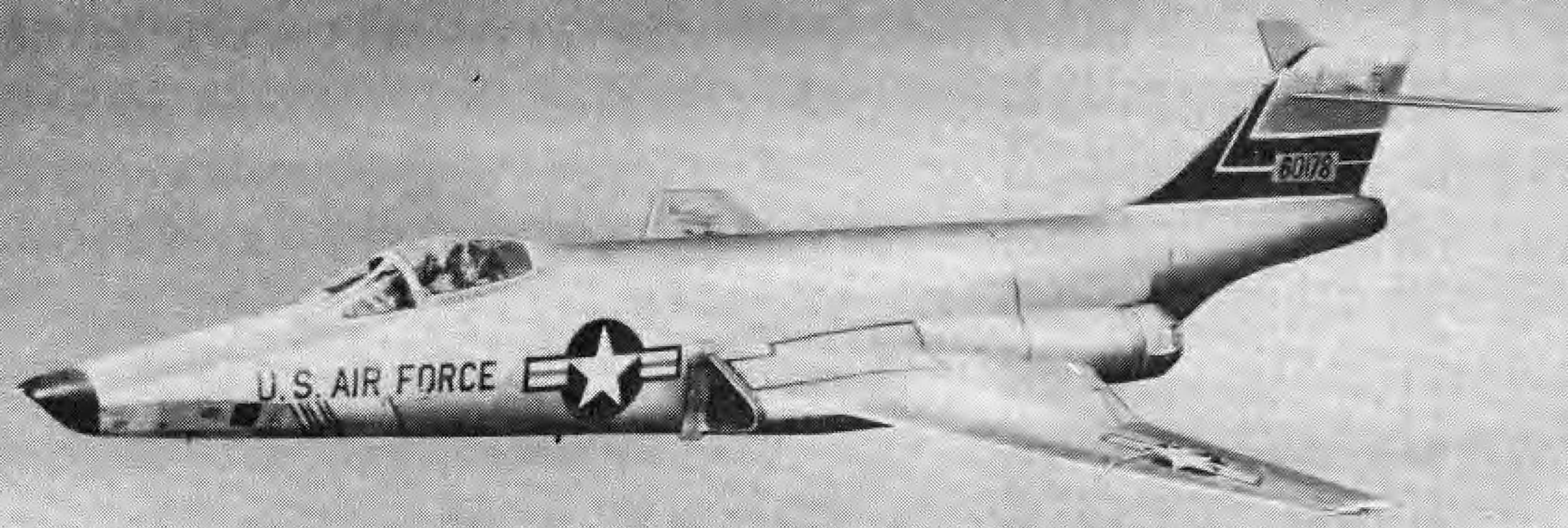
T.O. 1-1C-1-11

FLIGHT MANUAL

F/RF-101 FLIGHT CREW AIR REFUELING PROCEDURES

WITH KC-97L, KC-135



SUPPLEMENT XI

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LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

Commanders are responsible for bringing this publication to the attention of all affected Air Force personnel.

This change dated 25 July 1969 is to correct printing error on List of Effective Pages. See index, T.O. 0-1-1-1, for current status of Safety and Operational Supplements and Flight Crew Checklists.

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LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page.

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 46 CONSISTING OF THE FOLLOWING:

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Flyleaf 1 thru Flyleaf 2 Added	1 May 69
i	Original
ii	1 May 69
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CURRENT FLIGHT CREW AIR REFUELING CHECKLIST

1-1C-1-11CL-1 1 Aug 65 Changed 1 May 1969

*The asterisk indicates pages changed, added, or deleted by the current change.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

USAF ACTIVITIES.—In accordance with T.O. 00-5-2.

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SAFETY SUPPLEMENTS SUMMARY

Safety Supplements are identified by the addition of "-SS-" and consecutive dash numbers to the basic publication number. A supplement number will never be used more than once. The supplements you receive should follow in sequence and if you are missing one, check the index, T.O. 0-1-1-1, to see if it was issued and, if so, is still in effect. That supplement may have been replaced or rescinded before you received your copy. If it is still active, see your Publication Distribution Officer and get your copy.

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FOREWORD

SCOPE. This manual is designed to be used in conjunction with the applicable Flight Manual and to provide information to all crewmembers who participate in air refueling operations. Deviations from the procedures contained in this manual must be authorized in detail by a specific operations order or a command directive. Proper control and utilization of the manual will insure concurrent intercommand distribution of standard and up-to-date air refueling data to tanker and receiver crewmembers. Detailed information concerning individual airplane air refueling systems, limitations, and performance is not contained in this manual.

SOUND JUDGMENT. Procedures in this manual are mandatory and must be performed in the prescribed manner, except where deviations are required in the interest of safety of flight.

HOW TO GET PERSONAL COPIES. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel – it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Numerical Index and Requirements Table (T.O. 0-1-1-1). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. A system shall be established at each base to deliver these publications to the crews immediately upon receipt.

WARNINGS, CAUTIONS, AND NOTES. The following definitions apply to Warnings, Cautions, and Notes found throughout the manual.

WARNING – Operating procedures, techniques, etc, which can result in personal injury or loss of life if not carefully followed.

CAUTION – Operating procedures, techniques, etc, which can result in damage to equipment if not carefully followed.

Note – An operating procedure, technique, etc, which is considered essential to emphasize.

SHALL, WILL, SHOULD, AND MAY. The following definitions apply to the words shall, will, should, and may.

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SHOULD –Normally used to indicate a preferred but nonmandatory method of accomplishment.

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YOUR RESPONSIBILITY – TO LET US KNOW. Recommended changes to this manual will be prepared and processed in accordance with the appropriate major command's directives governing Flight Manual changes. Headquarters TAC, (DOFT-E), will process and assure proper coordination of all change requests initiated with USAFE, PACAF, and TAC. Headquarters TAC will also coordinate on all SAC initiated change requests. All change requests will then be forwarded to 1st Combat Evaluation Group (SAC). Changes to tactics and procedures that are peculiar to only one command's airplanes or operation will follow the same routing for transmission and coordination. The other command will not attempt to change or rule on the validity of such changes. The Tanker Division of 1st Combat Evaluation Group (SAC) will insure that all required coordination is accomplished on all recommended changes and forward final recommendations to Commander, OCAMA, Tinker Air Force Base, Oklahoma, Attention: OCNEAF, for final action. OCAMA will take the necessary action to incorporate change requests into the manual. Supplements and/or changes to this manual are not authorized, except when coordinated as previously specified. All routine changes will be initiated on AF Form 847 and routed for coordination as specified above.

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OPERATIONAL SUPPLEMENTS IN THIS CHANGE

Number	Date	Short Title	Disposition
T.O. 1-1C-1-11S-4	1 March 1968	Abbreviated Emergency Procedures Checklist.	Page AR-4
T.O. 1-1C-1-11S-5	8 March 1968	Airplanes equipped with Air-To-Air Tacan.	Page 3-1, 3-3
T.O. 1-1C-1-11S-7	19 March 1968	Preclude aircraft equipment damage due to possible separation of drogue hose.	Page 4-2, 4-4

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SECTION I
GENERAL

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MISSION PLANNING

GENERAL

The air refueling operation requires precise and detailed planning to insure success. Consideration must be given to each factor resulting from the use of various receiver/tanker combinations and their capabilities and limitations. The most efficient performance and procedures may not be the optimum for either the receiver or tanker; however, it necessarily must be within the operating limitations of each. Crewmembers must be thoroughly familiar with all the planning factors used in determining how the mission is to be flown. Each receiver unit should maintain a file of supplemental tanker manuals (T.O. 1-1C-1-1 and T.O. 1-1C-1-3) which cover air refueling procedures in greater detail.

CONTROL OF TANKER/RECEIVER FORCES

An airborne tanker force commander and alternate commanders, as required by the mission, will be designated for each air refueling area. Commanders will be highly experienced in air refueling operations and will be familiar with all aspects of air refueling. During operational missions, the tanker commander is in command of the air refueling operation and will coordinate with the receiver force commander to insure successful mission completion. During an operational situation, deviations from planned air refueling altitude and track may be made by the tanker commander to insure successful mission accomplishment. Deviations will be based on all factors pertinent to successful completion of the air refueling operations.

OPERATIONAL PLANS

Appropriate operations plans will be published to cover all operational missions. This planning may be delegated by the major command to the numbered air forces involved, but should be jointly reviewed for necessary changes. The controlling agency directing the mission will be responsible for obtaining enroute and air refueling clearances for all missions in accordance with existing procedures. Operations plans will contain specific instruction on the items which follow:

Air Refueling Initial Point (ARIP)

The geographical coordinates for a designated ARIP will be specified.

Air Refueling Control Point (ARCP)

The geographical coordinates for a designated ARCP will be specified. When ARCP's are located at 60 degrees north latitude or above, polar navigation (USAF grid) may be required to provide common grid headings. Crews will be briefed and coordination assured between tanker and assigned receiver crews as to grid configuration requirements and heading reference to be used.

Air Refueling Control Time (ARCT)

The ARCT will be specified in ZULU time or in time after receiver launch.

Abort Points

Provision for wind-adjusted abort points will be provided for all refueling tracks.

Completion Points

A previously coordinated geographic point will be designated as the completion point for fuel transfer on all enroute refueling except buddy operation.

Communications

Communications will be as prescribed in USAF, major air command and numbered air force CEI's, pertinent JANAP's, ACP's, ICAO procedures, enroute publications, regulations, and other existing instructions, unless specific instructions to the contrary are in the operations plans. UHF/VHF will normally be used for interplane communication. When radio communications are necessary, tactical call signs will be used. Call signs, rendezvous and refueling frequencies, IFF/SIF modes and codes, control channels, and recognition and authentication procedures will be specified in this section.

Alternate Plans

If alternate refueling routes and tracks are applicable, they will be planned with the same detail and specifics required for the primary route.

Line-Up

Receiver line-up and tanker assignment will be specified. Tanker cell composition and arrangement will be specified.

Buddy Operations

Cell arrangement and receiver/tanker pairing will be specified.

Recovery And Emergency Bases

All air refueling operations should be conducted in areas which are within range of suitable airfields to allow safe recovery of tankers and receivers if briefed transfer of fuel cannot be accomplished. If air refueling is not accomplished, aborting receivers will contact the controlling agency and proceed to the recovery base. If more than one element of receivers abort, they will maintain altitude separation as briefed.

Standby And Spare Tanker Requirements

Spare tankers will be provided, as necessary, to insure the required number of tankers is available to support the mission. One airborne spare will normally be provided for four or less primary tankers.

AIR REFUELING REPORTS

When required, normal air refueling reports will be relayed to major air commands.

FLIGHT PLANNING

Air refueling tracks should be planned to coincide with the receiver's route of flight, where possible. Crewmembers will be briefed and will become thoroughly familiar with the weather forecast for the air refueling area so that alternate plans can be utilized when the primary track is unsuitable.

Airspeeds And Altitudes

The optimum airspeeds and altitudes for both tankers and receivers must be compromised when arriving at a common altitude which is safely within the performance capabilities of each. Airspeed and altitude will vary depending on receiver drag, and free air temperature. The following information will be used for planning purposes and will apply for KC-135 buddy cruise and air refueling unless specifically directed otherwise. Lower altitudes will be required for abnormally high free air temperatures. (Refer to Air Refueling Performance Compatibility Charts, this Section.) Optimum airspeed is 300 KCAS at 30,000 feet for cruise and air refueling.

Note

Minimum air refueling airspeed is 285 KIAS due to stall characteristics at high gross weights. Maximum refueling airspeed is 310 KCAS due to structural limitations of probe and boom receptacle.

Tankers normally use the enroute cell formation to and from the air refueling area when a block altitude clearance can be obtained. The controlling agency directing the mission will be responsible for obtaining an enroute and air refueling altitude clearance for training and operational missions.

Offload/Onload Requirements

Based upon the appropriate charts, the fuel transfer requirements will be computed against the profile as specified in the operations plan. Forecasted seasonal weather effects will be compensated for.

Fuel Reserve Requirements

For deployment operations, the last receiver in the cell will depart the penetration fix at the abort or destination base with a minimum of 30 minutes of fuel remaining. The fuel remaining requirement will be computed for maximum endurance at 10,000 feet. If an alternate airfield is required, fuel minimums will be as specified in pertinent directives. Following are minimum fuel requirements: Alternate (20 minutes) 2000 pounds and abort/destination (30 minutes) 3000 pounds.

Tankers will carry sufficient fuel on board to allow for 15 minutes additional orbit time to accommodate late receivers.

Weather

Weather minimums are prescribed by AFM 60-16 (as supplemented by major commands). Buddy departure minimums are 1500 feet and 3 NM for day takeoffs and 2500 feet and 3 NM for night takeoffs.

