (momentarily) | Man,Vis | |
| Perform APU Start Procedures if required | Man,Vis,Voc | |
| Set external power switch to CLOSE if applicable | Man,Vis | |
| Check T-R voltage | Vis | |
| Set battery power switch to NORMAL | Man,Vis | |
| | | |
| **Power On Inspection** | | |
| | | |
| Set FD Master Power Switches ON | Man,Vis | |

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| Task | Method | Error | Consequence |
|---|---|---|---|
| Ensure FD 109 Power Off Lights ON prior to placing switches ON | Vis | | |
| Set FD 109 master power switches to ON | Man,Vis | | |
| Ensure FD 109 power off lights are out | Vis | | |
| Perform ARR Panel Checks | | | |
| Set Master Refuel Switch to ON | Man,Vis | | |
| Press to test all indicator lights not illuminated | Man,Vis | | |
| Set manifold valves switch to FLIGHT | Man,Vis | | |
| Check main ARR/IFR valve switch CLOSED | Vis | | |
| Check tank level control switches CLOSED | Vis | | |
| Check Scavenge Switch OFF | Vis | | |
| Check Reverse Refuel Pumps Switch OFF | Vis | | |
| Check Slipway Door Switches CLOSED | Vis | | |
| Check signal amplifier power switch in NORMAL | Vis | | |
| Check manual toggle latch switch in RELEASE | Vis | | |
| Set Master Refuel Switch to OFF | Man,Vis | | |
| Check Engine Bleed Valves OPEN | Vis | Omission | Damage to wing structure |
| Perform Bleed Air Leak Detection Test | Man,Vis | Omission | Damage to wing structure |
| Press bleed air leak detection test switch | Man,Vis | Omission | Damage to wing structure |
| Check all LEAK DET, OVER PRESS and OVER TEMP Lights ON | Vis | Omission | Damage to wing structure |
| Release Test Switch | Man,Vis | | |
| Ensure Lights go out after releasing test switch | Vis | | |
| Close Generator Breaker Switches | Man,Vis | | |
| Set Remaining Switches ON as required | Man,Vis | | |
| Set VOR to ON | Man,Vis | | |
| Set TACAN to ON | Man,Vis | | |
| Set VHF Radio ON | Man,Vis | | |
| Set UHF Radio ON | Man,Vis | | |
| Set HF Radio ON | Man,Vis | | |
| Set Autopilot ON | Man,Vis | | |
| Set RGA Power Switches ON | Man,Vis | | |
| Set Instrument Power Gyro | Man,Vis | | |
| Ensure Required Publications Are available | Vis | Fail to notice missing publications | Could be critical in emergency situations |
| Ensure presence of Aircraft Flight manuals | Vis | Use improper flight manual | Could result in use of improper emergency procedures |
| Check Interphone and oxygen | Man,Vis,Aud | | |
| Perform FSAS preflight procedures | | | |
| Ensure FSA/CAS POWER Switch ON | Man,Vis | | |
| Accomplish IFMP Interface Test | Man,Vis | | |
| Check Fuel Status indications | Vis | Omission - this is only display of CG | Could result in overweight takeoff |
| Press fuel key | Man,Vis | | |
| Press Data Key | Man,Vis | | |
| Press Malfunction Data Key | Man,Vis | | |
| Verify Airplane Type | Vis | | |
| Verify Engine Type | Vis | | |

69

| Task | Modality | Error Type | Consequence |
|---|---|---|---|
| Verify Brakes and Anti-Skid type | Vis | | |
| Check ICDU STATUS Displays | Vis | | |
| Check System Status Display | Vis | | |
| Slew ICDU Display to Bus Status 2/3 | Man,Vis | | |
| Check Bus Status Display | Vis | | |
| Check WT and Balance Info on ICDU for FSAS | Man,Vis | | |
| Obtain Crew Report | Man,Voc,Aud | | |
| Set interior lights | Man,Vis | | |
| Check wheel wells clear | Vis | Omission, incomplete check | Could injure maintenance personnel |
| Ensure System Pressure Switches ON | Vis | | |
| Check anti-skid | Vis | | |
| Check fuel quantity reading | Vis | | |
| Check Hydraulic System Pressure | Vis,Man,Aud,Voc | | |
| Check Hydraulic System quantity | Vis,Man,Aud,Voc | | |
| Check Pump Supply Guards CLOSED | Vis,Man,Aud,Voc | | |
| Press to Test all gages | Vis,Man,Aud,Voc | | |
| Record actual readings on Form 14, | Vis,Man,Aud,Voc | | |
| 365-4, and flight log | | | |
| Check Hydraulic Pressure | Vis,Man,Aud,Voc | | |
| Check L,R Systems & Pilot's reserve | Vis,Man,Aud,Voc | | |
| pressure gages in Normal range | | | |
| Turn on autopilot yaw damper switch | Man,Vis | | |
| Check Gear Warning Light extinguished | Vis,Man,Aud,Voc | | |
| Complete control and trim check | Vis,Man,Aud,Voc | | |
| Check Fuel Dump Actuator | Man,Vis | Can only check on ground | Could result in overweight landing |
| Check Boom retracted | Aud,Voc | | |
| Set Fuel Dump Switch to FUEL DUMP | Vis,Man,Aud,Voc | | |
| Set Fuel Dump Switch to OFF | Man,Aud | | |
| Ensure Wheel Well Doors clear | Voc,Aud | | |
| Receive Report from each Crew member | Aud | | |
| Check INS/DNS CDU Test Switch (if applicable) | Vis | | |
| Check DNS NAV INOP Light illuminated | Vis | | |
| Check Flap lever in 50 degree detent | Vis | | |
| Depress Copilot's autopilot Disengage button | Man,Vis | | |
| Set Stabilizer Trim as required | Man,Vis | | |
| Set Flap Lever to 40 degree detent | Man,Vis | | |
| Move Flap Lever through 30 degree | Man,Vis | | |
| to 20 degree detent | | | |
| Set Flap Lever to 0 degree detent | Man,Vis | | |
| Set Flap Lever to 30 degree detent | Man,Vis | | |
| Set Flap Lever to 0 degree detent | Man,Vis | | |
| Set Navigation Lights | Man,Vis | | |
| Set Flash-Steady Switch to FLASH | Man,Vis | | |
| Set all Fuel Boost Pump Switches to ON | Man,Vis | Omission | Could result in engine flame out on takeoff |
| Set Bright-Dim Switch to BRIGHT | Man,Vis | | |

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| Task | | Response | Error Type | Comments |
|---|---|---|---|---|
| Set #2 Tank-To-Engine-Manifold valve switch to OPEN | | Man,Vis | | |
| Set air refueling line valve switch to OPEN | | Man,Vis | | |
| Report ACDS Lights ON if applicable | | Vis,Voc | | |
| Report ACDS Lights OFF if applicable | | Vis,Voc | | |
| **Starting Engines & Before Taxi** | | | | |
| Fasten seat belts and harness | | Man,Vis | | |
| Set oxygen to 100% | | Man,Vis | Omission | Could be critical in rapid decompression |
| Set External Power Switch to CLOSE | | Man,Vis | | |
| Set Air Conditioning Master switch | | Man,Vis | | |
| Set Throttle to Cross Start RPM if required | | Man,Vis | | |
| Check Overhead Panel Caution lights out | | Vis | | |
| Set Generator Circuit Breaker switches to CLOSE | | Man,Vis | | |
| Set Beacon and Navigation Light switches to BOTH ON and STEADY | | Man,Vis | Omission | Distraction later in flight |
| Set Copilot's Instrument Power Switch to START | | Man,Vis | | Temporary Loss of Cockpit Lights |
| Set Pilot and Q-Inlet Heat Switches to ON | | Man,Vis | Omission | Loss of airspeed and altimeter |
| Set Engine Anti-Ice as required | | Man,Vis | | |
| Perform Taxi Report Procedures | | Man,Vis,Aud | | |
| Set Air Conditioning Master switch as required | | Man,Vis | | If cabin pressure is OFF, then warning light comes on passing 10K |
| Set altimeter to STANDBY | | Man,Vis | | |
| Confirm INS & DNS NAV INOP as required | | Vis | | |
| **Taxi** | | | | |
| Check hydraulic pressure, brakes, and steering | | Man,Vis | Omission | Can lose brakes with low hydraulic pressure |
| Obtain taxi clearance | | Man,Voc,Aud | | |
| Check/set anti-ice equipment as required | | Man,Vis | | |
| Set Anti-icing ON | | Man,Vis | | |
| Set Anti-icing OFF unless needed for takeoff | | Man,Vis | | |
| Set Flaps as required | Crew Coordination | Man,Vis,Aud | Omission | Warning horn comes on if set improperly |
| Check Overhead Panel | | Vis | | |
| Ensure bus tie, generator breaker and generator control lights extinguished | | Man,Vis | | |
| Check Main T-R Units for normal operation | | Man,Vis | | |
| Check Air Conditioning | | Vis | | |
| Check AC Ammeters for balanced load | | Man,Vis | | |
| Check Pressurization Panel for proper switch settings | | Vis | | |
| Check Circuit Open, IDG Failure and DISC system lights out | | Vis | | |
| Discuss Take-Off Data | | Voc,Aud | | |

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| Task | Detail | Sensory | Error | Consequence |
|---|---|---|---|---|
| Set Stabilizer Trim for Takeoff | | Man,Vis | | Could result in early rotation |
| Obtain Weather data | Weather station or ground control | Voc,Aud,Man,Vis | | |
| Recompute takeoff data if required | | Voc,Aud,Vis,Man,Cog | | |
| Obtain ATC clearance | Air Traffic Control (ATC) | Voc,Aud | | |
| Review and set N1 RPM indices | | Man,Vis | | |
| Set NAV aids for departure | | Man,Vis | | |
| Set FLT Director Mode & Climb Selector switches to RGA, Max Mode | | Man,Vis | Improper setting | Could lose back-up |
| Check door warning/OVHD panel caution light | | Man,Vis | | Engine fire, thrust reverser most critical |
| Close window & set Window Heat Switch | | Man,Vis | | |
| Accomplish Crew Take-off Report | | Voc,Aud | | |
| **Take-Off** | | | | |
| Set fuel panel for takeoff | | Man,Vis | | Boost pump switches off and aircraft low on fuel could starve the engines, mishap |
| Set lights as required | | Man,Vis | | |
| Turn Radar Intensity Switch clockwise | | Man,Vis | | |
| Hold yoke full forward | | Man | | |
| Check for FLT idle on all four engines | | Vis | | |
| Announce FLT idle on all four engines | | Voc | | |
| Set Take-Off thrust | | Man,Vis,Voc | | |
| Call 80 knots | | Voc | | |
| Call S1 | | Voc | | |
| Call pickle | | Voc | | |
| Call rotate | | Voc | | |
| Call climb speed | | Voc | | |
| Raise Gear | | Man,Vis | | |
| Move flaps up | | Man,Vis | | |
| **After Takeoff** | | | | |
| Begin ATC Communications | ATC | Man,Vis | | |
| Turn off Starter Switches (as required) | | Man,Vis | | |
| Turn on engine anti-ice (as required) | | Man,Vis | | |
| Check cabin pressurization | | Vis | Omission | Distraction later in flight |
| Set Fuel Panel as required | | Man,Vis | Omission | Mishap |
| Turn off RGA Power Switches | | Man,Vis | | |
| Turn off landing light | | Man,Vis | | |
| Direct crew to set 29.97 | Crewmember calls out 10,000' & 18,000' | Voc | Omission | Proper altitude necessary to avoid traffic |
| **Cruise** | | | | |
| Check hydraulics | | Vis | | |
| Check electrical system | | Vis | | |
| Monitor fuel system | | Vis | | |

72

| Task | Coordination | Mode | Could miss engine status information | Critical especially during icy conditions |
|---|---|---|---|---|
| Monitor oxygen system | | Vis | | |
| Monitor engine instruments | | Vis | Could miss engine status information | |
| Set fuel panel for cruise | Flight plan/crew coordination | Man,Vis | | |
| **Preparation for Contact** | | | | |
| Obtain permission to delay at the ARCP | ATC | Voc, Aud | | |
| until revised ARCI | | | | |
| Obtain block altitude | ATC/Flight plan | Voc, Aud | | |
| Request permission to conduct air refueling | ATC | Voc, Aud | | |
| Declare MARSA (Military Assumes | ATC | Voc | | |
| Responsibility for Separation of aircraft) | | | | |
| Compute Max Continuous Thrust setting | | Vis, Man, Cog | | |
| Post Max Continuous Thrust setting | | Man | | |
| Set Max Continuous thrust setting on N1 bug | | Man, Vis | | |
| Record end air refueling request from receiver | | Aud, Man, Vis | | |
| **Air Refueling** | | | | |
| Set altimeter to 29.92 or as briefed | | Man,Vis | | |
| Set Radios as required | | Vis, Man | | |
| Set air-to-air TACAN if required | | Vis, Man | | |
| Set Lights as required | | Vis, Man | | |
| Set Position Lights to STEADY and DIM | | Vis, Man | | |
| Count contacts | | Vis, Aud, Cog | After 5 dry contacts, must wet boom | Improper count results in equipment damage |
| Set Rendezvous Beacon Lights as required | | Vis, Man | Improper settings | Increases rendezvous difficulty for receiver |
| Complete fuel quantity check | | Vis, Man | | |
| Set No Smoking/Seat Belt lights ON as applicable | | Vis, Man | | |
| Set Autoplot VOR/LOC & Hdg Sel switches off | | Vis, Man | | |
| Set TACAN as required | | Vis, Man | | |
| Set 1 air refueling pump switches to ON | Crew Coordination | Vis, Man | | |
| Set Beacon Lights to BOTH ON and position lights | | Vis, Man | | |
| to BRIGHT | | | | |
| Complete post air refueling check | Crew Coordination | Man,Vis,Aud,Cog | | |
| Reengage autoplot as required | | Man | | |
| Provide post air refueling report to receiver | | Voc, Aud | | |
| Record Fuel quantity | | Vis, Man | | |
| Establish Cruise Configuration | | Vis, Man | | |
| Set position and rendezvous beacon lights | | Vis,Man | | |
| Set Altimeter to 29.92 | | Vis, Man | | |
| Turn off oxygen | | Vis, Man | | |
| **Descent** | | | | |
| Notify ATC air refueling terminated | | Voc, Aud | | |
| Pass reciever's requested route of flight | | Voc | | |