Minimum visibility for a VFR rendezvous is 5 NM. Minimum visibility for radar rendezvous is 1 NM. Special weather services are required to support operations involving air refueling. It is paramount to the success of these operations that a single coordinated forecast be provided to the agency having overall control (making launch decisions). It is also imperative that a close Meteorological Watch be maintained throughout an operation to aid in making recalls, diversions, etc, if unexpected weather conditions critical to the operation occur.

AIR REFUELING PERFORMANCE COMPATIBILITY CHARTS (KC-135)

Figure 1–1 contains a performance chart which provides recommended cruise altitudes based on temperature conditions and nautical miles per 1000 pounds of fuel for one tanker and two receivers (configured for the most common deployment drag index). Normally, air refueling will also be conducted at the recommended cruise altitude and airspeed. Adverse factors affecting receiver capability during air refueling, such as drag induced by receptacle doors or practical thrust requirements necessary to maintain airplane position within a restricted flight envelope are not considered in the charts.

The performance chart is based on a specific calibrated airspeed. This airspeed, established for the tanker and receiver, is a compromise of the effects of airspeed, altitude, gross weight, and temperature on both types of airplanes. Since angle of attack is a direct function of calibrated airspeed, CAS provides a constant lift/drag relationship from sea level to approximately 30,000 feet while automatically compensating for variations in temperature. At approximately 30,000 feet the primary restrictive factor becomes the shock waves resulting from Mach, with the exact changeover altitude dependent on airplane design and the optimum airspeed envelope. By maintaining a programmed CAS and a constant pressure altitude, the nautical miles per 1000 pounds of fuel will remain constant because true airspeed and fuel flow vary directly with temperature changes. The specified CAS, therefore, provides a constant flight condition, satisfying the greatest number of variables encountered during cruise or air refueling operations. This will remain true for cruising altitudes that do not exceed the "changeover" altitude by more than 1000 or 2000 feet.

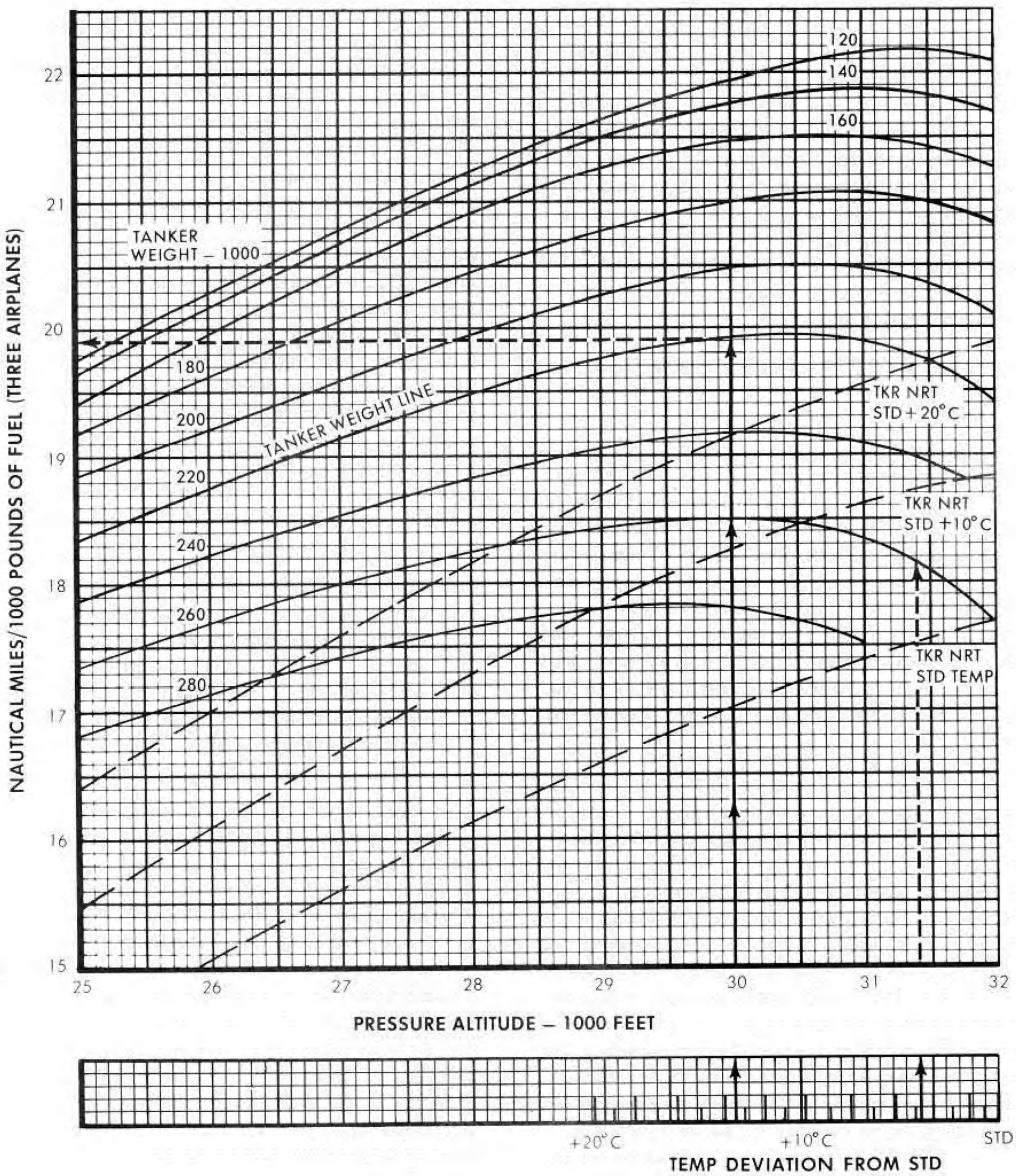
Temperature must receive primary consideration in mission planning, since an increase in ambient temperature (warmer than standard) results in decreased thrust. When the thrust required for a specific cruise altitude exceeds the thrust available (due to increased temperature), the cruise altitude must be lowered. The optimum tanker/receiver (element) cruise flight condition is, therefore, derived from the limiting factors of: Maximum cruise altitude versus temperature, as applied to receiver gross weight; and maximum cruise altitude versus temperature, as applied to tanker gross weight. During normal operations, the tanker maximum gross weight at cruising altitudes does not exceed 270,000 pounds. When the tanker does exceed this weight, and at temperatures more than 15°C above standard, the tanker's optimum cruise altitude may be slightly below that of the receiver. Since this condition requires the tanker to operate above the optimum for only a short period of time, and occurs so rarely, it has not been considered as a limiting factor. Therefore, maximum altitude restrictions are based on receiver capability, which can be considered constant, since the receiver periodically returns to a maximum gross weight condition on completion of air refueling.

Note

Temperature conditions that are colder than standard are seldom encountered. Even though a higher altitude capability is possible when colder temperatures exist, insignificant increase in range would be realized, since the airplane would be operating at a thrust setting above optimum in order to maintain the established CAS.

The receiver's maximum cruise altitude must be adjusted to provide the best cruise control (nautical miles per 1000 pounds of fuel) for the tanker/receiver combination and to arrive at a cruise planning altitude. The maximum operational cruise altitude for the receiver is determined by entering the element cruise performance chart with the temperature deviation from standard that is anticipated and proceeding vertically to determine the altitude. Progressing vertically along the altitude line until the appropriate tanker gross weight line is reached, the nautical miles per 1000 pounds of fuel then can be determined by proceeding horizontally to the left side of the chart. If, by inspection, a better fuel consumption rate can be realized by slightly reducing the altitude, the lower altitude should be used. In addition, the altitude selected should be rounded off to an even 1000 feet to establish a firm base altitude for simpler mission planning. Although at lower tanker gross weights the chart will indicate that an increased altitude will increase the nautical miles per 1000 pounds of fuel slightly, it must be remembered that the receiver's altitude restriction must still apply.

KC-135/TWO RF-101 ELEMENT CRUISE COMPATIBILITY CHART



NOTE:

1. RECEIVER DRAG – TWO 450-GALLON TANKS
2. ELEMENT KCAS–300
3. TEMP ALT CAPABILITIES BASED ON NORMAL RATED THRUST
4. RECEIVER CRUISE GROSS WEIGHT AVERAGE – 42,500 POUNDS
5. RECEIVER ALT/TEMP RESTRICTION BASED ON FULL LOAD
6. TANKER RANGE DECREASED 3 PERCENT FOR BOOM INSTALLATION

Figure 1–1

Note

There is no significant increase in range when a combination of cruise climb and toboggan is attempted. Essentially, the same cruise control is obtained by reducing power as weight decreases, since neither the tanker nor receivers are operating at their design optimum airspeeds.

Element cruise nautical miles per 1000 pounds of fuel is based on the tanker's specific gross weight condition, combined with a constant receiver gross weight condition. Element cruise nautical miles per 1000 pounds of fuel can be determined for any number of receivers from the following formula:

Element Cruise nautical miles per 1000 pounds of fuel =

$$\frac{(Tnm)\,(Rnm)}{(Rnm) + (Rn)\,(Tnm)}$$

Where: Tnm = Tanker nautical miles per 1000 pounds of fuel

Rnm = Receiver nautical miles per 1000 pounds of fuel

Rn = Number of receivers

Sample Problem

An example for the use of the chart is presented on figure 1–1.

Given:

a. Temperature: 5°C above standard.

b. Tanker Gross Weight (Level Off): 260,000 pounds.

Find:

a. Receiver Altitude Capability (31,400 Feet).

b. Cruise Planning Altitude (30,000 Feet).

c. Element Cruise Initial Fuel Consumption (18.5 NM per 1000 Pounds of Fuel) (Tanker Gross Weight: 260,000 Pounds).

d. Element Cruise Fuel Consumption (19.9 NM per 1000 Pounds of Fuel).

Solution:

a. Find receiver altitude capability by entering the performance data chart with temperature deviation from standard (+5°C), and reading the altitude directly above +5°C (31,400 feet).

b. Find cruise planning altitude by first finding the intersection of the altitude (31,400 feet) and the tanker gross weight line (260,000 pounds). By inspection, this is not the optimum planning altitude, since the maximum nautical miles per 1000 pounds of fuel is attained at approximately 30,000 feet. Therefore, 30,000 feet should be established as the planning altitude.

c. Find the initial nautical miles per 1000 pounds of fuel for 30,000 feet horizontally to the left of the intersection of the 30,000-foot line and the 260,000-pound tanker gross weight line (18.5 NM per 1000 pounds of fuel).

d. Find the nautical miles per 1000 pounds of fuel for 220,000-pound tanker gross weight horizontally to the left of the intersection of the 220,000-pound gross weight line and the 30,000-foot altitude line (19.9 NM per 1000 pounds of fuel).

Note

The dashed lines on the chart depict the tanker altitude capability for standard day temperature, STD +10°C and STD +20°C. The intersection of a temperature line and the applicable tanker gross weight line fall on the tanker altitude capability at normal rated thrust.

COMMUNICATIONS

GENERAL

CAUTION

Air refueling will not be accomplished unless interplane communication capability is maintained between tankers and receivers except during an emergency.

During air refueling operations communications between tanker and receiver flight crews must be a highly coordinated effort. Lengthy and improper call signs often cause confusion and/or block essential radio transmissions.

Strict radio discipline must be adhered to at all times. Mandatory calls for receivers are as follows:

a. Initial radio contact a minimum of 15 minutes prior to the ARCT.

b. When reaching level off altitude prior to air refueling, report altitude to tanker leader, unless security would be compromised.

c. When visual contact between tanker(s) and receiver(s) is established or lost.

d. The receiver flight leader will advise the tanker when to assume air refueling airspeed (KC-135 only).

e. When hookup or disconnect is made during probe/drogue air refueling.

Airplanes will use tactical call signs for buddy-type operations and for point parallel rendezvous when tanker and receiver call signs have been coordinated prior to takeoff. When call signs have not been coordinated, tankers and receivers will

employ call signs based on orbit point and cell color as indicated.

a. In multiple air refueling areas, tankers will use the air refueling track/area code name, plus ARCP, plus cell position. Example: "Long Bow George Lead." After positive identification is accomplished, the call sign may be shortened to "George Lead." Tankers on buddy refuelings will use code name, plus cell position. Example: "Andy 2."

b. In multiple air refueling areas, receivers will use their tactical call sign, plus cell color, plus cell position. Example: "Reno Red Lead." After positive identification is accomplished, this call sign may be shortened to "Red Lead." On buddy refuelings, receivers will use cell color, plus position. Example: "Green 3."

c. Spare tankers will use as a call sign the orbit point suffixed by the words, "Tanker spare." Example: "Ann Tanker Spare."

Unless otherwise directed, communication between tankers and receivers will be maintained during all normal rendezvous, precontact, and air refueling operations. Voice transmissions, however, will be held to the absolute minimum required. Tankers will begin monitoring designated radio frequencies and will have electronic rendezvous equipment operating at no less than 30 minutes prior to the ARCT. Receivers will advise the tankers of any change in ETA, number of airplanes in the receiver force, position reporting requirements (if applicable), and other pertinent information as far upstream of the ARCP as possible, but in no case later than 15 minutes prior to the ARCT. The tanker commander will insure that the receiver commander is informed of the number of operational tankers available and weather in the air refueling area and at the recovery base. The receiver will provide and the tanker will confirm receiver's inbound track and true airspeed, turn range and offset distance. Rendezvous equipment signal identification and reliability must be made known to both crews, together with range information, as soon as possible.

Note

- On initial radio contact, when air refueling with a KC-97L tanker, the receiver will request and the tanker will confirm the desired air refueling boom procedures (MANEUVERING or RIGID).
- AEW&C airplanes or GCI/FAA facilities, when available, may be used as a backup source of information for rendezvous and communications relay purposes.

ORAL COMMUNICATIONS

The following terminology will be used as a guide when oral instructions are necessary:

STABILIZE – Hold receiver steady in present position.

FORWARD – Move receiver forward.

BACK – Move receiver backward.

DOWN – Descend receiver.

UP – Ascend receiver.

RIGHT – Move the receiver right.

LEFT – Move the receiver left.

Communications during rendezvous should be held to an absolute minimum. The actual air refueling operation should be performed when possible under complete radio silence. Occasionally, situations will arise, such as air refueling under adverse conditions or with an inexperienced receiver pilot, when it will become necessary for the boom operator to give the receiver oral corrections. The following voice procedure is to be used as a guide when oral communications are necessary, but is not to be construed as the exact words the boom operator will use in all instances. When the receiver(s) reaches 1/2 NM in trail, the boom operator will establish radio contact with the receiver(s) by stating, "Radio Check." Receiver(s) will acknowledge.

a. Establish radio contact. "(Receiver call sign), this is (Tanker call sign) boom operator, radio check." Receiver(s) will acknowledge. When the receiver or flight leader reaches precontact position and stabilizes at a zero rate of closure, the boom operator will state, "(Receiver call sign), note your altimeter reading, cleared to the contact position, (Tanker call sign) ready."

Note

The Boom Operator will clear subsequent receivers from observation position to the precontact position. Continue with paragraph b as written.

b. Voice procedure for normal contacts. Boom operator will begin communications when receiver reaches approximately 50 feet from contact position. Direction, if required, will precede distance for receiver to move and will be given in 10-foot increments until receiver reaches approximately 10 feet from contact position. Example: "Forward 50," "Forward 40," "Forward 30," "Forward 20," "Forward 10." When receiver reaches approximately 10 feet from contact position, all corrections will be given in smaller increments for receiver to move. Example: "Up 4," "Forward 8," "Up 2," "Forward 6," "Forward 4," "Forward 2," "Down 2," "Back 2." When contact is established, state, "(Tanker call sign) contact." Receiver pilot acknowledges by stating, "(Receiver call sign) contact." If tanker and/or receiver air refueling system does not advance to contact, the boom operator or receiver pilot will initiate a disconnect.

c. Voice procedure for tanker manual operation and manual boom latching (KC-135).

(1) Receiver briefings.

(a) Tanker manual operation briefing. "(Receiver call sign), the following contacts will be made in tanker manual operation. Receiver air refueling system will remain in normal. Receiver pilot must initiate all disconnects. (Tanker call sign) ready." Receiver pilot acknowledges transmission by stating, "(Receiver call sign) ready."

Note

The boom operator can initiate a disconnect with the receiver system in NORMAL, and the tanker signal system operative.

(b) Manual boom latching briefing. "(Receiver call sign), the following contacts will be made in manual boom latching and receiver pilot must initiate all disconnects. (Tanker call sign) ready." Receiver pilot acknowledges transmission by stating, "(Receiver call sign) ready."

(2) Disconnect. Use the word disconnect or call breakaway, as the case warrants, prior to the receiver reaching envelope limits.

d. Voice procedure for tanker manual operation and manual boom latching (KC-97L).

(1) Receiver briefings.

(a) Tanker manual operation briefing. "(Receiver call sign), the following contacts will be made in tanker manual operation. Receiver air refueling system will remain in normal. Receiver pilot must initiate all disconnects. Inform boom operator when receiver air refueling system is in contact-made (Tanker call sign), ready." Receiver pilot acknowledges transmission by stating, "(Receiver call sign) ready."

(b) Manual boom latching briefing. "(Receiver call sign), the following contacts will be made in manual boom latching. Receiver pilot must initiate all disconnects. Inform boom operator when receiver air refueling system is in contact-made, (Tanker call sign) ready." Receiver pilot acknowledges transmission by stating, "(Receiver call sign) ready."

EMERGENCY COMMUNICATIONS

Emergency messages will be sent in plain language when urgency outweighs security. If distances involved exceed UHF/VHF range, messages from airplanes equipped only with UHF/VHF communications will be relayed by airplanes equipped with HF communications. To avoid confusion, it may be necessary for the tanker or receiver commander to designate the relay airplane. Emergency or distress messages will be transmitted to the following applicable agencies:

a. Other airplanes or stations on assigned interplane frequencies.

b. FAA/airways stations on the emergency UHF/VHF channel.

VISUAL SIGNALS

During air refueling operations, tanker and receiver crews will normally transmit necessary information by use of radio; however, radio silence air refueling can be conducted provided the following precautions and procedures are observed:

CAUTION

Air refueling operations will be discontinued in the event of communications failure or tanker boom position instrument failure, except during an emergency.

a. Tanker crews and receiver pilots must be experienced in normal air refueling procedures.

b. The method, time, and place of rendezvous and amount of fuel to be transferred must be covered in the premission briefings.

c. Radio equipment on both airplanes must be operative and crews on both airplanes must monitor the same frequency during all air refueling procedures.

d. The boom operator will position his jackbox so that he is capable of transmitting to the receiver and receiving communication within his own airplane.

e. For KC-135 boom and all KC-97L air refueling the receiver director lights (red only) may be actuated with the receiver director light switches (coaching switches), when in the ready condition, to aid in positioning the receiver. A steady red light will indicate a large correction, and a flashing red light will indicated a small correction in the direction indicated by the red director lights. When in contact-made, the receiver director lights are automatically actuated by the boom position.

f. All precontact air refueling checks will be completed prior to the receiver reaching 1 NM in trail, except for final exterior light adjustment.

g. For KC-135 boom and all KC-97L air refueling, if an emergency air refueling is required without two-way radio communications, or during practice radio silence air refueling, the following visual signals will be used:

(1) Up-and-down movement of the boom ending in trail position with the boom extended 10 feet means that the tanker is ready for hookup.

(2) Boom retracted, up-and-down movement of the boom ending in stowed position indicates that there is a malfunction in the tanker and will be fixed shortly. The receiver should remain in the precontact position until the malfunction is corrected or until the receiver deems it necessary to depart.

(3) Side-to-side movement of the boom ending in trail position, with the boom extended 10 feet, indicates that the tanker is fully operative and requests that the receiver check his air refueling system.

(4) Side-to-side movement of the boom with the boom retracted and ending in trail indicates that prescribed fuel load has been transferred.

(5) Side-to-side movement of the boom ending with the boom in the stowed position indicates that the tanker air refueling system is completely inoperative.

(6) The need for a disconnect when the situation does not warrant a breakaway will be indicated by pressing emergency breakaway signal switch causing receiver director lights to go out. Receiver pilot, observing that all receiver director lights go out, will immediately initiate a disconnect and return to the precontact position.

(7) KC-135. The need for emergency breakaway by the tanker will be indicated by the receiver director lights being turned off and on rapidly and by the lower rotating beacon being turned on during drogue air refueling. Receiver pilot will immediately initiate disconnect and institute breakaway procedure.

(8) KC-97L. The need for emergency breakaway by tanker prior to contact made will be indicated by receiver director lights being turned on and off rapidly by actuation of the director light test switch. The need for emergency breakaway by tanker while in contact will be indicated by receiver director lights being turned off and on rapidly by actuation of the lighting system selector switch. Receiver pilot will immediately initiate the breakaway procedure.

(9) Should the receiver pilot desire a breakaway, he will initiate breakaway procedure and close slipway door(s).

Note

If the need for an emergency breakaway occurs during practice radio silence air refueling, oral breakaway procedures will be initiated.

(10) To indicate termination of air refueling, the receiver will turn upper anticollision light on or off, as applicable.

(11) A steady probe light from receiver indicates an emergency fuel shortage exists and air refueling operations must be conducted.

h. If necessary to use tanker manual operation during communication failure, the following visual signals will be used:

(1) Boom operator will indicate use of tanker manual operation by trailing fully extended boom. The receiver pilot will acknowledge by flashing any available bright light. Boom operator will then retract boom into ready position and stand by for hookup.

(2) Should the receiver pilot desire to initiate manual boom latching, he will move into precontact position and signal by flashing any available bright light. Receiver will remain in the precontact position until his signal has been acknowledged by the boom operator, which will be one up-and-down movement of the boom fully extended ending with boom in the ready position.

i. KC-135 visual signals for probe and drogue air refueling.

(1) Boom in trail, fully extended, indicates that the tanker is ready for hookup.

(2) Boom stowed indicates that the tanker (or receiver, if applicable) is unable to transfer fuel.

j. KC-97L visual signals for probe and drogue air refueling.

Note

- Visual signals for probe and drogue will be as outlined in steps g(1) thru (6) and (8) thru (11) above.
- Tanker manual and receiver manual boom latching while under radio silence will be accomplished during emergency conditions only.

LIGHTING

While accomplishing a rendezvous during the hours of darkness or during periods of limited visibility, the tanker will have all specified exterior lights on full bright to aid in visual sighting. Flares may be utilized if available. When used, the tanker leader will inform the receiver leader of the color of the flare being fired. This will be done at the request of the receiver leader to aid receivers in identifying the tanker cell or to assista receiver in identifying his assigned tanker.

All tanker exterior lights will be turned ON at least 15 minutes prior to the latest known receiver ETA for the ARCP. During rendezvous and descent, the receiver position light switches will be set in accordance with the appropriate flight crew operational procedures manual. While approaching the precontact/contact position, the receiver pilot can adjust lighting as required by the boom operator.

Single KC-97L tankers performing a rendezvous will always display red in the rendezvous beacon light.

Single KC-135 tankers will display red and white.

Note

If the spare is used during the air refueling, the appropriate color code will be displayed until the receiver is in the precontact position. To further aid in identification, tanker position lights will be placed on BRIGHT and FLASHING for numbers 1, 3, and 5. Position lights for numbers 2 and 4 will be BRIGHT and STEADY. Position lights will be set prior to takeoff. After the receiver has established visual contact and has closed to 1/2 NM in trail, tankers will turn position lights to STEADY and DIM and turn lower rotating beacon and rendezvous beacon lights OFF. When fighter receivers reach the observation position, tanker will turn underwing, underbody, and nacelle illuminating lights to DIM. Exterior lights will then be adjusted as requested by the receiver pilot.

KC-97L rendezvous beacon light color coding is as follows:

FORMATION POSITION	LIGHT COLOR
1	Red
2	White
3	Green
4	Amber
5	Red

Note

All tankers in the formation will display the appropriate rendezvous beacon light color until the tankers have been identified by their respective receivers. The last tanker will keep the upper anticollision light on during the rendezvous and throughout the air refueling.