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| Task | Reference | Channel | Comments |
|---|---|---|---|
| Make position reports when out of radar contact | | Voc | |
| Update weather | | Voc,Aud,Man | |
| Make entries in landing data card | Weather, Fuel panel, Crew Coordination | Vis, Man | |
| Perform Test Engine Monitoring test (TEMS) | | Vis, Man | |
| Set Anti-icing equipment | | Vis, Man | |
| Accomplish descent checklist | | | |
| Review descent and approach procedures | Weather, FLIP documents, landing data | Voc | |
| Set N1 RPM Index | Landing data | Vis, Man | |
| Set Radio Altimeters | FLIP documents | Vis, Man | Wrong altitude setting — Could result in ground impact |
| Set and select Nav Aids | FLIP documents | Vis, Man | |
| Recheck anti-icing equipment | Weather | Vis, Man | |
| Check Electric and Hydraulic Systems | | Vis | |
| Set Cabin Pressure Controller at 500 ft | Weather | Vis, Man | |
| above field pressure altitude | | | |
| Set Altimeters | Weather/ATC | Vis, Man | |
| Turn on landing lights | | Vis, Man | |
| **Approach and Landing** | | | |
| Review approach procedure | | Vis, Voc, Cog | |
| Ensure speed brakes are set to zero | | Vis, Man | |
| Set RGA power & speed deviation switches ON | | Vis, Man | |
| Ensure flaps set as desired | Crew Coordination | Vis, Man | |
| Set and Select Nav Aids | | Vis, Man | |
| Monitor Altitude, Airspeed, Sink Rate, | | Vis, Man | |
| ground speed and wind shear, A/C attitude | | | |
| Set fuel panel for landing | | Vis, Man | |
| Set Flaps for landing | Crew Coordination | Vis, Man | |
| Confirm A/C on center line for landing | | Vis | |
| Call VDP | | Voc | |
| Call out MDA/DH | | Voc | |
| Call missed approach point if necessary | FLIP documents | Voc | |
| Advise pilot when engines decelerate to | | Voc, Vis | If asymetric condition, safety impact |
| ground idle during landing rollout | | | |
| Check Anti-Skid after gear lowered | | Vis | |
| Check Rudder Pressure in hydraulic set | | Vis | |
| **After Landing** | | | |
| Set Starter Switches as required | | Man,Vis | |
| Set lights as required | | Man,Vis | |
| Set Engine Anti-ice as required | | Man,Vis | |
| Set pilot, Q-inlet, and window switches to OFF | | Man,Vis | |
| Set Flaps to UP | | Man,Vis | |
| Set speed brakes to Zero | | Man,Vis | |
| Set cabin manual pressure control to FULL DECREASE | | Man,Vis | |

| Task | | Switch left on inadvertently | Electric shock hazard to ground members |
|---|---|---|---|
| Set Air Conditioning Master switch to RAM AIR | Man,Vis | | |
| Set pilots' radar intensity to full counter clockwise | Man,Vis | | |
| Set HF Radio to OFF | Man,Vis | | |
| Ensure INS accuracy check complete | Man,Vis,Aud,Voc,Cog | | |
| Turn off Auto Pilot | Man,Vis | | |
| Zeroize Ciphony Control Panel if required | Man,Vis | | |
| Set Manifold Valve Switch to WING REFUEL | Man,Vis | | |
| Apply External Power as required | Man,Vis | | |
| Set External Power Switch to TRIP if required | Man,Vis | | |
| Set External Power Switch to CLOSE | Man,Vis | | |
| Ensure Wheel Well Doors clear | Vis | | |
| Set Generator Switches | Man,Vis | | |
| Set Line Valve to CLOSED | Man,Vis | | |
| Set A/R Pumps to OFF | Man,Vis | | |
| Set Circuit Breakers as required | Man,Vis | | |
| Check autopilot power switch ON | Vis | | |

# NAVIGATOR'S TASK LISTING

| TASK | INFORMATION IN | MODALITY | ERRORS | ERROR EFFECTS |
|---|---|---|---|---|
| **Preparation for Flight** | | | | |
| Perform Mission Planning | | | | |
| Select correct charts | Schedule,JNC charts | Man,Vis,Cog | | |
| Develop route of flight to meet mission timing | Schedule,AP1B,AP1A | Man,Vis | Route developed incorrectly | Violation of foreign airspace |
| Plot celestial navigation leg on charts | Schedule,Flight plan | Man,Vis | | |
| Place special use airspace data on charts | HO-249,Air almanac, Star/sun volumes | Man,Vis | | |
| Place air refueling data on charts | Scheduling,AP1B,AP1A | Man,Vis | | |
| Place emergency airfields on charts | IFR supplement,Tech order | Man,Vis | | |
| Annotate highest terrain and obstructions on chart | Enroute charts, AP1A,CHUM | Man,Vis | | |
| Annotate level off point | Crew Coordination | Man,Vis | | |
| Annotate ADIZ entry point | Enroute charts, TAC communications office | Man,Vis | | |
| Complete Mission Paperwork | Schedule,HO-249,Air almanac | Man,Vis | | |
| Complete Form 200 | Wind sheets,Crew Coordination | Man,Vis,Cog | Record wrong wind/velocity | |
| Complete navigator briefing guide | Flight plan,Charts | Man,Vis | | |
| Complete Scheduling blocks of Mission Accomplished Report (MAR) | MAR | Man,Vis | | |
| Review and study Flight Information Publication (FLIP) and General Planning (GP) requirements | Enroute charts,AP1A,AP1B | Man,Vis | | |
| Conduct crew flight briefing | Crew briefing guide | Voc | | |
| Discuss mission requirements with wing intelligence and communications officers | TAC communications office and Intelligence | Voc,Aud | Transcription | Inaccurate code for incoming threat |
| Check Form 200 and chart for accuracy | Whiz Wheel, Form 200,Chart | Man,Vis,Cog | | |
| Fill out known information on in-flight log | Wind sheet,Form 200 | Man,Vis | | |
| Determine Where Celestial observations will take place | | Man,Cog | | |
| Perform Base Operations Duties | | Aud | | |
| Attend Weather Briefing | | | | |
| Check weather for impact on mission timing | Weather shop | Aud,Voc | Not realizing impact of | Miss rendezvous |
| Review approach plates and enroute charts | Weather shop | Man,Vis,Cog | | |
| Check Flight Notices to Airmen (NOTAMS) | | Vis | | |
| Perform Squadron Preflight Activities | | | | |
| Check Flight Schedule for changes | | Vis | | |
| Review Flight Crew Information File (FCIF) | | Vis | | |
| Synchronize Crewmembers' watches | Clock | Man,Vis | | |
| Check Aircraft parking spot | SOF | Voc,Aud | | |

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| Task | Reference | Medium | Consequence |
|---|---|---|---|
| Check receiver status | SOF | Voc,Aud | |
| Attend Crew Briefing and Cell briefing | CELL lead | Aud | |
| Pick up Helmet and Oxygen Mask from life support | | Man,Vis | |
| Pick up required in flight publications | Intel, TAC communications office | Man,Vis | |
| Pick up classified information | SOF intelligence,TAC comm. office | Man,Vis | Inaccurate decoding / Compromise classified mission |
| Check KIK-18 | | Man,Vis | |
| Pick up KY-58 | | Man,Vis | |
| Perform Exterior Inspection | | | |
| Attend Crew Assembly | | Aud | |
| Review 781 writeups | | Vis | |
| Load Equipment onto Aircraft | | Man,Vis | |
| Review Crew Aircraft Evacuation plan | | Vis | |
| **Power Off Inspection** | | | |
| Check portable oxygen bottle | | | |
| Check Cleanliness, general condition, and stored in normal position | Dash 1 | Vis | |
| Check For pressure approximating 300 psi | Dash 1 | Vis | |
| Check Altitude Selector Knob in NORMAL position | Dash 1 | Vis | |
| Service Portable Oxygen Bottle | Dash 1 | Man,Vis | |
| Replace Portable Oxygen Bottle | Dash 1 | Man,Vis | |
| Hook up helmet to oxygen | | Man,Vis | |
| Prepare navigator station for preflight | | | |
| Take out charts and equipment | | Man,Vis | |
| Take out Navigation Publications | | Man,Vis | |
| Ensure Celestial Tables and Air almanacs on board and current | | Man,Vis | |
| Perform IFF Control Panel preflight | | | |
| Set Master Switch OFF | TAC Communications office | Man,Vis | |
| Set Mode 4 Code Switch to A or B | KIK-18 | Man,Vis | |
| Set Mode Enabling Switches OUT | | Man,Vis | |
| Set Mode 4 On/Out Switch ON | | Man,Vis | |
| Set Mode 3/A code selectors to zeroes | | Man,Vis | |
| Check MSU-INS and MSU-DNS Mode selectors OFF | | Man,Vis | |
| Check CDU power switch in NORMAL or AUX | | Man,Vis | |
| Set APN-218 Doppler Switch to OFF | | Man,Vis | |
| Set Search Radar Control Panel | | Man,Vis | |
| Set FTC Switch OFF | | Man,Vis | |
| Set IAGC Switch OFF | | Man,Vis | |
| Set PATT switches as desired | | Man,Vis | |
| Set Bearing Switch as desired | | Man,Vis | |
| Set STC Dial full counterclockwise | | Man,Vis | |

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| Task | Code |
|---|---|
| Set Stab Switch OFF | Man,Vis |
| Set Gain Control full counterclockwise | Man,Vis |
| Set Heading Select Knob to local magnetic variation | Man,Vis |
| Set Scan Switch OFF | Man,Vis |
| Set Test Meter Switch to "MAG" | Man,Vis |
| Set Range Switch to 3:30/5 | Man,Vis |
| Set Function Switch OFF | Man,Vis |
| Set Radar Pressurization Control switch to ON | Man,Vis |
| Set Radar/Rendezvous Control Panel | Man,Vis |
| Set Master Power Switch OFF | Man,Vis |
| Set Pulse Width Switch (as required) | Man,Vis |
| Set Code Selector Switches | Man,Vis |
| Set electronic cabinet cooling switch to on | Man,Vis |
| Set Search Radar Indicators | Man,Vis |
| Set Range Delay Switch OFF | Man,Vis |
| Set Intensity Control Knob fully counterclockwise | Man,Vis |
| Set range control knob fully clockwise | Man,Vis |
| Set interphone panel switches | Man,Vis |
| Set FSA/CAS power switch OFF — Crew Coordination | Man,Vis |
| Check Oxygen System | Man,Vis |
| Turn Oxygen Supply Lever ON | Man,Vis |
| Don Flight Helmet and Oxygen Mask | Man,Vis |
| Check Helmet and Mask connections | Man,Vis |
| Place Regulator-Diluter Lever to 100% | Man,Vis |
| Test Oxygen Mask for leaks | Man,Vis |
| Place Emergency Oxygen Toggle lever to EMERGENCY | Man,Vis |
| Place Regulator-Diluter Lever to NORMAL | Man,Vis |
| Place Emergency Toggle Lever to center position | Man,Vis |
| Place Oxygen Supply Lever OFF | Man,Vis |
| Place Oxygen Regulator-Diluter lever to 100 percent | Man,Vis |
| Test Helmet Transmit/Receive capability | Man,Vis |
| Take off helmet | Man,Vis |
| Don headset | Man,Vis |
| Test transmit/receive capability | Man,Vis |
| Complete Crew Report | Voc,Aud |
| Place Interphone Rotary Switch to CALL position | Man,Vis |
| Acknowledge Crew Position (verbally) | Voc,Aud |

| Power On Inspection | | | | |
|---|---|---|---|---|
| Set control panel switches as required | | Man,Vis | | |
| Perform N 1 compass preflight | | Man,Vis | | Fly off course |
| Check latitude correction pointer OFF | | Man,Vis | Overlook a compass error | |
| Set Compass to correct MAG heading | | Man,Vis | | |
| center Annunciation Pointer | | | | |
| Accomplish Grid Check | | Man,Vis | | |
| Perform INS/DNS System Preflight | | | | |
| procedures | | | | |
| Check INS Doppler Status Panel | | Vis | | |
| Set MSU-INS and MSU-DNS Mode selectors | Crew Coordination | Man,Vis | | |
| to ALIGN | | | | |
| Turn on FSA/CAS power switch | | Man,Vis | | |
| Perform APN-218 Doppler Checks | | Man,Vis | | |
| Turn Mode Selector to LAND | | Man,Vis | | |
| Perform Bit Test | Base operations | Man,Vis | | |
| Turn Mode Selector to OFF | | Man,Vis | | |
| Insert INS and DNS | | Man,Vis | | |
| Set IFF Mixer Switch as desired | | Man,Vis | | |
| Set IFF Antenna Switch to BOTH | | Man,Vis | | |
| Set RAD - TEST/MON Switch to OUT | | Man,Vis | | |
| Set IFF master switch to NORMAL | KIK-18 | Man,Vis | | |
| Test Modes 1, 2, 3/A and C | | Man,Vis | | |
| Encode Mode 4 | | Man,Vis | Keying errors | Must recheck all other code settings |
| Check Mode 4 light out | | Man,Vis | | |
| Set master switch to STANDBY | | Man,Vis | | |
| Set Mode 1, 2, 3/A, and C switches | | Man,Vis | | |
| required | | | | |
| Set Mode 1, 2, and 3/A Codes | | Man,Vis | | |
| Set Audio/Light Switch | | Man,Vis | | |
| Set RAD - TEST/MON Switch | | Man,Vis | | |
| Turn APN-59 Function Switch to STBY | Weather | Man,Vis | | |
| Perform Altimeter Preflight procedures | | | | |
| Set Altimeter to correct Barometric | | Man,Vis | | |
| Compare Altimeter setting with field | | Man,Vis | | |
| elevation | | | | |
| Accomplish DNS Interface Test | Flight plan | Man,Vis | | |
| Accomplish INS Interface Test | IFR supplement | Man,Vis | | |
| Insert Waypoint Data | IFR supplement | Man,Vis | Keying errors | Could severely impact mission success |
| Insert TACAN Data | | Man,Vis | Keying errors | Could affect navigation accuracy |
| Verify waypoints | | Man,Vis | | |
| Perform launch authentication procedures | | | | |
| Load KY-58 | | Man,Vis | | |
| Request authentication and launch | | Voc,Aud | | |
| message from command post | | Man,Vis | | |

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| Task | Notes | Modality |
|---|---|---|
| Respond With correct Authentication | | Vis |
| Install sextant stool and sextant | | Man,Vis |
| Check sextant mount | | Man,Vis |
| Check sextant desiccant | | Man,Vis |
| Check averager | | Man,Vis |
| Check sextant alignment | | Man,Vis |
| Observe a celestial body | | Man,Vis |
| Perform celestial precomp | | Man,Vis |
| Resolve sextant accuracy | | Man,Vis |
| Remove and stow sextant and stool | | Man,Vis |
| Turn FSA/CA3 Power Switch ON | | Man,Vis |
| Fit Lite Preserver Unit (LPU) | | Man,Vis |
| **Starting Engines And Before Taxi** | | |
| Perform starting engines and before taxi checklist procedures | | Man,Vis |
| Turn Oxygen System ON | | Man,Vis |
| Set INS/DNS System to NAV Mode | | Vis |
| Don Gloves | | |
| Monitor engine start | | Vis |
| Perform aircraft electrical power check | | Man,Vis |
| Check For at least One Generator on line | | Man,Vis |
| Set IFF Master Switch to STANDBY | | Man,Vis |
| Turn APN-218 doppler mode selection ON | | Man,Vis |
| Turn search radar to STBY | | Man,Vis |
| Set Radar/Rendezvous Beacon as required | | Man,Vis |
| Perform warning and indicator light test | | Aud,Man,Vis |
| Report over Interphone "Ready to Taxi" | | Man,Vis |
| Check receiver status | | Voc,Aud |
| Ensure Taxi Clearance received | | Voc,Aud |
| **Taxi** | | |
| Perform search radar turn on procedures | | Man,Vis |
| Set Function Switch to SEARCH | | Man,Vis |
| Adjust Intensity Control | | Man,Vis |
| Adjust heading mark intensity control | | Man,Vis,Cog,Aud,Voc |
| Set Scan Switch as desired | Crew Coordination | Voc,Aud |
| Set Stab Switch to UP | Ground and clearance control | Man,Vis,Aud |
| Fine-tune Radar | SOF | Man,Vis,Aud |
| Check beacon capability | | Man,Vis |
| Perform radio procedures | | Man,Vis |
| Ensure Departure Clearance is received | | Voc,Aud |
| Ensure Flight Safety Check by (SOF) is accomplished | | Voc,Aud |