KC-135 identification lighting is as follows:

TANKER NUMBER	LIGHT COLOR UPPER	LIGHT COLOR LOWER
1	Red	Red
2	White	White
3	Red-White	Red-White
4	White	Red

RECEIVER DIRECTOR LIGHTS (KC-97L)

Receiver director lights (station 750) (figure 1–2) used during precontact and/or air refueling appear as follows:

DIRECTION	LIGHT COLOR
DWN	Red
FWD	Red Green
AFT	Red
UP	Red

BOOM MARKINGS AND RECEIVER DIRECTOR LIGHTS (KC-97L)

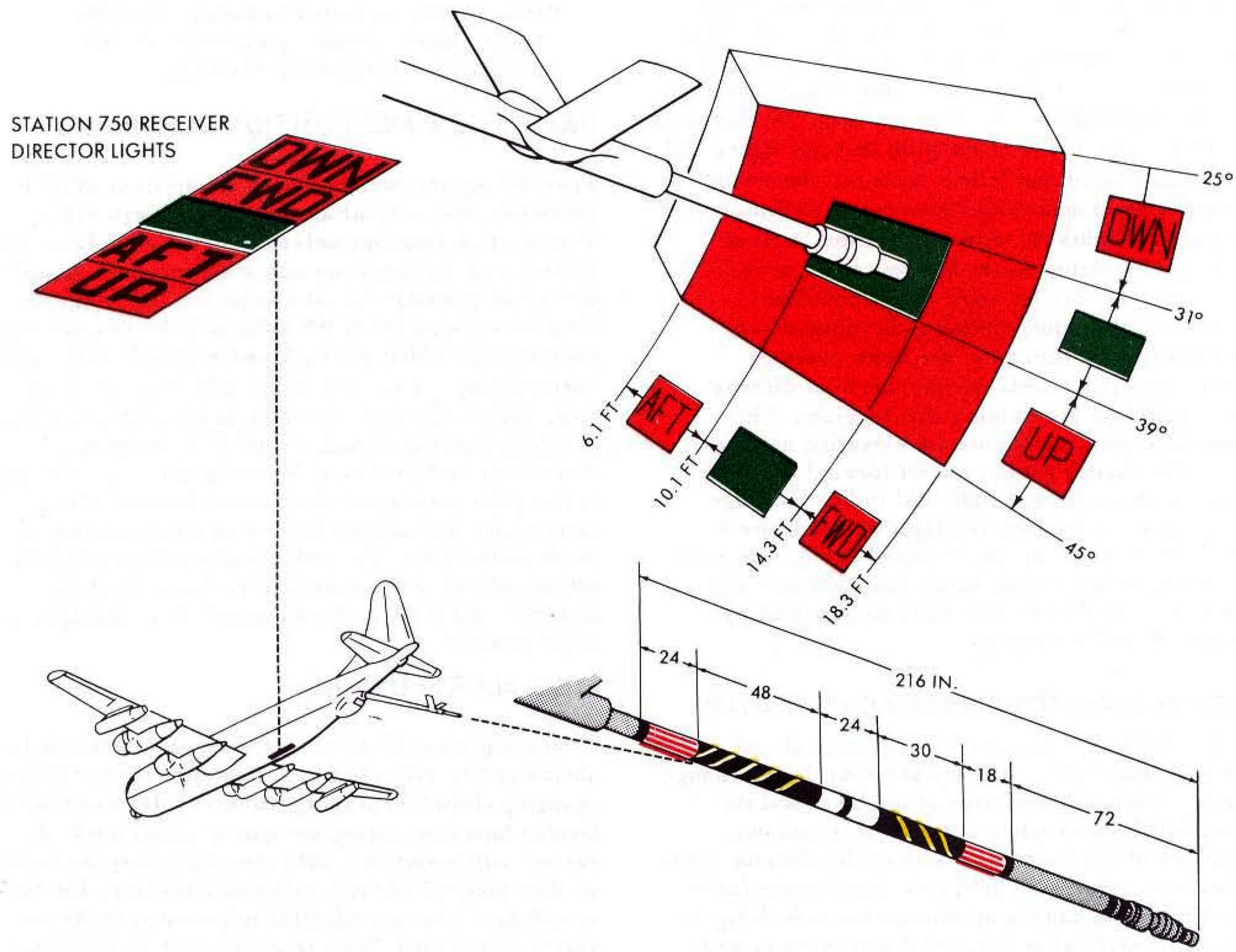


Figure 1–2

a. A steady red light indicates a large correction is required in the direction indicated. A flashing red light indicates a small correction is required in the direction indicated.

b. A steady green light indicates the receiver is in the correct position.

c. All receiver director lights out indicate need for disconnect, but not breakaway.

d. All receiver director lights flashing indicate breakaway.

RECEIVER DIRECTOR LIGHTS (KC-135)

Receiver director lights (figure 1–3) are on the bottom of the fuselage directly aft of the nose landing gear. They consist of two rows of lights; the left row for elevation and the right row for telescoping. The elevation lights consist of five colored panels with a green stripe, green and red colors, and two illuminated letters, D and U, for down and up respectively. Background lights are located behind the panels. The colored panels are illuminated by lights that are controlled by boom elevation during contact-made. On the telescoping side, the colored panels are not illuminated by background lights. There is an illuminated white panel between each panel to serve as a reference. The letters A for aft and F for forward augment the colored panels on the telescope side. On airplanes with TCTO 739, the receiver pilot director lights will remain illuminated and follow boom movements in both the contact made and disconnect conditions. There are no lights for azimuth position. A fluorescent yellow stripe on the bottom center of the tanker fuselage may be used as a centerline reference by the pilot. During radio silence, and in the ready condition only, the boom operator actuates the red panels on the receiver director lights to aid in positioning the receiver. The triangular-shaped panels are for elevation and the rectangular-shaped panels are for forward and back movement. A steady red light will indicate a large correction and a flashing red light will indicate a small correction in the direction indicated. The need for emergency breakaway during radio silence will be indicated by the receiver director lights being turned OFF and ON rapidly.

RECEIVER DIRECTOR LIGHTS (KC-97L/KC-135)

The director lights do not give true vertical and horizontal information. The up-and-down lights change because of angular movement of the boom and the fore-and-aft lights change because of in-and-out movements of the boom. The axis of the director lights system is inclined at a 30-degree angle to the fuselage. This angle causes an interaction in both lights when a true vertical or horizontal movement is made by the receiver. For example, flying straight forward while in contact will cause the boom to compress and also increase its angle with the tanker fuselage. The lights will show that the airplane is flying forward and down. If a true up movement is made, the boom will compress and also lessen its angle with the tanker fuselage, giving a combined up and forward indication from the lights. When this interaction between the lights is understood, it can be used to advantage in keeping position. Small fore and aft corrections can be made with little or no power change by moving vertically.

BOOM ENVELOPE LIMITS

The refueling envelope (figures 1-4 and 1-5) is limited by the refueling receptacle location. As long as the receiver is positioned within these limits, contact can be maintained despite rolling, yawing, or pitching.

CAUTION

- Approaching boom limits at a relatively high velocity can cause structural damage as a result of an inability to disconnect due to binding action of the boom nozzle.
- Due to the restricted refueling envelope boom limit switch, protection is not provided in azimuth or up elevation.

NAVIGATION AND POSITION REPORTING

Position reports, weather scout information, ATC information, and tactical air refueling reports will be sent in plain language unless directed otherwise. When tankers and receivers are operating together, tankers will be responsible for all navigation and reporting. Tankers equipped with HF radio will relay information for receivers which are equipped with only UHF radio. During buddy cruise, the tanker pilot will, once each hour, advise the receiver pilots of the cell geographic position, heading, distance, and ETE to the next checkpoint or destination, as applicable. As each receiver pilot leaves the observation position, the tanker pilot will advise the distance and heading to the best abort base. The tanker leader will, at cell termination, advise the receivers of position, heading, distance, and ETE to the receivers' next checkpoint or destination.

POST AIR REFUELING

Upon completion of the air refueling, the tanker will advise and receive clearance from the receiver before changing altitude or heading. Tankers will establish the briefed formation during the turn to return track. Receivers will maintain a safe clearance from the tanker as they proceed on their assigned missions. The tanker will give post air refueling information to the receiver as required. Upon termination of air refueling, all exterior lights will be returned to normal.

RECEIVER DIRECTOR LIGHTS ILLUMINATION PROFILE (KC-135)

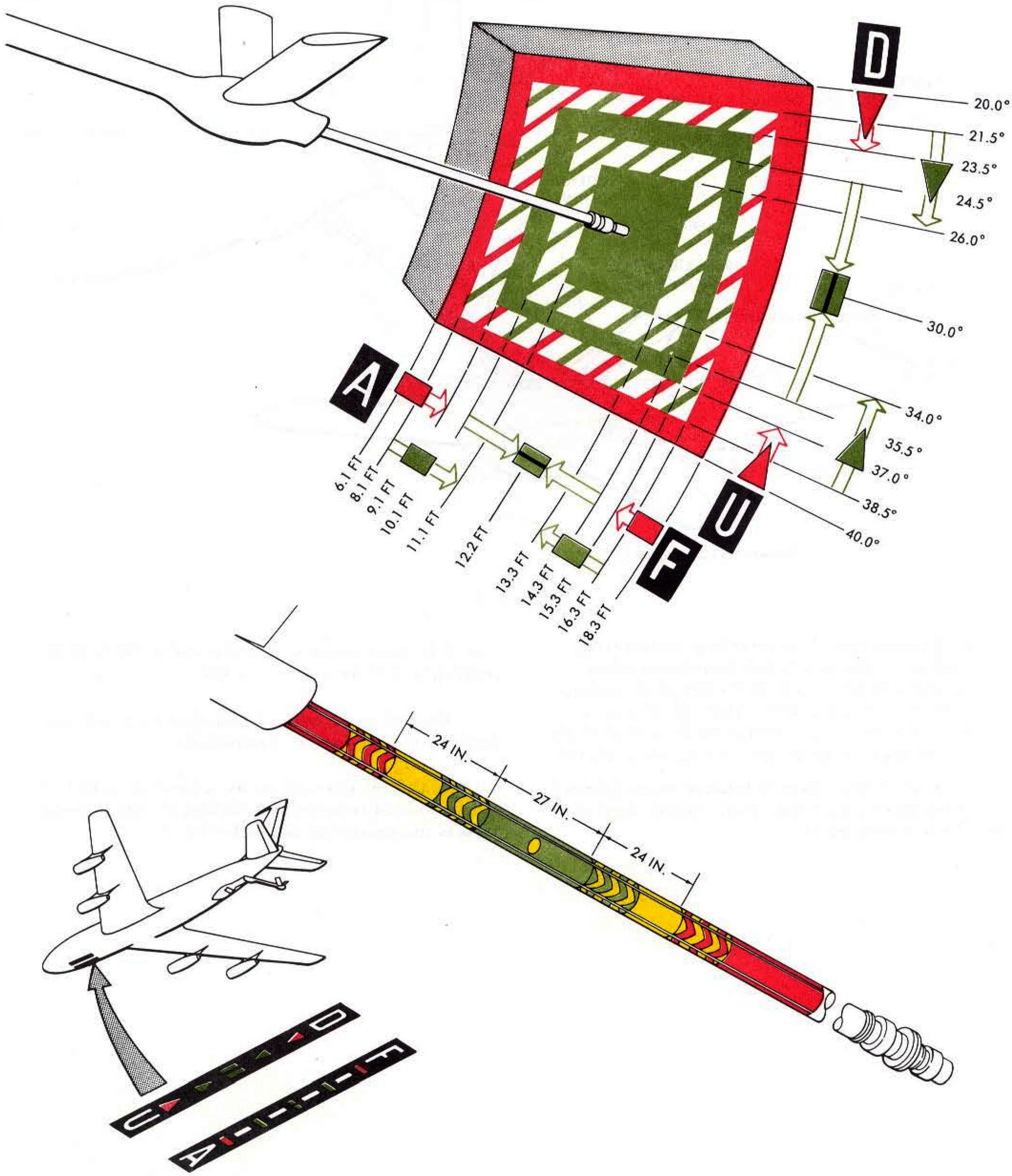


Figure 1–3

BOOM ENVELOPE LIMITS (KC-97L)

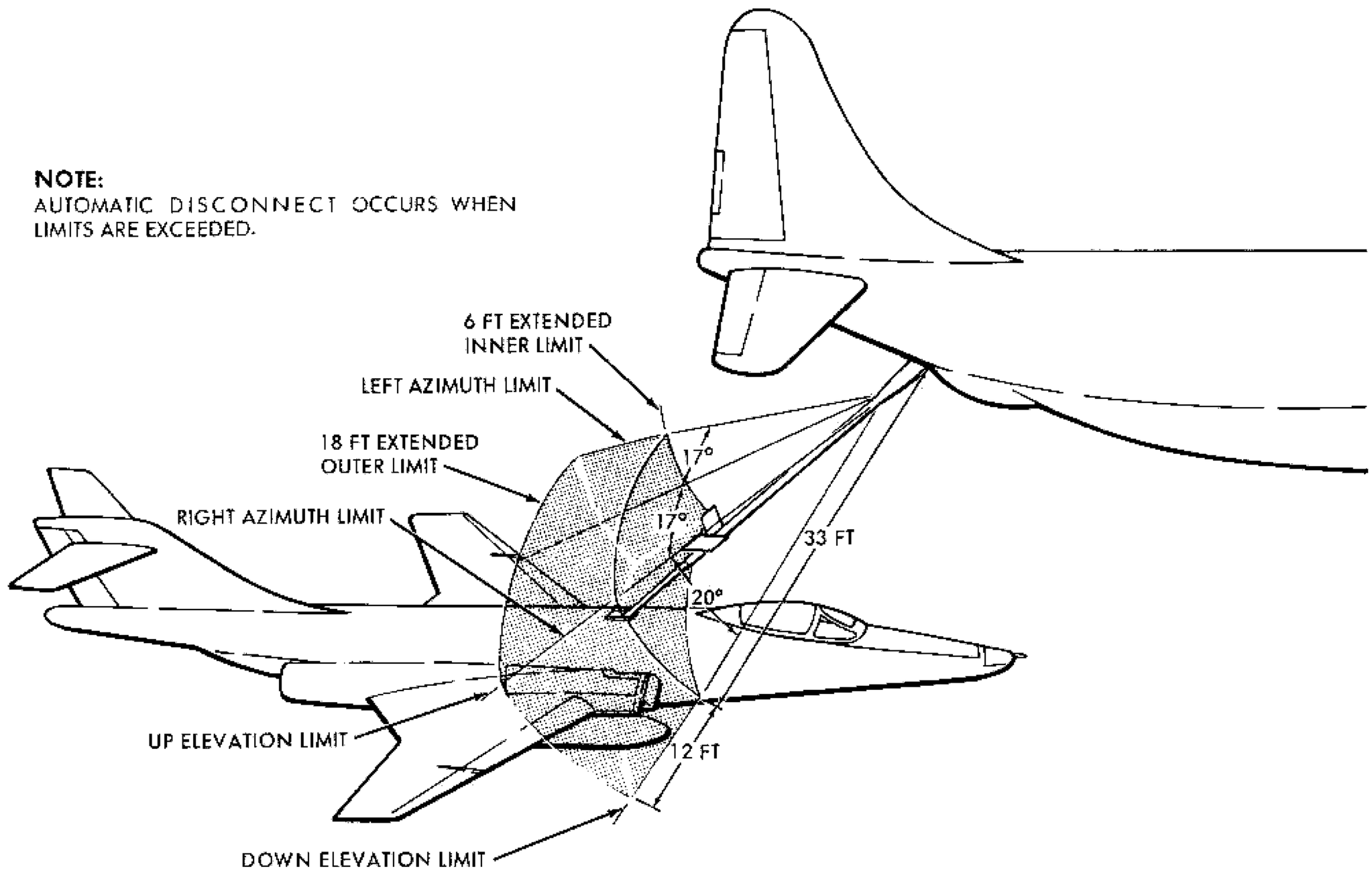


Figure 1–4

Following completion of air refueling, the receiver will maneuver to the prescribed formation position, obtain tanker offload report, and return to the primary UHF frequency (if applicable). After the receivers have re-formed, the tanker/tanker leader will give the following information to the receiver/receiver leader.

a. Position of disconnect in relation to the planned completion point; i.e., 5 NM north, 10 NM west of planned completion point.

b. A no-wind magnetic heading and distance to the receiver's next fix or recovery base.

c. Weather at the next air refueling point, recovery bases, and destination, if available.

d. Additional information, as requested, to include verification of receiver air refueling reports or position reports transmitted by the tanker force.

BOOM ENVELOPE LIMITS (KC-135)

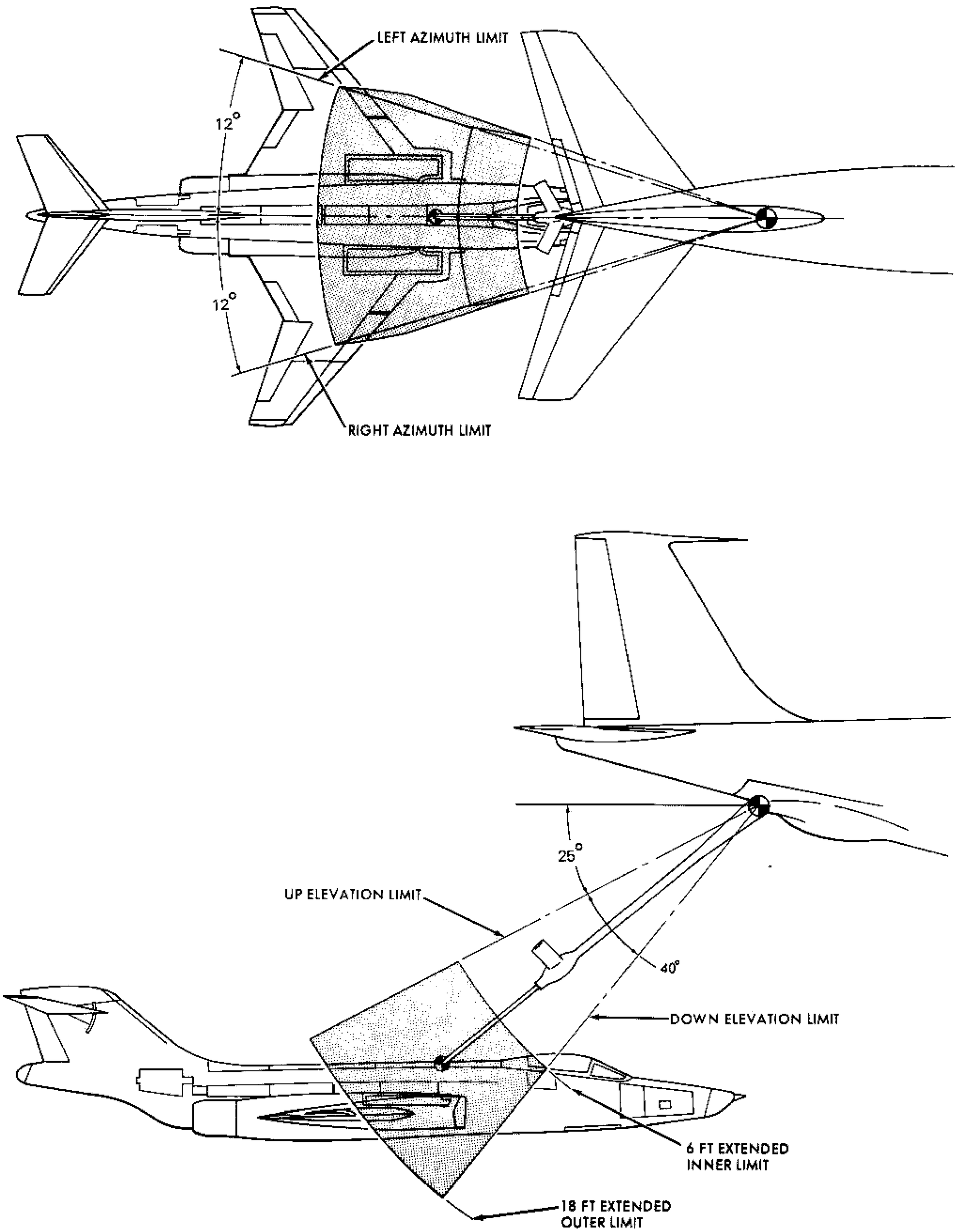


Figure 1–5

SECTION II
ENROUTE PROCEDURES

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GENERAL

The information contained in this section will apply when two or more airplanes are involved in an enroute cell formation with subsequent air refueling. If more specific instructions are necessary, they may be included in an operations order.

PREFLIGHT

Preflight procedures for air refueling missions do not differ from normal preflight procedures.

AFTER START

In addition, for after start check perform the following boom or probe checks:

Note

The canopy should be in the closed position for probe or boom checks to prevent the windshield blower from showering the cockpit with trapped moisture.

PROBE CHECK

1. IFR Probe Switch – EXTEND.
   Check for proper alignment and windshield blower operation.

CAUTION

To prevent cracking the windshield with the windshield blower, the PROBE CHECK should be accomplished in minimum ground time.

2. IFR Probe Light Switch – ON AND CHECK.
3. IFR Probe Light Switch – OFF.
4. IFR Probe Switch – RETRACT.
   Check that probe retracts completely with the doors closed, and windshield blower retracts.

BOOM RECEPTACLE CHECK

1. IFR Boom Receptacle Switch – EXTEND.
   Check for proper elevation of receptacle and windshield blower operation.

CAUTION

To prevent cracking the windshield with the windshield blower, the BOOM RECEPTACLE CHECK should be accomplished in minimum ground time.

2. IFR Ready Light – CHECK ON.
   If IFR ready light does not illuminate, depress IFR reset button. If ready light remains out, consult a qualified maintenance technician.
3. IFR Boom Receptacle Switch – RETRACT.

BUDDY PROCEDURES

A buddy departure is effected when the tanker(s) and receiver(s) take off from the same base and visual contact is maintained. Weather minimums for buddy departure are 1500 feet and 3 NM for day takeoffs and 2500 feet and 3 NM for night takeoffs.

TAXI

Start engines as required to make good taxi time. After engine start, the tanker will call, "Taxiing." Receiver(s) will check in with the tanker on a predetermined frequency. Each tanker will taxi with its

receiver(s) following. A space of 300 feet will be maintained between tankers and receivers. The taxi plan concerning aborted airplanes, etc, will vary with individual airfields.

LINE-UP

On runways at least 300 feet wide, the KC-135 will line up on the downwind side of the runway. If the join-up is to be accomplished in a turn, the receivers will line up with the wingman echeloned away from the direction of turn. If join-up is to be accomplished straight ahead, the wingman will be in right echelon. In either case, the receivers will be positioned on the upwind side of the runway, maintaining wing tip clearance.

Note

On runways less than 300 feet wide, the receiver will remain in the number 1 position until the tanker rolls.

TAKEOFF

Tankers and receivers will take off separately with the tanker rolling first. Forty-five seconds after the tanker has started to roll the receivers will release brakes and start their takeoff roll. The airplanes will correct toward the center of the runway during the first 3000 feet of the takeoff roll. Takeoff interval may be varied when weather, terrain, airfield conditions, or other local considerations dictate.

Aborts During Takeoff

When two or more airplanes are taking off in close succession, an aborting airplane will make an abort call as soon as possible, enabling succeeding airplanes to adjust the takeoff interval. This call is especially important when minimum visibility conditions exist.

ELEMENT JOIN-UP AND CLIMB

The following tanker climb airspeed schedule will be maintained:

Lead Element	300 KCAS
Second Element	310 KCAS
Third Element	320 KCAS
Fourth Element	330 KCAS

Note

In a three-element cell, the second and third elements will assume a climb airspeed of 320 KCAS and 330 KCAS, respectively. In a two-element cell, the second element will assume a climb airspeed of 330 KCAS.

After leveling off for wing flap retraction and acceleration, the tankers will accelerate to and maintain their assigned climb airspeed and 500 FPM rate of climb until element join-up is accomplished. If a ceiling is to be encountered prior to the completion of the join-up, the tanker will level off with a minimum of 500 feet clearance below the cloud layer and maintain assigned climb airspeed to provide visual flight conditions during the element join-up.

The element join-up will be accomplished on the outside of the turn or on the tanker's right wing during a straight-ahead join-up. After the element leader has stabilized in a formation position, the element leader will transmit the command for a crossover to place the element leader on the tanker's left wing and the wingman on the tanker's right wing. All turns by the tanker will normally be 20 degrees of bank. After the receivers have stabilized in their proper formation position, the element leader will inform the tanker pilot that he is cleared to establish climb power. At this time, the tanker pilot will slowly increase power and climb, maintaining the assigned climb airspeed according to his formation position.

SECTION III
RENDEZVOUS PROCEDURES

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GENERAL

The type of rendezvous will be dictated by mission requirements, type of airplanes involved, weather conditions, etc. When elements operate as a single-flight (buddy system), an on-course rendezvous should be utilized. However, if weather conditions for join-up at cruise altitude cannot be assured, a buddy departure should be employed.

If neither method is practical, each element should be assigned an ARCP and the point rendezvous and parallel orbit procedure used. When tanker and receivers operate as separate flights, the point rendezvous and parallel orbit will be primary with a head-on rendezvous as a backup method. After radio contact has been established, both tankers and receivers should be tuned to the same NAVAID, if possible, to improve rendezvous capability. The minimum flight visibility for a visual rendezvous is 5 NM. The minimum flight visibility for an electronic rendezvous is 1 NM.

TRACK

The inbound track of receivers to the ARCP has a definite bearing on the success of the rendezvous. Receivers should pass over the ARIP, if applicable, and make good the planned inbound track to the ARCP. If this is not possible due to weather, etc, tankers will be informed of the receivers' intentions as soon as practical. If radio contact between the tankers and receivers is not established prior to the ARCT, the tankers will be over the ARCP at the ARCT.

ALTIMETER SETTINGS

Unless otherwise directed, an altimeter setting of 29.92 inches Hg will be used for air refueling operations at or above transition altitude or when over water and operating in accordance with ICAO procedures. For all other air refueling operations, the briefed altimeter setting will be used.