| Task | | Mode | | |
|---|---|---|---|---|
| Fasten Seat Belt and Shoulder Harness | | Man,Vis | | |
| Perform safety check | | Man,Vis | | |
| Prepare For Takeoff | | | | |
| Report Ready For Takeoff | | Man,Vis | | |
| Perform before Takeoff Checklist | | | | |
| procedures | | | | |
| Set Radar/Rendezvous Beacon | | Man,Vis | | |
| Set IFF (as required) | | Man,Vis | | |
| Perform Takeoff Roll | | Vis | | |
| Perform takeoff duties | | | | |
| Monitor lead aircraft for MITO timing | | Vis | | |
| Record Takeoff Time | | Man,Vis | | |
| Monitor Aircraft Instruments | | Vis | | |
| Perform Initial Climbout procedures | | | | |
| Ensure positive rate of climb | | Vis | | |
| Ensure Gear Up | | Vis | | |
| Ensure Flaps are raised | | Vis | | |
| **Call Joinup** | | | | |
| Direct Pilot Into Enroute Formation | RAPCON | Man,Vis,Voc | | |
| Use All available equipment to effect | | Man,Vis | | |
| join up | | | | |
| Inform pilot of other aircraft's position | | Voc,Vis | | |
| Ensure Level Off In Altitude Block | | Man,Vis | | |
| Acquire lead aircraft on radar | | Man,Vis,Voc | Misread radar | Mishap |
| Make departure call | | Man,Vis,Voc | | |
| Monitor Departure Being Flown | | Vis | | |
| Ensure Correct Headings are flown | | Vis | | |
| Ensure Correct Altitudes are flown | | Vis | | |
| Perform after takeoff checklist procedures | | | | |
| Check IFF Mode 4 Caution Light off | | Vis | | |
| Reset Altimeter at Transition Altitude | | Man,Vis | | |
| Ensure Oxygen Requirements Are Met | | Man,Vis,Aud | Omission | |
| Ensure Oxygen is ON and at 100% when | | Man,Vis | | |
| aircraft is above 10,000 feet | | | | |
| Ensure Oxygen is readily available | | Man,Vis,Voc | | |
| above FL250 | | | | |
| Don Helmet above FL430 | | Man,Vis,Aud | | |
| Make 2,000' prior to Level Off Call | | Man,Vis,Aud | Omission | Mishap |
| Make 1,000' prior to Level Off Call | | Man,Vis,Aud | Omission | Mishap |
| Record Level Off Time | Training sheet | Man,Vis,Aud | | |
| Monitor Interphone And Radios | | Aud | | |
| Monitor Interphone and COMM radios | | Aud | | |
| from takeoff | | | | |

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| Task | Reference/Equipment | Cues | Error | Consequence |
|---|---|---|---|---|
| Monitor HF when out of home station UHF range during alpha monitor periods | | Aud | | |
| **Cruise** | | | | |
| Complete Communication Log | | Man,Vis | | |
| Request And record UHF Traffic | | Man,Vis,Aud,Voc | | |
| Accomplish HF Contact | | Man,Vis,Aud,Voc | | |
| Record HF Traffic | | Man,Vis,Aud,Voc | | |
| Monitor Radios And Interphone | | Aud | | |
| Monitor UHF Command Post/Cell frequency | | Aud | | |
| Monitor UHF Air Traffic Control frequencies | ATC | Aud | | |
| Monitor HF guard talk during alpha monitor period | | Aud | | |
| Update IFF Mode 3A as required | TACAN/VOR | Man,Vis,Aud | Omission | |
| Monitor Interphone as required | TACAN/VOR | Man,Vis,Aud | | |
| Monitor And Update Navigation Equipment | TACAN/VOR | Man,Vis,Aud | | |
| Update INS/ONS position | | Man,Vis | | |
| Monitor APN 59 Radar | | Man,Vis,Aud | | |
| Monitor Navigation Radio aids | | Man,Vis,Aud | | |
| Perform station keeping duties | | | | |
| Keep Aircraft within 10 NM of track | | Man,Vis,Aud,Voc | | |
| Direct Aircraft to avoid thunderstorms by 10 NM below FL230 | | Man,Vis,Aud,Voc,Cog | Misread radar | Aircraft damage |
| Direct Aircraft to avoid thunderstorms by 20 NM at or above FL230 | | Man,Vis,Aud,Voc,Cog | Misread radar | Aircraft damage |
| Make in-flight log entries | | Man,Vis | | |
| Record Aircraft position and time at all planned turn points | | Man,Vis | | |
| Record Aircraft position at least once every 30 minutes | | Man,Vis | | |
| Perform Celestial Navigation | Mission Accomplished Report | Man,Vis,Cog,Aud,Voc | | |
| Ensure Celestial Navigation clearance is obtained | | Man,Vis,Aud,Voc | | |
| Set Equipment as required for specific navigation Log | Navigation aids,INS,DNS,TACAN | Man,Vis | | |
| Take coast out fixes | | Man,Vis,Cog,Aud,Voc | | |
| Record accurate start position and time | Air almanac/HO-249 | Man,Vis,Cog | | |
| Compute "After Heading" and ETA to turn | | Man,Vis,Cog,Voc | | |
| Perform Celestial Procedures | | Man,Vis,Cog | | |
| Perform Dead Reckoning (DR) Navigation | | Man,Vis,Cog | | |
| Accomplish celestial pre-comps | | Man,Vis,Cog,Aud,Voc | | |
| Resolve MPP/FIX | | Man,Vis,Cog | | |
| Complete Log work on Form 200 | | Man,Vis,Cog | | |

| Task | | Code | Error | Consequence |
|---|---|---|---|---|
| Direct aircraft along planned route to coast end point/ADIZ | | Man,Vis,Cog,Voc | | |
| Accomplish celestial control time to air refueling control point | | Man,Vis,Cog | | |
| Monitor navigation equipment for malfunction | | Vis | | |
| Perform Overwater Navigation | | | | |
| Update INS/DNS as required | | Man,Vis,Cog | | |
| Set IFF as required | | Man,Vis,Cog,Aud | | |
| Set APN-218 to SEA | | Man,Vis | | |
| Track Aircraft Position | | Man,Vis | | |
| Use all navigation aids to monitor position within 20 NM of track | | Man,Vis,Cog | | |
| Update ETAs to Pilot as necessary for HF position report | | Man,Vis,Voc,Aud | | |
| Monitor Interphone and Radio | | Man,Vis,Aud,Voc | | |
| Perform Station Keeping Duties | Receiver | Man,Vis,Aud,Voc | | |
| Monitor Radar for Skin Paint or Beacon | Receiver | Man,Vis | | |
| Keep Pilot informed (verbally) on aircraft position | | Man,Vis,Voc,Aud | | |
| Ensure R2 Timing is met | | Man,Vis,Voc,Aud | | |
| Adjust TAS to make timing | | Man,Vis,Voc,Aud | Computation error | Timing not met |
| Adjust Track to make timing | | Man,Vis,Voc,Aud | Computation error | Timing not met |
| Perform Orbit Holding Procedures | | Man,Vis,Voc,Aud | | |
| Compute Orbit Headings | | Man,Vis,Cog | Computation error | Exit assigned airspace, miss rendezvous |
| Maintain ATC assigned airspace and altitude | | Man,Vis,Aud,Voc | | |
| Set Equipment As Required For Rendezvous | | Man,Vis | | |
| Monitor/Set Miscellaneous Equipment | | Man,Vis | | |
| Set Assigned Radio frequencies | | Man,Vis,Aud,Voc | | |
| Monitor Radios | | Aud,Voc | | |
| Set Altimeter as required | | Man,Vis | | |
| Monitor Attitude | Receiver | Vis | | |
| Establish Radio Contact With Receiver | | Man,Vis,Aud,Voc | | |
| Obtain Receivers information as required | | Man,Vis,Aud,Voc | | |
| Relay Tanker information as required | | Man,Vis,Aud,Voc | | |
| Compute Turn Range And Offset | | Man,Vis,Cog | Computation error | |
| Determine Turn Range from chart using TAS closure and drift inbound | | Man,Vis,Cog | | Miss rendezvous |
| Determine Offset required from chart using TAS and drift inbound | | Man,Vis,Cog | | |
| Set Oxygen Regulator As Required | | Man,Vis,Aud,Voc | | |
| Set Oxygen Regulator to ON | | Man,Vis,Aud,Voc | | |
| Set regulator:diluter Lever to 100% | | Man,Vis,Aud,Voc | | |
| Perform Rendezvous | | | | |
| Ensure ATC clearance to air refuel received | | Man,Vis,Aud,Voc | | |
| Conduct Point Parallel Rendezvous | | Man,Vis | | |

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| Task | Notes | Code | | |
|---|---|---|---|---|
| Establish Offset | | Man,Vis | | |
| Accomplish Automatic Direction Finder (ADF) check | | Man,Vis | | |
| Accomplish Positive Beacon ID | | Man,Vis | | |
| Start Timing | | Man,Vis | | |
| Instruct Pilot to turn at turn range | Radar,compass,DME | Man,Vis,Voc,Aud | | |
| Monitor echelon position | | Vis | | |
| Place Beacon to STBY as required | | Man,Vis | | |
| Initiate Overrun Procedures | | Aud,Voc | | |
| Perform Precontact | Crew Coordination, contact light | Man,Vis | | |
| **Air Refuelling** | | | | |
| Set Equipment As Required | Crew Coordination, contact light | Man,Vis | | |
| Set Rendezvous Beacon Control to STBY | Crew Coordination | Man,Vis | | |
| Record Air Refueling Data | | Man,Vis | | |
| Record Number of contacts | | Man,Vis,Aud,Voc | | Violate air refueling track |
| Record Amount of fuel transferred | | Man,Vis,Aud,Voc | Excessive transfer | Inadequate amount of fuel for transfer |
| Monitor Cell Formation | | Man,Vis | | |
| Tune Radar for optimum picture | | Man,Vis | | |
| Keep Pilot advised of position | | Man,Vis,Voc,Aud | | |
| Maintain ATC Clearance Requirements | | Man,Vis | Requirements not maintained | Airspace violation |
| Alter Aircraft as necessary to maintain course within 10 NM of cleared course | | Man,Vis,Voc,Aud,Cog | | |
| Monitor And update NAV systems | | Aud,Man,Vis | | |
| Monitor interphone and Radios | | Aud | | |
| Monitor UHF Radios | | Aud | | |
| Monitor HF Radio | | Aud | | |
| Monitor interphone | | Aud | | |
| Perform Breakaway Procedures | | Man,Vis,Voc,Aud | | |
| Configure Radar to stinpaint Receiver at bottom of AR block | | Man,Vis | | |
| Set APN-69 to OPERATE | | Man,Vis | | |
| Monitor Attitude | | Man,Vis,Voc,Aud | | |
| **Post Air Refuelling** | | | | |
| Set Radar/Rendezvous Beacon to OFF | | Man,Vis | | |
| Monitor Radios | | Man,Vis,Aud | | |
| Set Altimeters | | Man,Vis | | |
| Check Oxygen | | Man,Vis | | |
| Open fuel tank circuit breakers | | Man,Vis | | |
| Terminate Celestial/over water navigation | | Man,Vis | | |
| Accomplish Final DR position and announce ETA to coast end | Coordinate with lead aircraft | Man,Vis,Cog,Voc | Error - ADIZ violation | Violate ADIZ entry point |
| Accomplish coast end fix | | Man,Vis,Cog,Voc | | |

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| Task | Reference | | Man/Vis/etc. |
|---|---|---|---|
| Terminate celestial navigation clearance | | | Man,Vis,Voc |
| Check N1 and J4 compass heading | IFR supplement | | Man,Vis,Voc |
| Assume cell lead navigation responsibilities | | | Man,Vis,Voc,Aud |
| **Plan Divert** | | | |
| Plan divert | | | Man,Vis,Cog,Aud,Voc |
| Prepare chart | | | Man,Vis,Cog,Voc |
| Compute distance, time, and fuel | Crew Coordination | | Man,Vis,Cog,Voc |
| Prepare for Descent | | | Man,Vis,Cog |
| Navigate To IAF | | Mishap | Man,Vis | Altitude Errors |
| Monitor #1 aircraft | Crew Coordination | | Man,Vis |
| Review Penetration and Approach | ATC | | Man,Vis,Cog,Aud,Voc |
| Review highest terrain | Metro | | Man,Vis |
| Review emergency airfields | | | Man,Vis |
| Review special use airspace | | | Man,Vis,Aud,Voc |
| Authenticate mission change | | | Man,Vis,Aud,Voc |
| Monitor weather reports | | | Man,Vis,Aud |
| Monitor Aircrew Terminal Information service (ATIS) | RAPCON and command post | | |
| Set Altimeters | | | Man,Vis |
| Fasten safety belt and shoulder harness | | | Man,Vis |
| Ensure Approach Clearance received | | | Man,Vis,Aud,Voc |
| Contact Command Post | | | Man,Vis,Aud,Voc |
| **Descent** | | | |
| Perform Descent Altitude Procedures | | | |
| Make "2,000' Prior to Assigned altitude" call | RAPCON | Mishap | Man,Vis,Voc | Miss altitude call |
| Make "1,000' Prior to Assigned altitude" call | | Mishap | Man,Vis,Voc | Miss altitude call |
| Monitor Cell breakup | | | Man,Vis,Aud,Voc,Cog |
| Perform Instrument Approaches | Approach plate | | Man,Vis,Aud,Voc,Cog |
| Perform Airborne Directed Radar Approach (ARA) | Approach plate | | Man,Vis,Aud,Voc,Cog |
| Relay Ground Speed and Drift information | | | Man,Vis,Voc,Aud |
| Ensure Altitude Restrictions are met | | Mishap | Man,Vis,Voc | Altitude violation |
| Configure Radar | | | Man,Vis |
| Direct Descent as published as required | | | Man,Vis,Voc,Aud |
| Monitor Approach | | | Man,Vis |
| Monitor Radios | | | Man,Vis,Aud |
| Monitor timing as required | | | Man,Vis |
| Perform Safety Checks | | | |
| Scan For Traffic | | | Vis |
| Check Flap setting | | | Vis |

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| Task | Notes | Codes |
|---|---|---|
| Check Gear position down | | Vis |
| Check Pilot Approach Speed | | Vis |
| Check Fuel Panel | Approach plate | Vis |
| Announce approach for decision height | Approach plate | Man,Vis,Voc |
| or MDA | | |
| Call Missed Approach Point as required | Chart | Man,Vis,Voc |
| Perform Go Around as required | | Man,Vis,Voc,Aud |
| Ensure Missed Approach Procedure Are | | Man,Vis,Voc |
| accomplished | | |
| Advise Pilots of any hazards noted | | Man,Vis,Voc |
| Make Required Altitude calls | | Man,Vis,Voc |
| **After Landing** | | |
| Record Time | | Man,Vis |
| Monitor landing roll out/ground speed | | Vis |
| Accomplish after landing checklist | | |
| Call command post | | Voc,Aud |
| Pass landing time | | Voc,Vis |
| Get parking | | Aud,Voc |
| Monitor radios | | Aud,Vis |
| Turn Equipment Off | | |
| Set Mode 4 Code Switch | r setting / Harm ground personnel | Man,Vis |
| Set Mode 4 On/Out Switch OUT | | Man,Vis |
| Set IFF Master Switch OFF | | Man,Vis |
| Turn APN-218 System OFF | | Man,Vis |
| Turn DNS MSU Switch OFF | | Man,Vis |
| Set Search Radar Control Panel | | Man,Vis |
| Set Gain Control counter clockwise | | Man,Vis |
| Set Intensity Control counter clockwise | | Man,Vis |
| Set Heading Marker Control clockwise | | Man,Vis |
| Set Scan Switch OFF | | Man,Vis |
| Set Stab Switch OFF | | Man,Vis |
| Set Function Switch OFF | | Man,Vis |
| Set APN-88 Control Panel OFF | | Man,Vis |
| Set Oxygen System | FLIP documents | Man,Vis |
| Set Supply Lever OFF | | Man,Vis |
| Set Diluter Lever 100% | | Man,Vis |
| Ensure Oxygen pressure bleeds to Zero | | Man,Vis |
| Perform INS Accuracy Check Procedures | | |
| Select Way Point | | Man,Vis |
| Press Hold Key | | Man,Vis |
| Record latitude and longitude coordinates | | Man,Vis |
| Press Hold Key | | Man,Vis |
| Load Pure Present Position | | Man,Vis |
| Load Airplane Actual Position | | Man,Vis |

| Task | | | |
|---|---|---|---|
| Set Data Selector to DIST/TIME | | Man,Vis | |
| Press WY PT CHG Key | | Man,Vis | |
| Press 1 and 2 Keys in sequence | | Man,Vis,Cog | |
| Record Distance from left-hand data display | | Man,Vis | |
| Press Clear Key | | Man,Vis | |
| Record Nav Time of last flight | | Man,Vis | |
| Calculate nav accuracy | | Man,Vis,Cog | |
| Turn INS MSU Switch OFF after period | Omission | Man,Vis | Dead battery, can't align INS, flt delay |
| Set IFF/SIF As Required | | Man,Vis | |
| Set Mode 2 Code (as required) | | Man,Vis | |
| Set FSA/CAS power OFF | | Man,Vis | |
| Zeroize Code in KIK-18 and KY-58 | Omission | Man,Vis,Cog | Compromise secrets |
| Offload Flight Equipment | | Man,Vis | |
| Offload Passengers | | Man,Vis | |
| Enter Navigation systems maintenance discrepancies into Form 781 | | Man,Vis,Cog | |
| Perform maintenance debriefing | | Voc,Aud,Vis | |
| Relay INS accuracy check information | | Voc,Aud,Man,Vis,Cog | |
| Perform squadron/base operations duties | | | |
| Turn in comm kit, KIK-18, KY-58 and | Omission | Man,Vis | Compromise secrets |
| FLIP documents | | | |
| Complete mandatory aircrew requirements | Crew Coordination | Man,Vis,Cog,Aud,Voc | |
| Complete SAC Form 157 | | Man,Vis,Cog | |
| Turn in all navigation mission paperwork | | Man,Vis | |
| Turn in helmet and mask to life support | | Man,Vis | |
| Perform crew mission debriefing | | Vis,Cog,Voc,Aud | |

# BOOM OPERATOR'S TASK LIST

## Cargo Loading

| TASK | OUTCOME | MODALITY | ERRORS | ERROR EFFECTS |
|---|---|---|---|---|
| Plan Cargo Loading | For proper loading within design limits of aircraft | Man,Vis,Aud,Voc,Cog | | |
| Check Cargo Unit Dimensions | For fit into aircraft | Man,Vis,Aud,Voc | Transcription | Incorrect cargo load plan |
| Check for Hazardous Materials | Special forms, packaging, securing | Man,Vis,Aud,Voc | Transcription | Customs/safety problems |
| Determine Weights of Cargo Units | For CG calculations, footprint limits | Man,Vis,Aud,Voc | Transcription | Incorrect load plan and CG |
| Determine CG location of large cargo loads | For CG calculations, positioning in cargo area | Man,Vis,Aud,Voc | Transcription | Incorrect load plan and CG |
| Compute Contact Area Pressures | Cannot exceed limit | Man,Vis,Cog | Misread tables | Damage to floor of cargo bay |
| Determine Shoring Requirements | To disperse weight over greater area so that it stays within limits | Man,Vis,Cog | | |
| Determine Load Plan of Cargo | To ease unload, stay within limits | | Misplace equipment | Incorrect cargo load plan, CG |
| Complete Forms 83, 83A, and 84 | Aircraft load plans (actual schematics with calculations) | Man,Vis,Cog | | |
| Determine Total Load and Aircraft CG location | This will feed into mission planning and takeoff data | Man,Vis,Cog | Error in CG location | |
| Coordinate and Order Flight Meals | Taking orders from crew, making the request to the flight kitchen | Man,Vis,Aud,Voc | | |
| Check Tail Support Strut Installed | Must be in place prior to loading to keep aircraft from falling on its tail | Man,Vis | Omission, improper installation | Tipping of aircraft/damage |
| Check Chock position | Move from tire to compensate for tire compression during cargo loading | Man,Vis | Improper placement | |
| Check Ground Wire Installed | Must be installed for electrical hazard safety | Man,Vis | Omission | Safety hazard |
| Check Cargo Loading Area clear | Remove obstructions, debris, loose equipment | Man,Vis | Omission | Trip hazards, damage to equipment |
| Check Fire Extinguisher available | For fire safety | Man,Vis | Omission | Fire safety hazard |
| Check Tiedown Equipment | Ensure adequate quantity, in proper condition | Man,Vis | Omission | Damage to cargo |
| Check Shoring | Ensure adequate quantity, in proper condition | Man,Vis | Insufficient amount | Time factor (to get more shoring) |
| Open Cargo Door | For access to cargo bay | Man,Vis | Not opened far enough | May not clear vehicle/damage |
| Check Cargo Door Sill protected | Place shoring on door sill area to protect latching mechanism | Man,Vis | Omission | Latching mechanism damage, Safety of Flight (SOF) |
| Stow Seats | Fold them up out of the way | Man,Vis | Omission | Seats can get in way/damage |
| Position Shoring | In path of cargo to be loaded to disperse weight during loading | Man,Vis | Misplacement | Damage to floor |
| Check Manifest and Waybills | Cargo must have accompanying paperwork | Man,Vis,Cog | Omission, misread | Customs problems |
| Check Mounted Cargo secured to carrier | Equipment on trailers, loaders should be properly secured | Man,Vis | Omission, improper mounting | Damage to vehicle, cargo, and aircraft |
| Brief Load Team Members | Assign them their positions, duties | Aud,Voc | Omission, inadequate briefing | Bad coordination, time factor |

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| Task | Description | Codes | Error | Consequence |
|---|---|---|---|---|
| Position Loading Vehicle | Direct the vehicle to the cargo door for proper positioning | Man,Vis | Improper backing signals | Aircraft and vehicle damage |
| Load Cargo | Load each piece in proper order, position in accordance with Forms 83 | Man,Vis | Misplacement of cargo | CG problems and aircraft and cargo damage |
| Secure Cargo | in accordance with T.O.s | Man,Vis | Asymmetric and improper tiedown | Shifting of cargo, damage |
| Stow Loose equipment | Walkthrough of cargo area to secure all unsecured equipment | Man,Vis | Omission | Trip hazards, SOF |
| | | | | |
| **Preparation for Flight** | | | | |
| Complete DD Form 365-4 weight and balance information | Calculate aircraft takeoff gross weight, CG, and ensure its within limits | Man,Vis,Cog | Math errors and incorrect information | CG errors |
| Complete AF-781, AF-791, and AFTO-78 | 781-flight time, 791-fuel offload report 78-structural life report | Man,Vis,Cog | Incorrect information and incorrect tail number | Bad mission paperwork |
| Perform Boom Operator Portion of mission briefing | Inform crew of offload schedule, etc | Man,Vis,Aud,Voc | | |
| Brief Offload Type | Boom or drogue | Man,Vis,Aud,Voc | | |
| Brief Offload Amount | Fuel weight | Man,Vis,Aud,Voc | | |
| Brief air refueling control times | Contact times | Man,Vis,Aud,Voc | | |
| Brief Receiver Type | Type of receiving aircraft | Man,Vis,Aud,Voc | | |
| Brief Receiver Callsigns | | Man,Vis,Aud,Voc | | |
| Base Operations Activities | | | | |
| Check Crew Information File | For base closures, changes, etc. | Man,Vis | | |
| Coordinate Life Support Equipment | For each crewmember and any additional passengers | Man,Vis,Aud,Voc | Insufficient amount or wrong type | Time factor and passenger problems |
| Attend Weather Briefing | | Vis,Aud | | |
| Pick up Flight Meals | | Man,Vis | | |
| | | | | |
| **Preflight** | | | | |
| Perform Interior Inspection | | | | |
| Perform Crew Assembly | Brief where oxygen bottles located | Man,Vis,Aud,/oc | | |
| Review Aircraft Forms | Become aware of aircraft disposition, problems, and status | Vis,Aud,Voc | | |
| Load on Personal and Professional equipment | Bags, helmets, publications, secrets | Man,Vis | | |
| Enter Aft Aircraft | To start APU | Man,Vis | | |
| Start APU | For internal aircraft power | Man,Vis | Omission | No power to aircraft, time |
| Check Crew Equipment Stowed | Bags and equipment stowed, headsets, helmets, publications, etc on seat | Man,Vis | Omission, wrong location | Time factor |
| Walkthrough Aircraft to Determine preflight schedule | A first look around to see if there will be any problems | Man,Vis | | |
| Check Circuit Breakers | Ensure all are in | Man,Vis,Cog | Omission, misread | SOF, time factor |
| Remove And stow Nose Gear Ground downlock And Release Handle | To allow nose gear retraction after takeoff | Man,Vis | Omission | Nose gear will not retract, SOF |

| Perform Boom Operator's Forward station preflight | Emergency equipment checks | | | |
|---|---|---|---|---|
| Check Portable Oxygen Bottle | Check service record, selector in NORMAL | Man,Vis | Omission, misread | SOF |
| Check Interphone Panel settings | Selector switches on INTERCOM, check intercom channel | Man,Vis | Water switch in wrong position | |
| Check Interphone | Put on helmet, check transmit and receive | Man,Vis,Aud,Voc | Omission | Headset or panel may not work |
| Perform Oxygen System check | Regulator function check | Man,Vis | | |
| Perform Crew Report | Check CALL position on intercom - also serves as a reference point for | Aud,Voc | | |
| Perform Sextant Check | Sextant condition and operation | Man,Vis | | |
| Position Navigator's Sighting stool | If you need it to reach the mount | Man,Vis | Improper positioning | Stool can collapse. SOF |
| Check Sextant Mount | Check for damage to mount, that it's not installed backwards | Man,Vis | Installed backwards | Incorrect Zn for celestial shots |
| Install Sextant | | Man,Vis | | Sextant damage. misalignment |
| Check Alignment of Sextant | Check accuracy of sextant | Man,Vis | Improper alignment | Inaccurate celestial shots |
| Check Timer | For proper operation, accuracy | Man,Vis | Omission | May not average over 2 min |
| Perform Instantaneous Shoot | Final check of sextant operation, provides sextant correction | Man,Vis,Cog | Shoot false body | Inaccurate reading of sextant |
| Remove And store Sextant | | Man,Vis | | |
| Remove And store Sextant Stool | | Man,Vis | | |
| Perform cargo compartment preflight | | | | |
| Check cargo compartment air condition master switch in MANUAL | Keeps hot air from entering cabin | Man,Vis | | |
| Check passenger station oxygen panel | Place in OFF and 100% for switch position check and operation | Man,Vis | Omission, switch in wrong position | Possible depletion of oxygen supply |
| Check Emergency Interphone Panel | Operation check with a headset | Man,Vis,Aud,Vis | Omission | SOF |
| Check Aft Compartment Interphone panel | Operation check with a headset | Man,Vis,Aud,Vis | Omission | SOF |
| Check Gaseous Oxygen System quantity gage | Adequate pressure | Man,Vis | Omission, misread | SOF |
| Check Gaseous Oxygen System valves | Valve position | Man,Vis | Omission, wrong position | SOF |
| Check Air Outlet Doors and defrost slide | Backup defroster for boom pod windows | Man,Vis | Omission | Backup defroster may be inoperable |
| Open Sighting Door | Checks door operation, allows flow of hydraulic fluid | Man,Vis | Omission | Sighting door may be inoperable |
| Check Interphone Panel | Operation check with a headset, ensure communication with pilots and navigator | Man,Vis,Aud,Voc | Omission, improper switch position | SOF (communications with receiver) |
| Check Oxygen Regulator | On, 100%, function | Man,Vis | Omission, improper switch position | SOF, depletion of aircraft oxygen |
| Check IBO Oxygen Regulator | On, 100%, function | Man,Vis | Omission, improper switch position | SOF, depletion of aircraft oxygen |
| Check Emergency Override Switch | Should be in NORMAL position | Man,Vis | Omission | System configuration unknown |
| Check Boom Limit Switches | Should be ACTIVE | Man,Vis | Omission | No automatic boom limits |
| Check Indicator Lights | Indicate whether boom is in automatic or manual retract mode | Man,Vis | Omission | Lights may be inoperable |
| Set telescope-at-disconnect switch | Should be in MANUAL | Man,Vis | Set to AUTO | Damage if selected with boom stowed |
| Check Circuit breakers | All should be in, reset if required | Man,Vis,Cog | Omission | SOF |

| Task | Description | Detection | Error | Consequence |
|---|---|---|---|---|
| Set air refueling boom operators panel master switch ON | Gives power to Boom Pod panels, allows reading of the gauges | Man,Vis | Omission | No DC power to air refueling equipment |
| Check Boom fully retracted | Check gauge for full retraction | Man,Vis | Omission | |
| Perform Signal Coil Test | Press to test for either open or shorted | Man,Vis | Omission | May have no disconnect capability |
| Set Underbody and Underwing lights ON | Turn on to full bright | Man,Vis | Omission | No lights for receiver under KC-135 |
| Check Nozzle Light and Taxi mounted floodlight | Turn on, ask Crew Chief if they're on | Man,Vis | | |
| Check Sighting Door open | | Man,Vis | Not ensuring door opened completely | Damage to door, inoperable in flight |
| Close Sighting Door Lever | Must close it prior to takeoff | Man,Vis | | |
| Set Ruddevator Trim Control at ZERO | For trim starting point (Normal setting for lighters) | Man,Vis | Omission | Changes angle of boom ruddervators puts stress on boom - damage |
| Perform Boom Compartment Checks | | | | |
| Recheck All Applicable Switches | | Man,Vis | Boom latch lever not closed | Could drop boom |
| Perform miscellaneous preflight procedures | | | | |
| Verify DD Form 365-4 data | Verify cargo and fuel loaded correctly, make changes to 365-4 if required | Man,Vis,Cog | Math errors, misread | CG and aircraft performance impacts |
| Conduct Ground Safety Locks Check | Gear locks removed and stowed in aircraft | Man,Vis | Omission,miscount | Gear cannot retract, SOF |
| Inform Pilot of Actual Takeoff weight and center of gravity | | Vis,Voc | | |
| Ensure Cargo and loose equipment secure | Walkthrough to ensure all equipment and cargo is stowed and tight | Man,Vis | Improper tiedown | Shifting and loosening of cargo |
| Perform APU Accumulator Check | Check for correct pressure | Man,Vis | Omission | Insufficient pressure for restart |
| Close Cargo Door and Emergency exit hatches | To allow pressurization, keep out smoke and fumes | Man,Vis | Omission, improper procedure | SOF and depressurization in flight |
| Brief Passengers | On emergency procedures | Man,Vis,Aud,Voc | Omission | Passengers not briefed on SOF |
| Perform Passenger Loading | | Man,Vis,Aud,Voc | | |
| Check Seats and Safety Belts | Check for serviceability | Man,Vis | Omission | SOF |
| Position Life Support Equipment | Head count and oxygen kits match up | Man,Vis | Omission, improper inspection | SOF |
| Check Passenger Information Cards | Currency, sufficient number of cards | Man,Vis | Omission | SOF and outdated cards |
| Remove floor obstructions | Ensure passenger area is clear | Man,Vis | Omission | SOF and trip hazard |
| Install boom operator's compartment entry panels | | Man,Vis | Omission | SOF and fall hazard |
| Open Cargo Door | | Man,Vis | | |
| Position Passenger Loading Stand | | Man,Vis | | |
| Brief Passengers | Brief individuals that will be seated near emergency exits | Man,Vis,Aud,Voc | Omission | SOF |
| Direct personnel to seats and verify manifest | | Man,Vis,Aud,Voc | | |
| Check Cargo Manifest | All items accounted for | Man,Vis | Omission | Customs problems |
| Secure Baggage and loose equipment | | Man,Vis | Omission | SOF and shifting of baggage |
| Designate/Brief Troop Commander | Delegate command of passengers | Man,Vis,Aud,Voc | Omission | |