TANKER RENDEZVOUS EQUIPMENT

Tanker rendezvous equipment consists of the following:

KC-97L

Automatic Direction Finder AN/ARA-25
Interrogator AN/APX-29A

KC-135

Automatic Direction Finder AN/ARA-25
Radar Beacon AN/APN-69
Tacan (A/A) AN/ARN-72 TCTO 676

RECEIVER RADIO/NAVIGATION/RENDEZVOUS EQUIPMENT

Receiver radio navigation/rendezvous equipment consists of UHF, TACAN, ADF, UHF/DF, IFF, and
Tacan (A/A) AN/ARN-72 TCTO 555

KC-97L RENDEZVOUS PROCEDURES

After initial radio contact has been established between the tanker and receiver force commanders, the tanker lead navigator will assume radio control of the rendezvous and request the receiver force commander to squawk a specific mode on his IFF. Radar identification can be made by having the receiver alternately change modes or go to STANDBY upon command. When positive radar contact is established, the controlling tanker navigator will so inform the receiver force commander, Steers, given in magnetic course to tanker force, will be given to bring the receiver(s) into the tanker's 6 o'clock position. Receiver(s) will be provided

with range and course information at least every 20 NM until the receiver(s) to tanker range decreases to 70 NM; every 10 NM down to 20 NM; then range and course data will be given, when practical, at not more than 2-NM intervals until visual contact by the boom operator. In the event radar contact is not established, the UHF/DF will be utilized until positive radar contact or visual sighting by the boom operator is obtained. With radio contact established, and all required information relayed between the tanker and receiver commanders, the tanker force commander will forward position reports for the entire force. When the receiver force commander has all the tankers in sight, he will state, "Tally-Ho." When individual receiver pilots have their assigned tanker in visual contact, they will so state. The tanker lead navigator may direct the receiver(s) to go to STANDBY on their IFF, if required. When within 1 NM, receivers, when directed, will change to air refueling frequency, if required, and effect closure to the observation or precontact position, as applicable, on their respective tankers. If radio contact has not been established 100 NM from the ARCP, the receiver pilots will turn their IFF to normal, mode 2, or as assigned in the operations order. When the IFF signal is receiver before radio contact has been established, the tanker navigator will instruct the receiver pilot to change modes until the receiver complies, indicating receipt of instructions. This procedure will be continued until normal radio contact is established or a successful rendezvous is completed.

STATIC RENDEZVOUS

The tanker(s) normally establishes a left-hand racetrack pattern anchored on an orbit point with 25-NM legs. The lead tanker will occupy the lowest altitude with 2000 feet vertical separation between tankers. In this operation, the actual rendezvous can be made at any point around the orbit with the air refueling done in the pattern. Length of the orbit legs can be adjusted as required. Receivers will normally be assigned an air refueling altitude.

HEAD-ON RENDEZVOUS

The tanker approaches the receiver(s) head-on and makes a procedure turn to roll out on the receiver(s) course with the receiver(s) approximately 5 NM in trail.

POINT RENDEZVOUS

The tankers will normally orbit over a designated point in a racetrack pattern to the left and parallel to the receivers' air refueling track upstream from the ARCP. Tankers will plan to arrive over the ARCP simultaneously with the receivers.

Receivers should depart the ARIP at an altitude higher than the tanker (weather permitting) to effect better radar contact and better fuel economy. The letdown point should be computed by the receivers to insure termination of letdown 5 NM behind the tanker formation, and 500 feet below. When receivers are 5 NM in trail, the tanker force will set air refueling power, lower booms, and prepare for hookup. A stowed boom indicates that the tanker is unable to transfer fuel.

KC-135 RENDEZVOUS PROCEDURES

ON-COURSE RENDEZVOUS

On-course rendezvous is preferred under the cell cruise concept. Weather conditions must be such that join-up at cruise altitude can be assured.

Departure And Climb

Tactical receiver formation and climb procedures will be as directed within the applicable operational procedures manual. All airplanes will maintain Flight Manual climb schedules until reaching a computed level-off position. The receiver departure time will be adjusted to place him at altitude in trail of the tanker. The tanker will level off, on course, at the programmed cruise altitude and establish 260 KCAS to permit receiver overtake. The receiver will level off, on course, 2000 feet below the tanker's base altitude and establish a closing airspeed. After visual contact is established, the receiver will request the tanker to accelerate to enroute or air refueling KCAS.

WARNING

All airplanes will use a standard altimeter setting with altimeter correction properly applied.

Note

Receivers will establish radio contact with the tanker on the assigned cell frequency at the earliest possible time. When air or ground radar control is available, it should be used to effect tanker/receiver closure until visual contact is made.

Early Arrival Of Receivers

In the event receiver(s) arrive at the ARCP ahead of the tanker(s), the following procedures will apply: Receivers will orbit over the ARCP in the same pattern and timing prescribed for tankers, maintaining 2000 feet below the assigned air refueling altitude. Upon arrival of the tanker(s) and after visual contact has been established, the receiver(s) will join in orbit to precontact position and will accomplish contact after rolling out on the air refueling track.

Join-Up

Receivers will call "Tally-Ho" when they have visual contact.

WARNING

All airplanes will apply the proper corrections to obtain KCAS.

If weather conditions preclude join-up, altitude separation and planned cruise airspeed will be maintained until join-up can be effected or an abort point is reached.

POINT RENDEZVOUS/PARALLEL ORBIT

The tanker will establish an orbit pattern with 2-minute legs and 30-degree bank turns to the left with the ARCP at the downstream end of the leg that coincides with the receiver's intended air refueling track. The tanker will orbit at Mach 0.78 or 270 KCAS, whichever is lower. Tankers will arrive at the orbit 15 minutes before the planned ARCT. Tankers will monitor the designated radio frequency a minimum of 30 minutes prior to the ARCT. The appropriate air refueling airspeed will be assumed upon request of the receiver commander. Receivers will monitor the air refueling frequency and will attempt to establish contact as soon as possible but in no case later than arrival at the ARIP. As soon as reliable radio contact has been established between the tanker and receivers, DME/radial information from a common TACAN/VORTAC station will be exchanged if available. Receivers will depart the ARIP, maintaining buddy cruise speed at 2000 feet below the tanker base altitude and will maintain this altitude until visual contact is made with the tanker(s). When the receivers call departing the ARIP, the tanker(s) will fly the reciprocal of the receiver's inbound track, offset 10 miles to the receiver's left. The tanker forces will turn to the receiver's track upon determining the 26-degree relative bearing position to the receivers. After the tanker completes his 180-degree turn to the refueling heading, he will give UHF/DF steers and if available, TACAN/VORTAC DME and radial information. The receivers will continue to respond with TACAN/VORTAC correlation to facilitate the join-up. UHF/DF steers to the tanker will only be given when the receiver is in a tail chase position or if the initial rendezvous fails. The receiver will be requested to use the tone button or depress mike button without talking. If radar contact has been established by the receivers, additional guidance from the tanker is not necessary. Upon achieving visual contact with each other, the tanker and receiver forces will initiate the precontact procedure.

Note

If radio and radar contact between the tanker and receiver have not been established prior to the ARCT, the tanker will maintain orbit over the ARCP until 15 minutes after the ARCT, unless otherwise briefed. During daylight hours, fuel will be dumped in 1000-pound increments during each turn away from the ARCP. This dumping will commence 10 minutes prior to the ARCT and will be discontinued 15 minutes after the ARCT. For EWO operations, unless otherwise briefed, the tanker orbit will be maintained until fuel is expended to the amount required to reach the scheduled landing base with minimum fuel.

AIR-TO-AIR TACAN RENDEZVOUS PROCEDURES

(See Section III, T.O. 1-1C-1-3.)

POINT RENDEZVOUS/PARALLEL ORBIT BETWEEN ORBITING TANKERS AND TANKER ESCORTING FIGHTERS

The orbiting tanker(s) will establish an orbit pattern at the ARCP at the downstream end of the leg that coincides with the receiver(s) intended air refueling track. Both tanker(s) and receiver(s) will monitor the designated radio frequency at a minimum of 30 minutes prior to the ARCT. The escorting tanker will establish radio contact with the orbiting tanker at the earliest possible time. At 200 NM from the ARCP, or after completing last enroute air refueling, the entire receiver cell will formate on the lead tanker, who now becomes the escorting tanker. After receiver assembly with the escorting tanker, the other tanker(s) in the cell may reduce airspeed and, when clear of the escorting tanker/fighter formation, execute a left turn and proceed enroute to destination. If the tanker cell is to remain intact, the following tanker(s) will assume a 1-NM intrail formation stacked up 500 feet on the escorting tanker.

The escorting tanker will home on the orbiting tanker(s) when the closure rate is at a minimum (orbiting tanker/cell is on the air refueling track leg of the orbit) to establish a basic heading for rendezvous. At 80-NM range the escorting tanker/cell will initiate a 1000 FPM descent to 2000 feet below the base air refueling altitude. (For a formation, the highest tanker in the escorting cell will descend to 1000 feet below the base air refueling altitude.) When the cell has leveled off, the cell will be in an intrail formation, stacked up with 500 feet vertical separation, 1 NM in trail. The escorting tanker navigator will monitor the range and will begin a countdown in 10-NM increments from the 100-NM range to the 70-NM range. This will prepare the orbiting tanker/cell for the

turn to the reciprocal of the air refueling track at the 70-NM range call.

If the orbiting tanker/cell is flying on the air refueling track, it will immediately execute a left turn, (30-degree bank) to the reciprocal track, and will maintain that heading. After the orbiting tanker has departed the orbit on the reciprocal of the air refueling track, proper lateral separation must be maintained by the escorting tanker. The escorting tanker navigator will continue to monitor the range and begin a countdown from the 50-NM range to the 30-NM range in 10-NM increments. After the 30-NM call, the countdown will be continued in 1-NM increments to the computed turn range, to prepare the orbiting tanker/cell for the turn to the air refueling track. The orbiting tanker/cell will turn to the air refueling track at the computed range call.

After the orbiting tanker/cell has rolled out on the air refueling track and visual contact is established, the escorting tanker/cell may reduce airspeed to 280 KCAS and, when clear of the fighter formation, execute a left turn and proceed to destination. Clearance from track by the escorting tanker/cell must be accomplished prior to receivers starting to climb.

If the escorting tanker is scheduled to join the refueling (orbiting) cell, it will accelerate to 300 KCAS and climb into the top cell position with its assigned receivers.

HEAD-ON RENDEZVOUS

The head-on rendezvous should be used only as a backup method. The tanker is not on an established orbit. As soon as reliable UHF contact is established, the receiver and tanker will alter to a head-on course, and the receiver will establish and maintain 2000 feet separation below the tanker and maintain buddy cruise airspeed. The tanker will offset approximately 10 NM to the right by altering 90 degrees right and then 90 degrees left.

Note

Ground radar assistance should be utilized to the maximum for this type of rendezvous.

STATIC RENDEZVOUS

The tanker(s) will establish a left-hand racetrack pattern anchored on an orbit point with 15-degree bank, 25-NM legs. For aid in making the rendezvous, the track will be divided into four sectors as shown in figure 3-1. This will permit the tanker to give his location to the receiver to facilitate rendezvous.

ORBIT TRACK SECTORS

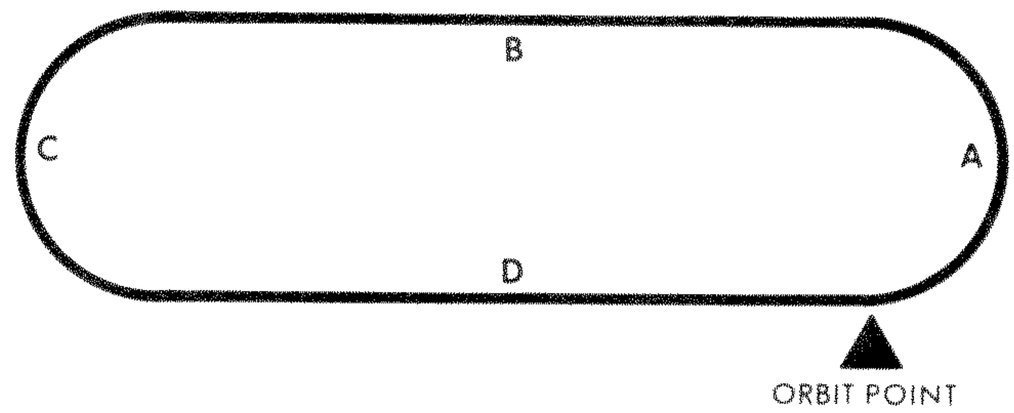

Figure 3-1

Positions will be given as "Entering C sector" or "Leaving B sector." In this operation, the actual rendezvous and refueling will be accomplished in the orbit pattern. Length of the orbit legs can be adjusted as required for a specific operation. Single or tanker formations may be used in static orbit. Single tankers will be separated by 4000 feet altitude; tanker formations will have 4000 feet between cell leaders. Receivers will remain at an altitude 2000 feet below the assigned tanker until visual contact is established. Tankers will orbit at standard orbit airspeed and will adjust to air refueling airspeed upon request of the receiver leader.

RENDEZVOUS OVERRUN

Note

If, during normal or alternate rendezvous procedures, the receiver has overrun the tanker, the tanker may direct the receiver to maneuver in order to decrease closure time, provided visual or electronic contact can be maintained or multiple control point patterns are not utilized.

In the event of an overrun by fighters, the receiver(s) will pass 2000 feet below the tanker to insure positive vertical separation. The receiver will decelerate to 290 KCAS or onset of buffet, whichever occurs first, and maintain air refueling heading. The tanker will accelerate to 355 KIAS (350 KCAS) or Mach 0.90, whichever is lower, and maintain air refueling heading. When the tanker is in positive visual contact ahead of the receiver, the receiver pilot will so indicate. The tanker will decelerate to air refueling airspeed, and normal formating procedures will be employed to establish contact.

SECTION IV
AIR REFUELING PROCEDURES

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GENERAL

The following information applies to all air refueling operations. It is essential that receiver pilots have a thorough understanding of the basic tanker air refueling procedures. The tanker boom is controlled by the boom operator while the fuel transfer (pressure, flow, quantity, etc) is normally controlled by the crew from the pilots' compartment. During air refueling operations, the actions and communications between tanker and receiver crews are of necessity a highly coordinated effort. Only through strict adherence to these prescribed procedures can a smooth, efficient team effort be realized.

RECEIVER FORMATION

CAUTION

No attempt should be made to accomplish air refueling unless the receiver pilot is proficient in close formation flying. Success in air refueling will be directly related to the degree of proficiency in close formation flying.

ELEMENT CRUISE FORMATION (BUDDY CRUISE)

Receivers fly route formation position on the tanker. (For extended VFR cell cruise formation, receivers may fly a spread formation.) Route and spread formations will be as specified in the operational procedures manuals. The receiver leader will be on the tanker left wing, number 2 receiver on the tanker right wing; with four receivers, numbers 1 and 2 will form on the left wing, numbers 3 and 4 on the right wing. Spacing may be closed up during IFR or night operations. When air refueling is required, the other receiver(s) will assume the observation position. The recommended weather formation position is to fly wing on the KC-135 stabilizer to avoid the great flex of the KC-135 wing in turbulence.

JOIN-UP

Receivers may approach a tanker formation in either route/tactical/fingertip or echelon formation. Reform should be planned for a minimum number of crossovers.

ROUTE/TACTICAL JOIN-UP/FINGERTIP

Normally the receiver leader will proceed to the precontact position. Number 2 receiver will proceed to the lead elements observation position. The second element (receivers 3 & 4) will proceed to an observation position on the tankers opposite wing. Each subsequent receiver will be cleared from the observation position to the precontact position by the boom operator. The refueling sequence will be 1, 3, 2, 4 or as designated by the receiver leader. Each

receiver, after refueling is completed, will rejoin to an outside wing position of his original element.

ECHELON JOIN-UP

Normally receiver leader and flight, in echelon formation, will proceed to the observation position. Each receiver will be cleared from the observation position to the precontact position by the boom operator. The receivers, after refueling is completed, will rejoin in echelon formation on the tankers opposite wing.

FUEL MANAGEMENT

Precautions to insure adequate internal fuel availability to complete the refueling operation will be taken prior to attempting contact with the tanker.

KC-97L PROBE AND DROGUE PROCEDURES

WARNING

- The receiver will stabilize in the precontact position and attain a zero rate of closure. If the receiver fails to attain stabilized position, or it becomes apparent that a closure overrun will occur, a breakaway will be initiated. Failure to initiate a breakaway under closure overrun conditions can result in a mid-air collision.
- Because of the magnitude of interrelated aerodynamic effects, flying two airplanes in close vertical proximity is not safe. Upwash and downwash effects may occur drawing the aircraft together. Low pressure areas created by an overrunning receiver flying under the tanker will affect static ports causing possible erroneous airspeed and altitude indications to both aircraft. The tanker autopilot altitude hold function may sense the low pressure as a climbing indication and initiate a descent into the lower airplane.

a. When approximately 1/2 NM behind the tanker(s), the receiver formation will reduce airspeed to 250 KIAS.

b. When approximately 2000 feet behind the tanker(s), the receivers will extend wing flaps.

c. As the receivers approach 1/2 NM in trail, the tanker(s) will increase airspeed to 220 KIAS.

Note

Air refueling will not be attempted above 20,000 feet because of insufficient military power.

MANEUVERING BOOM

When cleared by the boom operator, the receiver will move to the precontact position. When the tanker is ready for contact, the boom operator will state, "(Tanker call sign) ready," and the receiver pilot will state, "(Receiver call sign) ready," before attempting a hookup. The receiver should position the probe approximately 2 feet directly aft of the drogue. If necessary, the boom operator will aid in directing the receiver into position. When in position, the boom operator will fly the drogue into contact with the probe, actuate signal system manual contact switch, state, "(Tanker call sign) contact," and commence air refueling at the maximum rate for the receiver involved. The receiver pilot will state, "(Receiver call sign) contact," each time contact is made. The receiver pilot will monitor the receiver director lights for necessary corrections to remain in the air refueling envelope. After contact, the drogue should be pushed forward approximately 2 feet. (See figure 4-1.) If pushed too far forward, the excessive hose arc will cause hose whip. If a slight hose arc is not maintained, fore and aft stresses will cause premature disconnect. The boom operator will trigger disconnect prior to the receiver disconnecting. Normal disconnects will be coordinated with the boom operator to insure that fuel pressure is off and boom, hose, and drogue are aligned. For normal disconnects, the receiver will maneuver so the drogue is in the trail position and reduce power to move slowly aft until disconnect. Any time a disconnect occurs, the receiver pilot will state, "(Receiver call sign) disconnect," and the boom operator will acknowledge with, "(Tanker call sign) disconnect."

Note

Prior to contact the boom will be trailed at 0° azimuth, 35° elevation and 8 feet extension.

RIGID BOOM

When cleared by the boom operator, the receiver will move to the precontact position, and comply with precontact checklist. When the tanker is ready for contact, the boom operator will state, "(Tanker call sign) ready," and the receiver pilot will state, "(Receiver call sign) ready," before attempting a hookup. The receiver should position the probe approximately 2 feet directly aft of the drogue. If necessary, the boom operator will aid in directing the receiver into position. During all contacts the boom operator will hold the boom as motionless as possible. All contacts will be effected by the receiver pilot. When in contact the boom operator will state, "(Tanker call sign) contact," and commence air refueling at the maximum rate for the receiver involved. Prior to contact, the boom will be trailed at 0° azimuth, 35° elevation and fully extended, or that extension which affords the best drogue stability (not less than 10 feet).

Note

Initially, during "flying boom" operation, there is a tendency by the receiver to overcontrol and reduce power when the drogue is "flown" toward the probe. Once the receiver is stabilized in the contact position, reference should be shifted from the boom and drogue to the tanker to prevent a possible "out-of-cycle" condition.

CAUTION

Air refueling will be terminated when a crimp and/or fuel leak is observed in the hose, except in case of emergency or when continuance of refueling is dictated by operational necessity.

The receiver pilot will state, "(Receiver call sign) contact," each time contact is made. The receiver pilot will monitor the receiver director lights for necessary corrections to remain in the air refueling envelope. After contact, the drogue should be pushed forward approximately 2 feet, (See figure 4–1.) If pushed too far forward, the excessive hose arc will cause hose whip. If a slight hose arc is not maintained, fore-and-aft stresses will cause premature disconnect. The boom operator will trigger disconnect prior to the receiver disconnecting. Normal disconnects will be coordinated with the boom operator to insure that fuel pressure is off and boom, hose, and drogue are aligned. For normal disconnects, the receiver will maneuver so the drogue is in the trail position and reduce power to move slowly straight aft until disconnect.

CAUTION

The boom operator will not retract the boom to effect a disconnect except in case of an emergency. If a disconnect is made when the receiver is to the left, right, up or down from the normal trail position, the drogue could crack the canopy, damage the receiver fuselage, bend the probe, or break the probe tip off when it whips off the probe.

Note

Refueling techniques for rigid boom operation are the same as those described for KC-135 Probe and Drogue Procedures.

The receiver pilot must inform boom operator of contact. The receiver pilot will notify the boom operator prior to disconnect. The boom operator will trigger a disconnect to insure that fuel pressure is relieved.

KC-135 PROBE AND DROGUE PROCEDURES

WARNING

- The receiver will stabilize in the pre-contact position and attain a zero rate of closure. If the receiver fails to attain stabilized position, or it becomes apparent that a closure overrun will occur, a breakaway will be initiated. Failure to initiate a breakaway under closure overrun conditions can result in a mid-air collision.

- Because of the magnitude of interrelated aerodynamic effects, flying two airplanes in close vertical proximity is not safe. Upwash and downwash effects may occur drawing the aircraft together. Low pressure areas created by an overrunning receiver flying under the tanker will affect static ports causing possible erroneous airspeed and altitude indications to both aircraft. The tanker autopilot altitude hold function may sense the low pressure as a climbing indication and initiate a descent into the lower airplane.

PROBE AND DROGUE AIR REFUELING

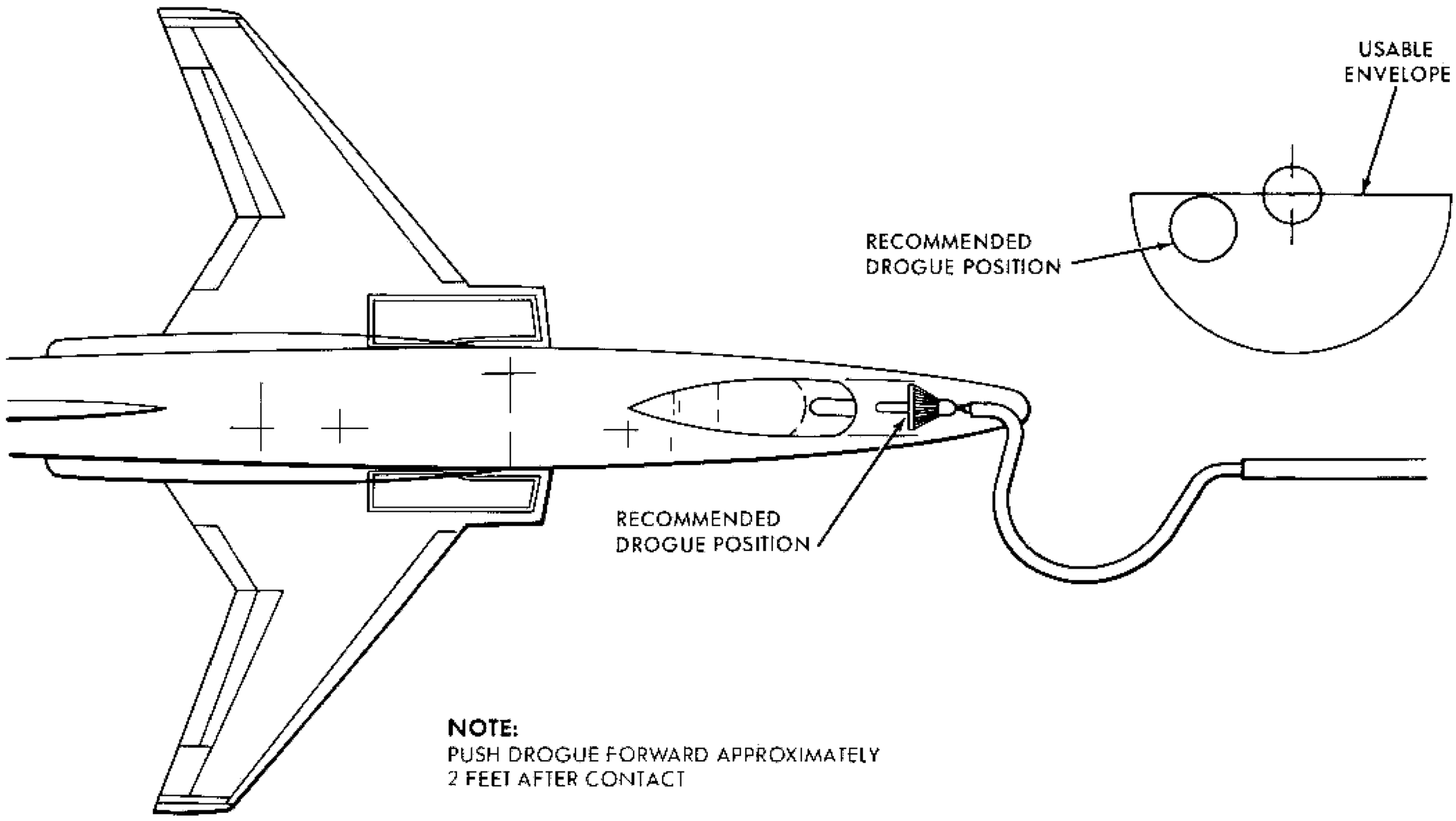

Figure 4–1

When the tanker is ready for contact, the boom operator will state, "(Tanker call sign) ready," and the receiver pilot will state, "(Receiver call sign) ready, " before attempting a hookup. The receiver pilot will state, "(Receiver call sign) contact," each time contact is made.

Note

Due to the boom operator's limited visibility of the drogue, it is possible for contact or disconnect to be accomplished without the boom operator's knowledge.

a. Upon receiving clearance, the receiver pilot will move up to the precontact position 5 to 10 feet directly aft of the drogue. When in the precontact position, the receiver pilot will comply with the PRECONTACT Checklist.

b. The receiver pilot will then allow the drogue to stabilize and select a formation reference point on the tanker. Using this reference, peripheral vision will include the drogue. The drogue should not be used as a primary reference, as drogue oscillation will invariably result in receiver overcontrol.

c. The receiver pilot will then add sufficient power to establish a closure rate not to exceed 3 knots. A combination of formation reference and peripheral vision will assist the pilot in moving straight forward toward the drogue.