**Starting Engines and Before Taxi**

| Task | Description | Detection | Error | Consequence |
|---|---|---|---|---|
| Start APU (if required) | | Man,Vis | | |
| Remove Entrance Ladder | Clear entrance area | Man,Vis | Omission | Cannot close door |

| Task | Description | Method | Error | Consequence |
|---|---|---|---|---|
| Close And latch Entry Door | | Man,Vis | Omission, not latched properly | SOF and depressurization |
| Stow Entrance Ladder | | Man,Vis | Omission, improper stowage | Trip hazard |
| Check Emergency Exit Hatches | Ensure aircraft integrity | Man,Vis | Omission, not latched property | SOF and depressurization |
| Turn on boom operator's compartment window heat switch | Window defroster | Man,Vis | Omission | Fogged sighting window and cold pod |
| Check air refueling line valve open | Fuel can be dumped through boom | Man,Vis | Omission | Cannot dump fuel if necessary |
| Cycle APU Generator Switch | Resets generator for next preflight | Man,Vis | Omission | Time factor for next aircrew |
| **Before Takeoff** | | | | |
| Notify passengers and extra crewmembers prepare for takeoff | Seat belts on | Aud,Voc | Omission | SOF, crew, and passengers may not strap in |
| Check cargo door closed and locked | Aircraft Integrity | Man,Vis | Omission, improper latching | SOF and depressurization |
| Complete TAXI Report | Report ready for takeoff | Aud,Voc | | |
| Walkthrough from boom pod | Last check before takeoff | Man,Vis | | |
| Monitor Electrical Control Panel | Backup flight crew | Vis | Omission, misread | SOF |
| **Takeoff and Climb** | | | | |
| Check passenger and extra crewmember status | Seat belts on | Man,Vis | | |
| Check Fuel distribution | Check 384-4F figures against actual, no leaks | Vis | Omission, misread | SOF |
| Check Circuit breakers | Reset if applicable (Not fuel system) | Man,Vis,Cog | Omission, misread | SOF and extra workload |
| Set Oxygen Panel ON, 100% | | Man,Vis | Omission | SOF |
| Fasten and lock safety belts and harness | Preparation for takeoff | Man,Vis | Omission | SOF |
| Complete Takeoff Report | Report ready for takeoff | Aud,Voc | Omission, not ready to report | Time factor |
| Monitor takeoff | Crosscheck and backup flight crew | Vis | Misread, improper reaction | SOF |
| **After Takeoff** | | | | |
| Turn Off Wheel Well Lights | | Man,Vis | Omission | Impacts life of light bulbs |
| Set air conditioning master switch to | | Man,Vis | Omission | No cabin pressurization |
| **CONDITION AIR** | | | | |
| Install Sextant Stool | | Man,Vis | | |
| Install Sextant | | Man,Vis | | |
| Check Cargo Compartment | Check for fumes, cargo, shifting, and passenger status | Vis | Omission, misread | Shifting cargo, smoke, and fumes |
| Turn On Nacelle Illumination | | Man,Vis | Omission | No light on engine nacelles |
| Set Boom Nozzle Light | Allows bulb to heat | Man,Vis | | |
| Set Boom Marker Lights | For fighter refuelings | Man,Vis | | |
| **Cruise** | | | | |
| Provide Crew Support (as required) | | Man,Vis,Aud,Voc,Cog | | |
| Take Celestial Observations | | | | |

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| Task | Description | Modality | Error | Consequence |
|---|---|---|---|---|
| Collect Azimuths and Elevations from navigator | To dial into sextant mount and position | Man,Vis,Aud | | |
| Dial in Azimuth and Elevation | sextant | | | |
| Take Celestial Observations | | Man,Vis | | |
| Give Elevations to Navigator | | Vis,Voc | | |
| **Air Refueling** | | | | |
| Perform Air Refueling Preparation procedures | | | | |
| Set Forward Oxygen Panel OFF, 100% | Moving from cockpit to boom pod | Man,Vis | Omission | SOF |
| Set Refueling Oxygen Panel | Plug into aircraft oxygen system, can stay on oxygen bottle | Man,Vis | Omission, incorrect setting | SOF |
| Monitor Command Radios | Listen for receiver's call | Aud | Omission | May not hear other aircraft |
| Set Sighting Door Lever OPEN | Opens door and checks for hydraulic power | Man,Vis | Omission | Vision restriction |
| Check Signal Coil | Can't disconnect without a "Good" condition | Man,Vis | Omission | If bad coil, cannot disconnect |
| Set Telescope-At-Disconnect | Fighters-MANUAL, others-AUTO | Man,Vis | Omission, set to AUTO | Could pull receiver into KC-135 |
| Ensure extension and elevation limit switches active | Check | Man,Vis | Omission, incorrect setting | |
| Set Emergency Override Switch | NORMAL-Limits are active, OVERRIDE-no limits | Man,Vis | Incorrect setting | Confusion of system configuration |
| Set receiver director light rheostats | Set intensity of Pilot Director indicator (PDI) lights | Man,Vis | | |
| Turn On air refueling Floodlight | Aids in depth perception | Man,Vis | | |
| Set ruddevator trim control to zero | | Man,Vis | Omission | Cannot lower boom until zeroed |
| Perform Boom Lowering Procedures | | | | |
| Raise Boom | To clear hook latch | Man,Vis | Omission | Cannot unlatch boom |
| Move Hook Latch | To allow lowering | Man,Vis | Omission | Cannot lower boom |
| Lower Boom | | Man,Vis | | |
| Extend Boom | Check "flight" characteristics | Man,Vis | Omission, not extending far enough | |
| Check Boom Controls | Control check: Left, right, up, down | Man,Vis | Omission, overcontrol | Damage fuel lines and boom structure |
| Obtain Radio Contact | | Man,Vis,Aud,Voc | | |
| Brief Receiver for Contact | Short communications check to ensure comm for breakaway | Aud,Voc | | |
| Set External Lights | | Man,Vis | | |
| Provide Visual commands to receiver | Via PDI lights | Man,Vis,Cog | Incorrect, not timely | SOF and time factor |
| Maintain Required communications with receivers | Via PDI lights or radio | Man,Vis,Aud,Voc | | |
| Maintain Proper Boom alignment | Keep light out of receiver's eyes; keep aligned with receptacle | Man,Vis | Incorrect | Strike receiver |
| Perform Air Refueling | | | | |
| Perform Contact Procedure | | Man,Vis | | |
| Monitor Boom Position indicators | Within limits | Vis | Incorrect position | SOF |
| Monitor Receiver position | Within limits (don't bow the boom) | Vis | Insufficient monitoring | Bind receptacle or strike receiver |
| Perform disconnect or breakaway procedures | If outside limits or before damage occur | Man,Vis | Omission | Pull receiver into KC-135 |

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| Task | Description | Classification | Error | Consequence |
|---|---|---|---|---|
| Recycle System for subsequent contacts | Reset button reconfigures PDI lights and signal amplifier | Man,Vis | Omission | PDI lights not reset, if in NORMAL after disconnect, no fuel flow |
| Perform Post Air Refueling | | | | |
| Set Ruddervator Trim Control to "0" | Reset trim for boom storage | Man,Vis | Omission | Cannot latch boom |
| Retract, Stow, and Latch Boom | Reduce aircraft drag | Man,Vis | Omission | Structural damage |
| Close Sighting Door with Sighting Door lever | Reduce aircraft drag | Man,Vis | | |
| Check Ruddervators locked | Reduces drag and checks boom fully stowed | Man,Vis | Omission | Stress on boom, aircraft control |
| Set Telescope-At-Disconnect switch | To MANUAL while boom is stowed | Man,Vis | Omission | Possible rapid boom retraction |
| Set external lights | Turn off PDI lights | Man,Vis | | |
| Set refueling station oxygen panel | Check Oxygen bottle quantity, turn off and bleed down pod oxygen | Man,Vis | | |
| Inform Pilot BOOM STOWED | | Aud,Voc | | |
| Return to Forward Cabin | Walkthrough to check on passengers | Man,Vis | | |
| Set forward station oxygen panel ON, 100% | | Man,Vis | Omission | SOF |
| **Descent** | | | | |
| Calculate landing center of gravity | To ensure within limits | Man,Vis,Cog | Math error, lookup error | Incorrect CG |
| Stow Sextant Stool and Sextant | | Man,Vis | Omission, damage to sextant | Trip hazard and sextant damage |
| Check Circuit Breakers | Reset as required | Man,Vis,Cog | | |
| Set Cargo Compartment Temp | As desired | Man,Vis | | |
| Walkthrough to Boom Pod | Ensure boom latched | Man,Vis | | |
| Perform Boom Latched Check | | Man,Vis | Omission | SOF and damage to aircraft on landing |
| Walkthrough to Forward Cabin | Return to cockpit for landing | Man,Vis | | |
| Fasten and Lock Safety Belt and shoulder harness | | Man,Vis | | |
| Monitor Electrical Control Panel | Flight crew backup | Vis | | |
| Monitor Fuel Panel | Flight crew backup | Vis | | |
| **After Landing** | | | | |
| Perform After Landing Procedures | | | | |
| Set Oxygen OFF, 100% | | Man,Vis | Omission | Deplete oxygen system |
| Install Nose Gear Ground Down Lock And Release Handle | Keep gear down and locked | Man,Vis | | |
| Check APU start accumulator pressure gauges | Ensure that accumulator did not bleed, sufficient pressure for next engine start | Man,Vis | Omission and insufficient pressure | |
| Set cargo compartment temperature control switch to manual | Temperature control in cargo bay | Man,Vis | | |
| Perform Aircraft Checks | | | | |
| Set Interphone | | Man,Vis | Omission | |
| Open Entry Door | | Man,Vis | | |
| Open Grill | | Man,Vis | | |
| Install Entrance Ladder | | Man,Vis | | |
| Close Grill | | Man,Vis | | |

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| Task | Description | Method | Error | Consequence |
|---|---|---|---|---|
| Set Boom Compartment Switches | Power down boom pod and return switches to default positions | Man,Vis | | |
| Perform APU Shutdown | | Man,Vis | | |
| Complete Form 781 | Maintenance write-ups | Man,Vis,Cog | | |
| Unload Passengers and Baggage | | | | |
| Open Cargo Door | | Man,Vis | | |
| Install Tail Stand | Prevent aircraft tilting and damage | Man,Vis | Omission, improper placement | Aircraft tipping |
| Ensure passenger loading stand in position | | Man,Vis | | |
| Unload Baggage | | Man,Vis | | |
| Check tail support strut installed | In place | Man,Vis | | |
| Check Position of Chocks | Against tires | Man,Vis | Omission | Aircraft could roll during unloading |
| Check External Power available | | Man,Vis | | |
| Check Ground Wire installed | | Man,Vis | Omission, improper sequence | Improper ground |
| Check cargo loading area clear | Prepare for transport vehicle | Man,Vis | Omission | Ground safety |
| Check Fire Extinguisher available | Fire safety | Man,Vis | Omission | Fire safety |
| Remove Tiedown Devices | | Man,Vis | | |
| Position Shoring | Shoring in place for removal of cargo | Man,Vis | Omission, improper placement | Damage to aircraft floor |
| Unload Cargo | | Man,Vis | | |
| Stow Aircraft Equipment | | Man,Vis | Omission | Trip hazard |
| Perform Maintenance Debriefing | | | | |
| Complete Form 78 | Structural record | Man,Vis,Cog | Omission | Incorrect records |
| Complete Form 781 | Flying time | Man,Vis,Cog | Omission | Incorrect records |
| Complete Form 791 | Fuel offload report | Man,Vis,Cog | Omission | Incorrect records |

# APPENDIX C

## WORKLOAD QUESTIONNAIRE AND RATINGS DESCRIPTION

## INSTRUCTIONS

**Introduction:** We are trying to determine the amount of workload, or mental workload as we call it, required for each crewmember during various phases of the mission or while accomplishing various checklists. A list of the phases/checklists we are interested in are shown on the next page. Place your ratings on this page. This list focuses on events that take place during the mission for each crewmember given the scenario below. Think of what you do (in the same scenario) during each event and make your rating accordingly. A 1-to-10 workload scale is provided along with a written description of what each number rating means. Please use the written descriptions as a guide when making a rating and please make ratings on your own.

**Workload Definition:** For our purposes, workload is composed of a <u>Time Factor</u>, a <u>Mental Effort Factor</u>, and a <u>Stress Factor</u>. Time refers to the total amount of time available to accomplish the given functions as well as any overlap of functions. Mental effort is the amount of attention or concentration required to perform the function, and Stress is the presence of confusion, frustration and/or anxiety associated with performing the function. In the Workload Chart you will notice the term "mental workload," remember that mental workload includes a time factor, mental effort factor, and a stress factor. Please consider these three factors when making a rating.

**Scenario:** You are the #2 aircraft in a 2-ship Cell/MITO leaving Mildenhall. You will be carrying support cargo and a crew chief. Your mission is to refuel F-4s over the Baltic Sea (assume no radar returns) in confined airspace. There is one refueling track, and a point parallel rendezvous will be used. The F-4s arrive late. After refueling, you head toward Fairford, your intended recovery base. Due to weather throughout the region, you are directed to recover to Zaragosa. After planning the divert, the lead navigator's equipment goes out and the #2 navigator must take on the lead navigation responsibilities. The communication level throughout this mission is EMCON-2.

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# WORKLOAD RATING SHEET

## MISSION EVENT     WORKLOAD RATING

Mission planning

Squadron/base ops and combat crew duties

Poweroff/walkaround inspection

Power on inspection

Starting engines and before taxi

Taxi

Before takeoff

Takeoff

Cell join up

Cruise #1

Preparation for contact

Air refueling

Cruise #2

Plan divert

Descent

Approach and landing

After landing

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# WORKLOAD RATING SCALE

| DIFFICULTY LEVEL | OPERATOR DEMAND LEVEL | RATING |
|---|---|---|
| VERY EASY HIGHLY DESIREABLE | OPERATOR MENTAL EFFORT IS MINIMAL AND DESIRED PERFORMANCE IS EASILY ATTAINABLE | 1 |
| EASY DESIREABLE | OPERATOR MENTAL EFFORT IS LOW AND DESIRED PERFORMANCE IS ATTAINABLE | 2 |
| FAIR MILD DIFFICULTY | ACCEPTABLE OPERA i OR MENTAL EFFORT IS REQUIRED TO ATTAIN ADEQUATE SYSTEM PERFORMANCE | 3 |
| MINOR BUT ANNOYING DIFFICULTY | MODERATELY HIGH OPERATOR MENTAL EFFORT IS REQUIRED TO ATTAIN ADEQUATE SYSTEM PERFORMANCE | 4 |
| MODERATELY OBJECTIONABLE DIFFICULTY | HIGH OPERATOR MENTAL EFFORT IS REQUIRED TO ATTAIN ADEQUATE SYSTEM PERFORMANCE | 5 |
| VERY OBJECTIONABLE BUT TOLERABLE DIFFICULTY | MAXIMUM OPERATOR EFFORT IS REQUIRED TO ATTAIN ADEQUATE SYSTEM PERFORMANCE | 6 |
| MAJOR DIFFICULTY | MAXIMUM OPERATOR MENTAL EFFORT IS REQUIRED TO BRING ERRORS TO MODERATE LEVEL | 7 |
| MAJOR DIFFICULTY | MAXIMUM OPERATOR MENTAL EFFORT IS REQUIRED TO AVOID LARGE OR NUMEROUS ERRORS | 8 |
| MAJOR DIFFICULTY | INTENSE OPERATOR MENTAL EFFORT IS REQUIRED TO ACCOMPLISH TASK, BUT FREQUENT OR NUMEROUS ERRORS PERSIST | 9 |
| IMPOSSIBLE | INSTRUCTED TASK CANNOT BE ACCOMPLISHED RELIABLY | 10 |

YES

NO

IS MENTAL WORKLOAD LEVEL ACCEPTABLE

YES

NO

ARE ERRORS SMALL AND INCONSEQUENTIAL

YES

NO

EVEN THOUGH ERRORS MAY BE LARGE OR FREQUENT CAN INSTRUCTED TASK BE ACCOMPLISHED MOST OF THE TIME

OPERATOR DECISIONS

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# APPENDIX D

# THREE MAN CREW TASK LISTS

## PILOT FUNCTIONS

Complete mission paper work
Discuss mission requirements with wing
  intelligence and communications officers
Attend pretakeoff brief
Complete Navigator briefing guide
Complete correlation sheet
Complete scheduling blocks of Mission
  Accomplished Report (MAR)
Review and study Flight Information Publication
  (FLIP) and general planning requirements
Conduct crew flight briefing
Check Form 200 and chart for accuracy

## COPILOT FUNCTIONS

Complete offload plan
Get Form 365 data from Boom
Print out Form 200
Discuss mission requirements with wing intelligence
  intelligence and communication officers
Attend pretakeoff brief
Input coordinates, airspeeds, altitudes, control times,
  gross weight, fuel load, receiver type and offload amounts
Select navigation charts
Develop route of flight to meet mission timing
Place special use airspace data on charts
Place emergency airfields on charts
Annotate highest terrain and obstructions on chart
Annotate level off point
Annotate ADIZ entry point (if applicable)
Predetermine rradar targets at action points

## BOOMER FUNCTIONS

Plan Cargo Loading
  Check Cargo Unit Dimensions
  Check For hazardous materials
  Determine Weights of Cargo Units
  Determine CG Location of Large cargo loads
  Compute Contact Area Pressures
  Determine Shoring Requirements
  Determine load plan for cargo
  Complete Forms 83, 83A, and 84
  Determine Total Load and Aircraft CG location
  Coordinate and Order Flight Meals
Perform Aircraft Exterior preparation for cargo loading
  Check Tail Support Strut installed
  Check Chock position
  Check Ground Wire installed
  Check cargo loading area clear
  Check Fire Extinguisher available
Perform Aircraft interior preparation for cargo loading
  Check Tiedown Equipment
  Check Shoring
  Open Cargo Door
  Check Cargo Door Sill protected
  Stow Seats
  Position Shoring
  Check Manifest and Waybills
  Check Mounted Cargo secured to carrier
  Brief Load Team Members
  Position Loading Vehicle
  Load Cargo
  Secure Cargo
  Stow Loose equipment
Perform Flight Crew Planning
  Complete DD Form 365-4 weight and balance
    information with computer by hand calculation
  Complete Other mission planning paperwork:
    AF-781, AF-791 or AFTO-76
Perform Boom Operator Portion of mission briefing
  Brief Offload Type
  Brief Offload Amount
  Brief Air Refueling Control times
  Brief Receiver Type
  Brief Receiver Callsigns
Discuss mission requirements with wing intelligence
  and communications officers
Attend pretakeoff brief

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## PILOT FUNCTIONS

Check weather
Check Notams
Compute take-off data
Conduct MITO/Cell briefing
File mission paper work (Flight plan, Weight and
Balance sheet, etc)
Check Aircraft and mission status and aircraft
parking spot
Brief planned flight demonstration maneuvers
Brief touch and go procedures
Brief deployment requirements if applicable
Brief Cell Procedures
Brief MITO procedures
Complete local mission planning/briefing
certificate and passenger manifest if applicable
Complete flight plan
Review Flight Crew Information File
Attend weather briefing
Attend crew briefing and CELL briefing
Pick-up helmet and oxygen mask from life support
Synchronize crewmembers' watches
Check receiver status

## COPILOT FUNCTIONS

Read Flight Crew Information File
Pick up Publications, Quick dons, helmet, and mask
from life support
Attend weather Brief
Update Takeoff data as required
Check Mode 4 caution light out
Attend crew briefing and CELL briefing
Check flight schedule for changes
Check weather for impact on mission timing
Check for departing and landing airfield pages
Pick-up classified information
Pick-up KY-58

## BOOMER FUNCTIONS

Check Flight Crew Information file
Coordinate Life Support equipment
Attend Weather Briefing
Pick up Flight Meals
Recompute weight and balance if necessary
Attend crew briefing and CELL briefing
Pick-up helmet and oxygen mask from life support

Check KIK-18

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# POWER OFF/WALKAROUND INSPECTION

## PILOT FUNCTIONS

Read AF Form 781
Notify crew of type of fuel on board
Verify APU with generator installed
Notify crew of engine start time
Brief AF Form 781 data
Review AF Form 781 data, as required
Complete mission and weather briefing
Announce start engine time
Provide additional instructions, as required
Start switch with APU has generator
Perform walkaround inspection
Inspect and close nose compartment
Check for presence of Foreign Object Damage (FOD)
Check nose wheel well
Check nose gear pin removed
Ensure nose gear pin removed
Ensure actuators are connected to nose gear doors
Check manual defueling valve cover closed
Check right wheel well
Check right system Hydraulic accumulator pressure
Check wheel well
Set manual refueling valve handle to FLIGHT
Check single point refueling accessible
Check single point refueling panel
Ensure landing gear door downlocks are removed
Ensure landing gear pins are removed
Check right wing
Check general condition of engines
Check fire bottle discharge indicator
Check all fuselage and tail assembly
Check general condition of fuselage/empennage
Check general condition of boom
Check top surface of wings
Check APU surface closed
Ensure APU inlet closed
Check left wheel well
Check left system hydraulic accumulator pressure
Check reserve brake accumulator pressure
Check wheel well/gear general condition
Ensure gear door downlocks removed
Ensure landing gear safety pins removed
Check left wing
Check general condition of engines
Check fire bottle discharge
Check fire bottle pressure
Inspect aircraft main fuselage area
Check pitot covers are removed
Ensure pins, downlocks and ground wires removed
Set Electronic Cabinet Cooling switch to ON
Set Search Radar Indicator
Set interphone panel switches as desired

## COPILOT FUNCTIONS

Attend Crew Assembly
Perform Interior Inspection (Power off)
Check FD/RGA Circuit Breaker
Check Instructor Oxygen Panel
Check Regulator OFF, Diluter lever at 100%
Bleed pressure down
Check Portable Oxygen Bottles
Set Altitude Selector Knob to NORM
Check pressure above 50 psi
Check Hydraulic Press. Switch OFF
Check Engine Starter Switch OFF (R)
Check PMC switches ON, guard closed
Check Emergency Hydraulic crossover valve lever in NORMAL
Check Pressurization/Air conditioning panel
Set Cabin Pressure Test Valve handle position
Set Cabin Manual Pressure Control OFF
Set Cabin Pressure Controller as required
Set Cabin Pressure Rate Of Change knob as desired
Set Air Conditioning Crossover switch OPEN
Set Cabin Temperature Control as desired
Set Air Conditioning Master switch to RAM AIR
Check Alternate Pressurization switches OFF & guards closed
Check Overhead Panel
Check radios in preset mode
Set manual frequency to initial planned frequency
Check UHF Comm 1
Check UHF Comm 2
Check VHF (if applicable)
Check all switches OFF
Check Flight Director Mode selector switch in GYRO
Check IDG Switches NORMAL (R)
Check Fire Switches IN
Check Inboard Spoiler Switch in CUTOFF
Check Landing Gear Handle DOWN, in Detent
Check Fuel Panel
Check all Fuel Valves CLOSED
Check all switches OFF
Set CDU Select Panel
Check Power Switch in NORM
Check CDU Select Switch in DNS
Check Radar Intensity Switch Full counter clockwise
Check Throttles CUTOFF
Check Rudder Power Switch OFF
Check Trim Servo Switch in NORMAL
Check Anti-Ice, Pitot Heat, and
Set Window Heat OFF
Perform External Power applications procedures if applicable
Set External Power Switch to TRIP
Check all Warning Flags
Set Battery Power Switch to EMERGENCY
Check EGT Lights
Check Battery voltage
Activate Alarm Bell
Perform APU Start Procedures
Set External Power Switch to CLOSE
Check T-R voltage
Set Battery Power Switch to NORMAL

## COPILOT FUNCTIONS (CONT.)

Take out Navigation Publications
Perform IFF Control Panel Preflight
Set Master Switch OFF
Set Mode 4 Code Switch to A or B (as required)
Set Mode Enabling Switches OUT
Set Mode 4 On/Out Switch ON
Set Mode 3/A Code Selectors to all 0s
Check MSU-INS Mode selectors OFF
Check CDU Power Switch in NORMAL or AUX
Set Search Radar Control Panel
Set FTC Switch OFF
Set I-GC Switch OFF
Set PATT switches as desired
Set Bearing Switch as desired
Set STC Dial full counterclockwise
Set Stab Switch OFF
Set Gain Control full counterclockwise
Set Heading Select Knob to local magnetic variation
Set Scan Switch OFF
Set Test Meter Switch to "MAG"
Set Range Switch to 3-306
Set Function Switch OFF
Set Radar Pressurization Control switch to ON
Set Radar/Rendezvous Control Panel
Set Master Power Switch OFF
Set Pulse Width Switch
Set Code Selector Switches
Set Interphone Panel Switches
Set FSA/CAS Control Panel
Set FSA/CAS Power Switch OFF

## BOOMER FUNCTIONS

Attend Crew Assembly
Start APU
Check Crew Equipment Stowed
Check Circuit breakers
Remove And stow Nose Gear Ground Downlock and release handle
Check Portable Oxygen Bottle
Check Interphone Panel settings
Check Interphone
Perform Oxygen System check
Perform Boom Operator's Forward station preflight
Perform Crew Report
Perform Cargo Compartment Preflight
Check Cargo Compartment A/C master switch in MANUAL
Check Passenger Station Oxygen Panel
Check Emergency Interphone Panel
Check Aft Compartment Interphone Panel
Check Gaseous Oxygen System Quantity Gage
Check Gaseous Oxygen System Valve
Perform Boom Operator's compartment preflight procedures
Check Air Outlet Doors and Defrost Slide
Open Sighting Door
Set Interphone panel switches

## BOOMER FUNCTIONS (CONT.)

Check Interphone panel
Check oxygen regulator
Check ISO oxygen regulator
Check emergency override switch
Check boom limit switches
Check indicator lights
Set telescope-at-disconnect switch
Check circuit breakers
Set A/R boom operator's control panel master switch ON
Check boom fully retracted
Perform signal coil test
Set underbody and underwing lights ON
Check nozzle light and tail mounted floodlight
Check sighting door open
Close sighting door lever
Set ruddevator trim control at ZERO
Perform miscellaneous preflight procedures
Verify DD Form 365-4 data
Conduct ground safety locks check
Inform pilot of actual takeoff weight and CG
Ensure cargo and loose equipment secure
Perform APU accumulator check
Close cargo door and emergency exit hatches
Check external power switch trip
Perform passenger loading
Check seats and safety belts
Position life support equipment
Check passenger information cards
Remove floor obstructions
Install boom operator's compartment entry panels
Open cargo door
Position passenger loading stand
Brief passengers
Direct personnel to seats and verify marked seat
Check cargo manifest
Secure baggage and loose equipment
Check portable oxygen bottles
Check cleanliness, general condition, and stored in normal position
Check for pressure approximating 300 PSI
Check altitude selector knob in NORMAL position
Service portable oxygen bottle if required
Replace portable oxygen bottle

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# POWER ON INSPECTION

## PILOT FUNCTIONS

- Check battery charging current
- Check battery charging level
- Pressurize hydraulic system
- Check pressure switches ON
- Set right system auxiliary pump switch to AUTO
- Set right system auxiliary pump switch to RESERVE BRAKE
- Set left system Auxiliary pump switch to AUTO
- Check antiskid system
- Check parking brake OFF
- Check Test panel indicators BLANK
- Set antiskid test switch to FWD
- Set antiskid test switch to AFT
- Ensure test panel indicators are BLANK
- Check hydraulic pressure in normal range
- Set speed brake switch to NORMAL
- Set inboard spoiler switch to NORMAL
- Set speed brake lever to 60 degrees
- Set yoke to full left
- Set yoke to full right
- Set yoke to center
- Set inboard spoiler switch to CUTOFF
- Set outboard switch to cutoff
- Set speed brake lever to zero degrees
- Return inboard and outboard spoiler switches to NORMAL
- Check aileron and glare shield clearance
- Move yoke left
- Move yoke right
- Move yoke center
- Check aileron trim
- Check trim indication
- Move yoke aft
- Move yoke center
- Check elevator trim
- Check manual trim
- Aileron main trim control switch NOSE DOWN then NOSE UP
- Set aux trim control switch to CUTOUT
- Set Stab trim control switch to NORMAL
- Check rudder
- Push rudder full LEFT
- Push rudder full RIGHT, then release
- Set rudder power switch OFF
- Set rudder power switch to ON
- Check rudder pressure
- Check rudder trim
- Check yaw damper system
- Set SYD switch to TEST, then ON
- Check DISENG light comes on and goes out within 35 seconds
- Set EFAS switch to TEST, then ON
- Check ratios
- Check L3 receiver
- Check VOR
- Check TACAN
- Check COMM 1 UHF
- Check COMM 2 UHF (ground radio)
- Check HF radio
- Set-up HAVE QUICK radios
- Determine HQ I or II availability
- Load Word of Day (WOD) or load Multiple WODs (MWOD)

## PILOT FUNCTIONS (CONT.)

- Set Time of Day (TOD)
- Practice WOD/MWOD
- Check operation of altimeters
- Check flight director heading mode
- Check instruments
- Check of dials and gauges
- Check Attitude Director Indicator (ADI)
- Check INS gyro
- Set clock
- Set oil temp selector switch to TEST
- Set oil temp selector switch to Id
- Check fuel quantity readings
- Check Rotation Go Around (RGA) mode Check flap and speed brake warning horn
- Check Autopilot
- Check autopilot turn knob in detent position
- Check autopilot engage switches ON, as required
- Rotate autopilot turn knob LEFT then RIGHT
- Rotate pitch knob NOSE UP, then NOSE DOWN
- Depress pilot's disengage button
- Activate sub trim switch
- Press test switch, if applicable
- Press valid/invalid test indicator, if applicable
- Check flight console for freedom of movement
- Set trim for take-off
- Move flight director mode selector to gyro
- Adjust reach, pedals, bolts and harnesses
- Ensure fuel panel set for take-off
- Perform CELL check
- Perform ground radio check
- Inform CELL lead ready to start engine
- Check APU accumulator pressure
- Set air pump to OFF
- Review takeoff and emergency procedures
- Perform FSACAS alignment and insertion procedures
- Check interphone and oxygen system
- Complete crew report
- Test and check interior lights
- Compare altimeter swing with field elevation
- Monitor INS interface test
- Perform INS System Preflight procedures
- Check INS Status Panel
- Insert INS prevent position
- Read way point data
- Verify waypoints

## COPILOT FUNCTIONS (CONT.)

- Check Reverse Picked Pump Switch OFF
- Check Stowaway Door Switches CLOSED
- Check Signal Amplifier Power Switch in NORMAL
- Check manual toggle latch switch in release
- Set master reload switch to OFF
- Set engine bleed valves OPEN
- Perform bleed air leak detection test
- Perform bleed air leak detection test switch
- Check all LEAK DET, OVER PRESS and OVER TEMP lights ON
- Release test switch
- Ensure lights go out after releasing test switch
- Close generator breaker switches
- Set remaining switches ON as required
- Set VOR to ON
- Set TACAN to ON
- Set VHF radio ON
- Set UHF radio ON
- Set HF radio ON
- Set autopilot ON
- Set RGA power switches ON
- Set instrument power gyro
- Ensure required publications are available
- Ensure presence of aircraft flight manuals
- Check parachute preflight completed
- Check interphone and oxygen
- Perform FSAS preflight procedures
- Ensure FSAS POWER switch ON
- Accomplish FMP interface test
- Check fuel status indications
- Press FUEL key
- Press DATA key
- Press malfunction data key
- Verify airplane type
- Verify engine type
- Verify brakes and anti-skid type
- Check ICDU status displays
- Check system status display
- Steer ICDU display to Blue status 2/3
- Check bus status display
- Check WT and Balance information ICDU for FSAS
- Obtain crew report
- Set interior lights
- Check wheel wells clear
- Ensure system pressure switches ON
- Check anti-skid
- Check fuel quantity reading
- Check hydraulic system pressure
- Check pump supply guards CLOSED
- Press to test all gauges
- Record actual readings on Form 14, 365-4 and flight log
- Perform hydraulic pressure checks
- Check L,R, system and pilot's reserve
- Ensure pressure gauges in normal range
- Turn on autopilot yaw damper switch
- Check gear warning light extinguished
- Complete control and trim check
- Check fuel dump actuator
- Check boom retracted
- Set fuel dump switch to FUEL DUMP

## COPILOT FUNCTIONS (CONT.)

- Set fuel dump switch to OFF
- Ensure wheel well doors clear
- Receive report from each crewmember
- Check INS/INS CDU Test Switch if applicable
- Check Fuel Dump Actuator
- Set Fuel Dump Switch to FUEL DUMP
- Check Flap lever in 50 degree detent
- Accomplish INS Interface Test if desired
- Depress Copilot's autopilot Disengage button
- Set Fuel Dump Switch to OFF
- Set Stabilizer Trim as required
- Set Flap Lever to 40 degree detent
- Move Flap Lever through 30 degree to 20 degree detent
- Set flap lever to 0 degree detent
- Set flap lever to 30 degree detent
- Set flap lever to 0 degree detent
- Set navigation lights
- Set flash-steady switch to FLASH
- Set all fuel boost pump switches to ON
- Set bright-dim switch to BRIGHT
- Report ACDS lights ON if applicable
- Report ACDS lights OFF if applicable
- Perform INS System Preflight procedures
- Set INS/INS Mode selection to ALIGN
- Turn on FSACAS power switch
- Set IFF Meter Switch as desired
- Set IFF Antenna Switch to BOTH
- Set RAD - TEST/MON Switch to CUT
- Set IFF Master Switch to NORMAL. Test Modes 1, 2, 3/A and C
- Check Mode 4 light out
- Set Master Switch to STANDBY (R)
- Set Mode 1, 2, 3/A, and C switches as required
- Set Mode 1, 2, and 3/A Codes as required
- Set Audio/Light Switch (as required)
- Set RAD - TEST/MON Switch (as desired)
- Turn APN-59 Function Switch to STBY
- Insert Waypoint Data

## BOOMER FUNCTIONS

- Continue with power off list if required
- Load KY-58
- Request Authentication and Launch message from command post
- Respond With correct Authentication
- Encode Mode 4

## COPILOT FUNCTIONS

- Perform Interior Inspection (Power On)
- Set FD Master Power Switches ON
- Ensure FD 109 Power Off Lights ON prior to placing switches ON
- Set FD 109 Master Power Switches to ON
- Ensure FD 109 Power Off Lights are out after placing switches ON
- Perform AFRR Panel Checks
- Set Master Reload Switch to ON
- Press to test all indicator lights not illuminated
- Set Manifold Valves Switch to FLIGHT
- Check Main APR/IFR Valve Switch CLOSED
- Check Tank Level Control Switches CLOSED
- Check Scavenge Switch OFF

# STARTING ENGINES AND BEFORE TAXI

## PILOT FUNCTIONS

Start APU if required
Fasten belts and harnesses
Turn oxygen to 100 percent
Set battery switch to EMERGENCY
Set hydraulic pressure switches
Set parking brakes
Check hydraulic pressure
Set starter switch to START *
Start 1 engine *
Set throttle to START at 25 percent N2 RPM *
Monitor engine instruments *
Set throttle to IDLE at 50 percent N2 RPM *
Set starter switch to OFF *
Turn on starter selector switch (last engine only)
Check overhead panel caution lights
Shutdown APU as required
Ensure external power and chocks are removed
Set battery switch to NORMAL
Turn on engine anti-ice as required
Reset altimeters
Check INS NAV INOP lights
Ensure taxi report complete
Don gloves

* Repeated for each engine

## COPILOT FUNCTIONS

Fasten seat belts and harness
Set oxygen to 100%
Set External Power Switch to CLOSE
Set Air Conditioning Master switch
Set Throttle to Cross Start RPM if required
Check Overhead Panel Caution Lights out
Set Generator Circuit Breaker Switches to CLOSE
Set Beacon and Navigation Light Switches to BOTH ON and STEADY
Set Copilot's Instrument Power Switch to START
Set Pitot and Q-inlet Heat Switches to ON
Set Engine Anti-Ice as required
Perform Taxi Report Procedures
Set Air Conditioning Master Switch as required
Set altimeter to STANDBY
Confirm INS NAV INOP as required
Set INS System to NAV Mode
Perform Aircraft Electrical Power check
Check For at least One Generator on line
Perform IFF Control Panel preflight procedures
Set IFF Master Switch to STANDBY
Turn search radar to STBY
Set Radar/Rendezvous Beacon as required
Perform Warning and Indicator Light Test
Check receiver status
Ensure taxi clearance received

## BOOMER FUNCTIONS

Perform Before Starting Engines procedures
Start APU (if required)
Remove Entrance Ladder
Close And latch Entry Door
Stow Entrance Ladder
Check Emergency Exit Hatches
Turn On Boom Operator's compartment Window Heat Switch
Check Air Refueling Line Valve OPEN
Cycle APU Generator Switch
Report over interphone "ready to taxi"
Don gloves
Turn oxygen system ON

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## TAXI

### PILOT FUNCTIONS

Check hydraulic pressure, brakes and steering
Check flight controls
Check flight instruments
Check speed brakes to ZERO
Set flaps
Advance power momentarily to begin taxi
Release parking brakes
Position airplane as required
Check powered rudder system
Check system and rudder power hydraulic pressure gauges
Push rudder pedal full LEFT
Push rudder pedal full RIGHT and hold
Push rudder pedal full LEFT and hold
Set EFAS and SYD switches to ON
Set EFAS switch to ON
Set yaw damper switch to ON
Review takeoff data
Ensure trim ready for takeoff
Check rudder trim at ZERO
Check aileron trim at ZERO
Check stab trim
Set and recheck NAV aids
Set flight director and climb selector switch to RGA mode
Set APU start-stop switches to STOP if required
Obtain last chance inspection
Set radar to STBY
Set parking brakes
Clear SOF for last chance inspection report
Check EFAS/SYD annunciators
Check annunciators
Check APU doors open and lights turned out
Close windows
Turn on window heat
Adjust throttle friction
Obtain MITO approval
Change radios to MITO discrete frequency
Obtain radio check on MITO frequency
Set power for MITO
Release parking brakes when directed by lead
Maintain spacing
Accomplish additional radio checks as appropriate
Accomplish takeoff report

### COPILOT FUNCTIONS

Check hydraulic pressure, brakes and steering
Obtain taxi clearance
Check/set Anti-ice Equipment as required
Set Anti-Icing ON
Set Anti-Icing OFF unless needed for takeoff
Set Flaps as required
Check Overhead Panel
Ensure Bus Tie, Generator breaker & generator control lights extinguished
Check Main T-R Units for normal operation
Check Air Conditioning and AC ammeters for balanced load
Check Pressurization Panel for proper switch settings
Check Circuit Open, IDG Failure and DISC system lights out
Discuss Take-Off Data
Set Stabilizer Trim for Takeoff
Obtain Weather data
Recompute Takeoff data if required
Obtain ATC clearance
Set NAV aids for departure
Set FLT Director Mode & Climb Selector switches to RGA, max mode
Check Door Warning/OVHD Panel caution light
Close window and set Window Heat Switch as required
Accomplish Crew Take-off Report
Set Function Switch to SEARCH
Adjust Intensity Control
Adjust heading mark intensity control
Set Scan Switch as desired
Set Stabilization Switch to ON
Fine-tune Radar
Check beacon capability
Ensure Departure Clearance is received
Set IFF squawk
Perform weather scan

### BOOMER FUNCTIONS

Notify Passengers and Extra crewmembers prepare for takeoff
Check Cargo Door Closed and Locked
Complete TAXI Report
Monitor Electrical Control Panel
Report ready for takeoff

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## BEFORE TAKEOFF

### PILOT FUNCTIONS

Accomplish before takeoff checklist
Ensure fuel panel set for take off
Ensure landing lights on
Rotate beacons as appropriate
Move starter switches to ignition
Turn on radar

### COPILOT FUNCTIONS

Set lights as required
Set Radar/Rendezvous Beacon (as required)
Set IFF (as required)
Call for pilot to move starter switches
    to IGNITION

### BOOMER FUNCTIONS

Check Passenger and extra Crewmember status
Check Fuel distribution
Check Circuit breakers
Set Oxygen Panel ON. 100%
Fasten And lock Safety Belts and Harness
Complete Takeoff Report

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## TAKEOFF

### PILOT FUNCTIONS

Advance power as required
Release parking brake as directed
Maintain left hand on nose wheel steering as required
Taxi into position and align aircraft with centerline
Assure flight idle
Maintain full pressure on yoke
Maintain spacing/timing as required
Direct copilot to set take-off thrust
Maintain directional control and wings level
Check airspeed at 90 knots
Maintain full forward until ground minimum control
    is reached
Acknowledge S1 interphone call as required
Activate Rotation Go Around (RGA) within 10 knots of
    rotation speed
Pull back on yoke until takeoff attitude is reached
Call for gear up
Follow command bars as required until reaching 2000
    feet above ground
Push forward on yoke
Call for flaps up
Check hydraulic pressure in low range
Look for lead aircraft visually or on radar
Monitor lead aircraft for MITO timing
Set takeoff thrust

### COPILOT FUNCTIONS

Adjust Radar Intensity
Hold yoke full forward
Check for FLT idle on all four engines
Announce FLT idle on all four engines
Set Take-Off thrust
Call 90 knots
Call S1
Call pickle
Call rotate
Call climb speed
Raise Gear
Move flaps up
Monitor lead aircraft for MITO timing
Perform Initial Climbout procedures
Advance power as required

### BOOMER FUNCTIONS

Monitor Takeoff (Overhead Control Panel)
Record Takeoff Time
Monitor aircraft instruments

108

# CELL JOIN UP

## PILOT FUNCTIONS

Perform joinup procedures as required
Maintain cell position as required
Call for climb power and after takeoff climb check
Ensure landing gear up
Ensure flaps up
Call for engine anti-ice on/off
Set starter switches as required
Set altimeter to 29.92 and radio altimeter MDA
  index to 2000 feet
Ensure oxygen on 100 percent
Ensure fuel panel is set
Ensure RGA switches off
Level Off
Pull power back
Set level flight attitude
Trim aircraft
Engage autopilot
Maintain formation position
Change position as required
Perform call communications as required
Terminate formation if necessary
Monitor interphone and radios
Ensure correct headings are flown
Ensure correct altitudes are flown
Perform climb altitude procedures
Perform after takeoff checklist procedures

## COPILOT FUNCTIONS

Turn off Starter Switches (as required)
Turn on Engine Anti-Ice (as required)
Check Cabin Pressurization
Set Fuel Panel as required
Turn off RGA Power Switches
Turn off landing light at 10,000 Ft. or sooner in weather
Set radio altimeters to 2000 Feet
Direct crew to set 29.92 Altimeter setting passing FL180
Direct Pilot Into Enroute Formation
Use All available equipment to effect Join Up
Inform Pilot of other Aircraft's position
Ensure Level Off in Altitude Block
Acquire lead aircraft on radar
Make departure call
Monitor Departure Being Flown
Make 2,000' prior to Level Off Call
Make 1,000' prior to Level Off Call

## BOOMER FUNCTIONS

Turn Off Wheel Well Lights
Check Cargo Compartment
Turn On Nacelle Illumination
Set Boom Nozzle Light (as required)
Set Boom Marker Lights (as required)
Check IFF Mode 4 caution light off
Monitor HF passing out of home station UHF range
  during Alpha monitor periods

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# CRUISE #1

## PILOT FUNCTIONS

Maintain cell position
Perform turbine engine monitoring system (TEMS) test
Monitor UHF Command Post/Cell frequency
Monitor UHF Air Traffic Control frequencies
Monitor HF giant talk during alpha monitor
period (as applicable)
Update IFF Mode 3A as required
Monitor APN 59 Radar
Monitor Navigation Radio aids
Keep Aircraft within 10 NM of track
Direct Aircraft to avoid thunderstorms by 10 NM below
FL230
Direct Aircraft to avoid thunderstorms by 20 NM at or
above FL230
Compute "Alter Heading" and ETA to turn
Perform Dead Reckoning navigation
Direct aircraft along planned route to coast end
point/ADIZ
Monitor equipment for malfunction
Set IFF as required
Track aircraft position
Perform CELL formation
Perform station keeping duties
Monitor radar for skin paint or beacon

## COPILOT FUNCTIONS

Check hydraulics
Check electrical system
Monitor fuel system
Monitor O2 system
Monitor engine instruments
Give control of HF Radio to BOOM
Complete Comm Log
Request And record UHF Traffic
Accomplish HF Contact
Record HF Traffic
Monitor UHF Command Post/Cell frequency
Monitor UHF Air Traffic Control frequencies
Monitor HF giant talk during alpha monitor
period (as applicable)
Update IFF Mode 3A as required
Monitor APN 59 Radar
Monitor Navigation Radio aids
Direct Aircraft to avoid thunderstorms by 10 NM below FL230
Direct Aircraft to avoid thunderstorms by 20 NM at or above FL230
Set equipment as required for specific navigation leg
Take coast out fixes
Complete Log work on Form 200
Monitor equipment for malfunction
Update and monitor INS as required
Set IFF as required
Track Aircraft Position
Use All navigation aids to monitor position within 20 NM of track
Update ETAs to Pilot as necessary for HF position report

## BOOMER FUNCTIONS

Provide Crew Support (as required)
Monitor UHF Command Post/Cell frequency
Monitor UHF Air Traffic Control frequencies
Monitor HF giant talk during alpha monitor
period (as required)
Update IFF Mode 3A as required

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# PREPARATION FOR CONTACT

## PILOT FUNCTIONS

Accomplish preparation for contact checklist
Check altimeter
Reset altimeter
Confirm altimeter setting
Ensure proper air refueling frequency
Disconnect autopilot elevator/pitch axis
Acuate stabilizer trim
Check stabilizer trim
Reengage autopilot elevator/pitch axis
Check autopilot stabilizer trim follow up
Set Air-to-Air TACAN
Establish air refueling echelon formation
Initiate 1/2 mile checklist
Check oxygen as required
Confirm oxygen setting correct
Set autopilot HDG SEL/VOR LOC switches to OFF
Place Beacon to STBY as required
Initiate Overrun Procedures (if applicable)
Perform Precontact
Monitor echelon position
Accomplish Automatic Direction Finder (ADF) check if applicable
Set Equipment As Required For Rendezvous
Perform station keeping duties
Set Assigned Radio frequencies
Monitor Radios
Set Altimeter as required
Monitor Altitude
Establish Radio Contact With Receiver as required
Obtain Receivers Information as required
Relay Tanker Information as required

## COPILOT FUNCTIONS

Obtain permission to delay at the ARCP until revised ARCI
Obtain block altitude
Request permission to conduct AR
Declare MARSA (Military Assumes Responsibility for separation of aircraft
Compute Max Continuous Thrust setting
Post Max Continuous Thrust setting
Compute turn range and off-set
Set Max Continuous thrust setting on N1 Bug
Compute turn range and off-set
Request end Air Refueling request from receiver
Establish fuel for off-load
Monitor fuel
Compute off-load
Determine which tanks to off-load fuel from
Determine number of pumps to use in off-load
Monitor fuel drain
Establish offset
Track where receivers are located
Log fuel
Place Beacon to STBY as required
Initiate Overrun Procedures if applicable
Perform Precontact
Instruct pilot to turn aat turn range and give a time to turn
Accomplish positive beacon ID if applicable
Start timing
Set Equipment As Required For Rendezvous
Set Assigned Radio frequencies
Monitor Radios
Set Altimeter as required
Monitor Altitude
Ensure RZ Timing is met
Adjust TAS to make timing
Adjust Track to make timing
Perform Orbit Holding Procedures
Compute Orbit Headings

## BOOMER FUNCTIONS

Perform Air Refueling Preparation Procedures
Set Forward Oxygen Panel OFF, 100%
Inform Passengers and extra Crewmembers
Set Refueling Oxygen Panel
Monitor Command Radios
Set Sighting Door Lever OPEN
Check Signal Coil
Set Telescope-At-Disconnect as required
Ensure Extension and Elevation Limit switches active
Set Emergency Override Switch
Set Receiver Director Light Rheostats
Turn On A/R Floodlight as required
Set Ruddevator Trim Control to Zero as required
Perform Boom Lowering Procedures
Extend Boom
Check Boom Controls
Obtain Radio Contact
Brief Receiver for Contact as Required
Set External Lights as required
Provide Visual commands to Receiver Required
Maintain Required communications with as required
Maintain proper boom alignment

## AIR REFUELING

### PILOT FUNCTIONS

Monitor receiver/observer position
Advance power as required
Maintain cell position
Perform General Air Refueling
Monitor Cell Formation
Tune Radar for optimum picture
Keep Pilot advised of position
Alter Aircraft as necessary to maintain course
   within 10 NM of cleared course
Monitor And update NAV systems
Monitor Interphone and Radios
Monitor UHF Radios
Monitor HF Radio
Monitor Interphone
Monitor Altitude

### COPILOT FUNCTIONS

Set altimeter to 29.92 or as briefed
Set Radios as required
Set Air to Air TACAN if required
Check oxygen
Set Lights as required
Set Position Lights to STEADY and DIM
Set Rendezvous Beacon Lights as required
Complete Fuel quantity check
Set No Smoking/Seat Belt lights ON as applicable
Set Autopilot VOR/LOC and Heading Select Switches OFF
Set TACAN as required
Set Fuel Panel for A/R
Set one A/R Pump Switch to ON
Set Beacon Lights to BOTH ON and
   Position Lights to BRIGHT
Perform General Air Refueling
Record Air Refueling Data
Record Number of contacts
Record Amount of fuel transferred
Monitor Cell Formation (If Required)
Tune Radar for optimum picture
Keep Pilot advised of position
Maintain ATC Clearance Requirements
Monitor And update NAV systems
Monitor Interphone and Radios
Monitor UHF Radios
Monitor HF Radio
Monitor Interphone
Set APN-69 to OPERATE
Monitor Altitude

### BOOMER FUNCTIONS

Perform Contact Procedure
Monitor Boom Position Indicators
Monitor Receiver position
Perform Disconnect or Breakaway Procedures
Recycle System for subsequent contacts

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# POST AIR REFUELING

## PILOT FUNCTIONS

Initiate post air refueling checklist
Assure fuel panel reconfigured for cruise
Assure radios reset
Set altimeter to 29.92 and check oxygen 100%
Reestablish cell position
Maintain cell position
Monitor Radios

## COPILOT FUNCTIONS

Complete post A/R check
Re-engage Autopilot as required
Provide Post A/R Report to Receiver/Cell
Set No Smoking/Seat Belt Lights as required
Record Fuel quantity
Establish Cruise Configuration
Set Position and Rendezvous beacon lights as required
Set Altimeter to 29.92 (as required)
Turn off oxygen (as required)
Set Radar/Rendezvous Beacon to OFF
Monitor Radios

## BOOMER FUNCTIONS

Perform Post Air Refueling
Set Ruddevator Trim Control to "0"
Retract, Stow, and Latch Boom
Close Sighting Door with Sighting Door Lever
Check Ruddevators locked Switch
Set External Lights
Set Refueling Station Oxygen Panel
Inform Pilot BOOM STOWED
Return to Forward Cabin
Set Forward Station Oxygen Panel ON, 100%
Open fuel tank circuit breakers as required

113

## CRUISE #2

### PILOT FUNCTIONS

Engage autopilot
Maintain formation position
Change position as required
Perform cell communications as required
Terminate formation if necessary
Assume Cell lead navigation responsibilities

### COPILOT FUNCTIONS

Notify ATC A/R terminated
Pass reciever's requested route of flight
Make position reports when out of radar contact
Obtain phone patch on HF radio to update weather
Establish VHF contact prior to coast-in
Assume Cell lead navigation responsibilities

### BOOMER FUNCTIONS

Provide crew support (as required)

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## PLAN DIVERT

### PILOT FUNCTIONS

Obtain destination weather
Direct copilot to determine range
Direct copilot to determine if there is enough fuel
    to reach destination
Direct crewmember to look up instrument flight
    rule supplement
Direct copilot to obtain proper clearances
Coordinate plan with #1 aircraft
Obtain destination weather/monitor air route
    traffic control center

### COPILOT FUNCTIONS

Compute fuel required for divert
Obtain ATC clearance
Compute distance and time

### BOOMER FUNCTIONS

Provide crew support as required

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## PILOT FUNCTIONS

Direct cell breakup
Call for descent checklist
Review weather
Review approach procedures
Direct Boom Operator to advise destination base of
  aircraft status
Brief the approach
Confirm N1 RPM Index set
Set specific altitude into radio altimeter
Insure navigation aides are set
Set starter switches to ignition
Direct anti-ice equipment use as required
Check switches and pressure of left, right, reserve
  brake and powered rudder system
Accuate brakes and check for gauge fluctuation
Reduce power to initiate descent
Ensure proper course, altitude and airspeed
Set appropriate altimeter setting
Confirm descent checklist complete
Review Penetration and Approach
Review highest terrain
Review emergency airfields
Review special use airspace
Monitor Aircrew Terminal Information Service (ATIS)
Fasten Safety Belt and Shoulder Harness
Ensure Approach Clearance received
Perform Descent Altitude Procedures
  Make "2,000' Prior to Assigned Altitude" Call
  Make "1,000' Prior to Assigned Altitude" Call

## COPILOT FUNCTIONS

Make entries in landing data card
Accomplish descent checklist
Review descent and approach procedures
Set N1 RPM Index
Set Radio Altimeters
Set and select Nav Aids
Set Anti-icing Equipment as required
Check Electric and Hydraulic Systems
Set Cabin Pressure Controller at 500 ft above field
  pressure altitude
Set Altimeters
Turn Landing Lights on
Calculate landing distance
Tune radar
Monitor radar
Configure radar
Communicate with weather for weather avoidancce
Call for descent checklist
Navigate To IAF
Review Penetration and Approach
Review highest terrain
Review emergency airfields
Review special use airspace
Monitor weather reports
Monitor Aircrew Terminal Information Service (ATIS)
Fasten Safety Belt and Shoulder Harness
Ensure Approach Clearance received
Perform Descent Altitude Procedures
  Make "2,000' Prior to Assigned Altitude" Call
  Make "1,000' Prior to Assigned Altitude" Call

## BOOMER FUNCTIONS

Calculate Landing Center of Gravity
Stow Sextant Stool and Sextant
Check Circuit Breakers
Set Cargo Compartment Temperature
Notify Passengers and Crewmembers
Walkthrough to Boom Pod
Perform Boom Latched Check
Walkthrough to Forward Cabin
Fasten and Lock Safety Belt and Shoulder Harness
Authenticate mission change
Set Altimeters
Contact command post
Set altimeters at navigation station

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## APPROACH AND LANDING

### PILOT FUNCTIONS

Call for before landing checklist
Ensure speed brakes set to ZERO
Ensure autopilot disengaged
Direct copilot to lower flaps as required
Set EFAS/SYD switches on
Ensure proper navigation aides selected and set
Direct copilot to lower landing gear
Confirm landing gear down and locked
Check anti-skid system
Direct additional flaps as required for landing
Ensure fuel panel set for landing
Ensure flaps set for landing
Raise speed brakes
Apply wheel brakes as required
Ensure 4 engines in ground idle
Maintain aircraft directional control
Taxi clear of the runway
Perform go around as required
Monitor landing roll out/ground speed
Monitor radios
Accomplish missed approach procedures
Scan for traffic

### COPILOT FUNCTIONS

Review Approach Procedure
Ensure Speed Brakes are set to zero
Set RGA Power & Speed Deviation Switches - ON
Ensure flaps set as desired
Check Rudder Hydraulic pressure
Set and Select Nav Aids
Monitor Altitude, Airspeed, Sink Rate, Ground Speed,
    Wind Sheer, and Altitude
Set fuel panel for landing
Set Flaps for landing
Confirm A/C on center line for landing
Call VDP
Announce Approach for Decision Height or MDA
Call missed approach point if necessary
Advise pilot when engines decelerate to ground idle
    during landing rollout
Check Anti-Skid after gear lowered
Check Rudder Pressure in hydraulic set
Ensure Altitude Restrictions are met
Monitor Approach
Monitor Radios
Monitor timing as required
Scan For Traffic
Ensure Missed Approach Procedures Are Accomplished
Make Required Altitude calls
Monitor landing roll out/ground speed

### BOOMER FUNCTIONS

Monitor Electrical Control Panel
Monitor Fuel Panel
Monitor Radios
Scan For Traffic
Check Flap setting
Check Gear position down
Check Pilot Approach Speed
Check Fuel Panel
Advise Pilots of any hazards noted
Record Time
Monitor command post radio

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# AFTER LANDING

## PILOT FUNCTIONS

Call for after landing checklist
Set starter switches as required
Direct copilot set engine anti-ice as required
Take time hack
Set speed brakes to ZERO
Taxi airplane to assigned parking location
Shut down inboard or outboard throttles
Confirm APU if required
Ensure flight director mode selector switch in GYRO
Direct engine shut down checklist
Set parking brake
Ensure INS accuracy check complete
Direct engine anti-ice to OFF (If not previously accomplished)
Set starter switches to OFF (If not previously accomplished)
Set battery power switch to EMERGENCY
Turn throttles off
Ensure APU start accumulator pressures are checked
Turn oxygen off
Ensure all electrical switches off or closed
Turn off window heat switches
Turn off instrument power gyro switches
Turn off boost pump and fuel valve switches
Turn off RGA power switches
Turn off FD #1 and #2 master power switches
Turn off radios and yaw damper
Turn off hydraulic pressure switches
Turn off lights
Ensure chocks installed and check brakes
Release parking brake
Stop APU as required
Set battery power switch as required
Perform walk-around inspection as required

Perform maintenance debriefing
Relay INS accuracy check information
Ensure aircraft security
Coordinate aircraft servicing
Ensure communication kit and classified documents secured
Complete AF Form 781
Relay crew and aircraft status to home base
Complete mission paperwork
Turn INS MSU switch OFF after parked
Relay INS accuracy check information
Assist in aircraft offload as required
Offload flight equipment
Perform crew mission debriefing

## COPILOT FUNCTIONS

Set lights as required
Set Engine Anti-ice as required
Set pitot, Q-inlet, and window switches to OFF
Set Flaps to UP
Call for speed brakes Zero
Set Cabin Manual Pressure Control to FULL DECREASE
Set Air Conditioning Master Switch to RAM AIR
Set Pilots' Radar intensity to full counter clockwise
Set HF Radio to OFF
Set Lights as required
Ensure INS Accuracy Check complete
Turn off Auto Pilot
Zerolize Ciphony Control Panel If required
Set Engine Anti-ice to OFF (If not previously accomplished)
Call for engine starter switches to off (If not previously accomplished)
Apply External Power as required
Set Air Conditioning Master switch to RAM AIR
Set External Power Switch to TRIP
Turn Equipment Off
Set Mode 4 Code Switch
Set Mode 4 On/Out Switch OUT

Set IFF Master Switch OFF
Set Gain Control CCW
Set Intensity Control CCW
Set Heading Marker Control CW
Set Scan Switch OFF
Set Stab Switch OFF
Set Function Switch OFF
Set APN-69 Control Panel OFF
Perform INS Accuracy Check Procedures
Select Way Point
Press Hold Key
Record Latitude and Longitude Coordinates
Press Hold Key
Load Pure Present Position
Load Airplane Actual Position
Set Data Selector to DIST/TIME
Press WY PT CHG Key
Press 1 and 2 Keys in sequence
Record Distance from left-hand data display
Press Clear Key
Turn INS MSU Switch OFF after parked
Set IFF/SIF As Required
Set Mode 2 Code (as required)
Set FSA/CAS power OFF
Assist In Aircraft Offload As Required

## BOOMER FUNCTIONS

Perform After Landing Procedures
Set Oxygen OFF, 100%
Install Nose Gear Ground Down lock and Release Handle
Check APU Start Accumulator pressure gages
Set cargo compartment Temperature control switch to Manual
Check APU Start Accumulator pressure gages
Perform Aircraft Checks
Set Interphone
Open Entry Door
Open Grill
Install Entrance Ladder
Close Grill
Set Boom Compartment Switches
Perform APU Shutdown
Complete Form 781

Unload Passengers and Cargo
Open Cargo Door
Install Tail Stand
Ensure Passenger Loading Stand in position
Unload Baggage
Check Tail Support Strut installed
Check Position of Chocks
Check External Power available
Check Ground Wire installed
Check Cargo Loading Area clear
Check Fire Extinguisher available
Check Cargo Door Sill protected
Stow Seats
Remove Tiedown Devices
Position Shoring
Unload Cargo
Stow Aircraft Equipment
Complete Form 76
Complete Form 791
Monitor radios
Record flight time
Zerolize code in KIK-18 and KY-58
Enter navigation systems maintenance discrepancies into Form 781
Turn in comm kit, KIK-18, KY-58 and FLIP publications