CAUTION

No attempt should be made to chase the drogue in pitch. Disregard small oscillations of the drogue while closing for contact. Contact from closure rates higher than 3 knots are likely to cause the hose to whip, possibly damaging the probe, drogue, or receiver.

Note

Slow closure rates may not firmly seat the probe for fuel transfer. Closing slowly on the drogue tends to cause the pilot to chase the drogue and make hookup less likely.

d. If the probe misses or hits the edge of the drogue, the receiver pilot will retard the throttle and move slowly straight back 5 to 10 feet.

e. After each unsuccessful attempt at contact the receiver pilot should back off and closely analyze the error which caused the missed contact.

f. After contact is effected, position the drogue as shown in figure 4–1. The hose is approximately 9 feet long and allows for approximately 5 feet of fore-and-aft movement of the receiver airplane without becoming disconnected, or damaging the hose. During all contacts the boom operator will hold the boom as motionless as possible. All contacts will be affected by the receiver pilot.

CAUTION

- Special precaution must be taken to prevent the hose from looping around the probe while in contact. Disconnects made with the hose in this position will result in serious damage. Under no circumstances should the aircraft be banked or turned until a disconnect has occurred and the receiver is clear of the hose and drogue.

- Air refueling will be terminated when a crimp and/or fuel leak is observed in the hose, except in case of emergency or when continuance of refueling is dictated by operational necessity.

After receiver contact, the boom operator will state, "(Tanker call sign) contact," and commence air refueling at the maximum rate. Any time a disconnect occurs, the receiver pilot will state, "(Receiver call sign) disconnect," and the boom operator will acknowledge with, "(Tanker call sign) disconnect." The receiver will move to a stabilized position a minimum of 5 feet behind the drogue and recheck air refueling switches while the boom operator recycles the boom to prepare for another contact.

g. If for any reason the receiver is not transferring fuel or is transferring at a less than normal rate, the tanker copilot will advise the receiver pilot. The receiver pilot will disconnect and clear the area aft of the drogue to permit the boom operator to cycle the boom.

DISCONNECT

After air refueling is complete, disconnect must be made directly aft and level with the drogue aligned to the free trail position. To prevent excessive side forces damaging the probe or receiver, the disconnect must be flown with the same care as the hookup.

CAUTION

The boom operator will not retract the boom to effect a disconnect except in case of an emergency. If a disconnect is made when the receiver is to the left or right from the normal trail position, the drogue could crack the canopy, damage the receiver fuselage, bend the probe, or break the probe tip off when it whips off the probe.

Note

Receiver pilots may experience fuel spray on the windshield during disconnect. Forward visibility is temporarily reduced depending on the amount of fuel spray (up to 30 seconds). This fuel spray may also cause fumes in the cockpit due to the engine ingesting the fuel spray and transmitting the fumes through the cockpit air conditioning and pressurization system. The fuel spraying is greatly reduced on a coordinated disconnect since the tanker fuel transfer pumps are turned off prior to disconnect.

BOOM AND RECEPTACLE PROCEDURES

WARNING

- The receiver will stabilize in the precontact position and attain a zero rate of closure. If the receiver fails to attain stabilized position, or it becomes apparent that a closure overrun will occur, a breakaway will be initiated. Failure to initiate a breakaway under closure overrun conditions can result in a mid-air collision.

- Because of the magnitude of interrelated aerodynamic effects, flying two airplanes in close vertical proximity is not safe. Upwash and downwash effects may occur drawing the aircraft together. Low pressure areas created by an overrunning receiver flying under the tanker will affect static ports causing possible erroneous airspeed and altitude indications to both aircraft. The tanker autopilot altitude hold function may sense the low pressure as a climbing indication and initiate a descent into the lower airplane.

When cleared by the boom operator, the receiver will move to the precontact position and comply with PRECONTACT Checklist. When ready for contact, the boom operator will state, "(Tanker call sign) ready," and the receiver pilot will state, "(Receiver call sign) ready." The receiver will move forward to the contact position and the boom operator will make contact. The receiver may request assistance from the boom operator in obtaining and maintaining position. Upon contact, the receiver pilot will state, "(Receiver call sign) contact," and the boom operator will state, "(Tanker call sign) contact," and air refueling will commence.

a. The receiver should approach the boom from 6 o'clock low, closing smoothly up a 45-degree incline rather than using a "Stairstep" approach. This technique permits greater depth perception for the receiver. Azimuth alignment is a simple matter of aligning the receptacle with the boom tip. As the receiver nose closes on the boom, constant cross reference between the boom and the tanker fuselage will alleviate any tendency to "chase" variations of boom trail position due to turbulence.

b. When the receiver has closed to the point that the boom tip hovers over the receptacle door, he is required only to maintain this position. The boom operator will then make the contact.

Note

Receivers will tend to be reluctant to close with the boom, due to its close proximity to the canopy. This reaction must be anticipated and overcome.

c. To maintain proper contact elevation and boom extension, the receiver pilot refers to the director lights located on the belly of the tanker and the colored

stripes painted on the extended boom. (See figures 1–2 and 1–3.) While in contact position the receiver has freedom in all three axes as depicted by figures 1–4 and 1–5.

d. If for any reason the receiver is not transferring fuel or is transferring at less than normal rate, the tanker copilot will advise the receiver pilot. The receiver pilot will disconnect and hookup again.

e. If the receiver approaches the limits of the boom, the boom operator should verbally state that the receiver is in an area of disconnect and give corrective instructions. Position should be maintained with minimum stabilator motion and smooth power adjustments.

CAUTION

If receiver director lights fail to illuminate when contact is established, the receiver pilot will initiate disconnect and return to the precontact position. If the malfunction cannot be rectified, further attempts at refueling will be at the discretion of the receiver pilot.

DISCONNECT

If a disconnect occurs prior to transferring the prescribed offload, the receiver will move to a stabilized position a minimum of 5 feet aft of the boom, reset air refueling system, and await clearance to resume contact position. Either the boom operator or the receiver pilot can effect a disconnect at any time; however, the boom operator will normally make the disconnect. Anytime a disconnect is experienced, it will be acknowledged by both the boom operator and receiver pilot by stating, "(Receiver or tanker call sign) disconnect," as applicable. When the required amount of fuel is transferred, initiate the disconnect. Upon disconnect, the receiver will slowly reduce power and drop down and aft.

Note

- During KC-97L tanker manual operation or manual boom latching operation, the receiver will be required to initiate all disconnects.
- During KC-135 tanker manual operation, receiver normal, the tanker disconnect signal sends both airplanes to disconnect provided the tanker normal system is operational. When the receiver is in the manual boom latching, the receiver must initiate the disconnect.

TOWING

When air refueling with the boom, it may be desirable to be towed. After notification from the pilot of his desire to be towed, and acknowledgement received from the tanker pilot and boom operator, the receiver pilot must ease slowly into the tow position (fully extended boom) to prevent a brute force pullout. Disconnect can be accomplished by either the boom operator or the receiver pilot.

TOBOGGAN

When altitude and atmospheric conditions result in thrust requirements that exceed the receiver's available thrust, a toboggan will be necessary. The toboggan technique is a coordinated effort between the tanker pilot and the receiver pilot.

a. The receiver pilot must call for a toboggan before reaching full military power.

b. The tanker pilot will very gently reduce power and initiate a rate of descent of 200 to 300 FPM while maintaining the air refueling airspeed throughout the toboggan maneuver.

c. If the receiver's power requirements continue to exceed the thrust capability, an increased rate of descent must be requested by the receiver pilot.

d. If hookup is to be maintained at the level-off altitude, the tanker pilot must make a very gentle change of attitude and a gentle power increase.

e. (KC-135). Should it become necessary for an element to toboggan while in cell formation, the tanker leader will direct the entire cell to toboggan.

AFTERBURNER AIR REFUELING

Afterburner air refueling should be limited to cases of tactical necessity and emergencies because a critical fuel shortage may result. When used, the following procedures will apply:

a. Receiver will receive fuel until full military thrust capabilities are reached.

b. Disconnect, select afterburner, select the required combination of speed brakes and afterburner, stabilize, initiate hookup, and complete transfer operation.

INTRACELL CRUISE

CRUISE POSITION

The tanker pilot will, once each hour during cruise, advise the receiver pilots of the cell geographic position, heading, distance, and ETE to the next checkpoint or destination, as applicable. As each receiver pilot leaves the observation position, the tanker pilot will advise the distance and heading to the planned abort base.

AIR REFUELING ABORT POINT

If the receiver pilot has not completed his onload upon reaching his geographic air refueling abort point (which has been adjusted for wind), the tanker pilot will so advise.

OXYGEN AND FUEL CHECKS

The receiver flight leader retains the responsibility of accomplishing necessary receiver oxygen, fuel, and pressurization checks during cell cruise.

ABORT PROCEDURES

When a receiver aborts during the air refueling mission, a wingman will accompany the aborting airplane to the abort base, unless otherwise instructed. If the receiver flight is composed of two or three airplanes, the entire receiver flight will abort. During cell operation (buddy system), if a receiver or tanker is required to abort, normally only the basic element will abort.

LOST WINGMAN PROCEDURES

In the event a receiver airplane becomes lost during refueling operations or during buddy cruise, the following procedures will apply:

a. The number 1 or 3 receiver, when flying on opposite sides of the tanker, will simultaneously reduce airspeed 10 knots and turn 15 degrees away from tanker heading. Hold for 15 seconds, then resume normal airspeed and heading.

b. The number 2 or 4 receiver, when flying on opposite sides of the tanker, will simultaneously reduce airspeed 10 knots and turn 30 degrees away from tanker heading. Hold for 15 seconds, then resume normal airspeed and heading.

c. Maintain altitude on KC-135, descend 500 feet below base altitude on KC-97L (this will afford 500 feet vertical separation between other tankers in the formation), and notify flight leader or tanker commander of the situation.

d. Attempt rejoin only after receiving clearance from tanker and when within radar or VFR capability.

EWO PROCEDURES (ACTUAL OR SIMULATED)

If required, when a receiver force is being air refueled during execution of an emergency war plan (either actual or simulated), the tanker commander will inform the receivers of the tanker position upon completion of air refueling by using the Air Refueling Area Grid System. (See figure 4–2.) The grid will be drawn to the same scale as the chart used for the mission. Eleven lines spaced 20 miles apart will be drawn perpendicular to the planned air refueling track. The rows between these lines will be labeled A through J, commencing from the ARCP. On each side of the planned air refueling track, 10 parallel lines will be drawn 10 NMI apart. The rows between these lines will be labeled 1 through 20, commencing at the left side of the grid. The area to the left of the direction of the planned air refueling track will always be designated as the left side. The block in which the tanker is located at the completion of air refueling will be the block given to the receivers. Each block will always be identified by the number-letter combination; i.e., 12-E, etc.

COMPLETION OF STATIC AIR REFUELING

All receivers will form on the right of the last tanker in the cell. Upon receiving clearance from the receiver leader, tankers will execute a level, left-hand turn to the return track. Tankers will establish trail route cell formation during this turn. Receivers will maintain altitude and airspeed until the tanker leader reports clear of track. Receivers will then proceed on their assigned mission. Tankers will maintain normal cruise/air refueling formation as indicated in figure 4–3 during cell operations.

NOTE

The Air Refueling formation may be changed from 60 degrees right echelon, 1 NM separation to 20 degrees right echelon, 1 NM separation when manuevering airspace or weather conditions so dictate. In those cases where 20 degrees echelon formation is used, all participating aircrews will be briefed.

RE-FORM

a. After disconnect, the receiver will depart the contact position by moving back and down to approximately the precontact position. The post contact check and the receiver will move to the briefed re-form position.

Note

- If the probe will not retract after air refueling, place the probe switch to EMERGENCY to return continuity to the fuel control panel and continue the mission at or below 310 KIAS.
- If the receptacle cannot be retracted after air refueling, place the probe switch to EMERGENCY. This will raise the probe and return continuity to the fuel control panel. The mission may be continued at or below 310 KIAS.

b. If tanks will not feed after completion of air refueling, any or all of the following procedures may be attempted to correct the situation:

(1) Positively check probe/receptacle switch in RETRACT position.

Note

If the air refueling system does not revert back to normal after air refueling, the wing and external tank full lights will indicate FULL (providing the tanks are full) without the pilot depressing the full check switch.

(2) Recycle probe/receptacle.

(3) Check fuel transfer circuit breaker in.

(4) Recycle fuel selector switches and check their proper position.

(5) If all previous steps fail, place probe switch to EMERGENCY extend position and check for proper fuel transfer. If fuel transfer is normal in this condition, leave switch in EMERGENCY and continue mission at or below 310 KIAS.

AIR REFUELING AREA GRID

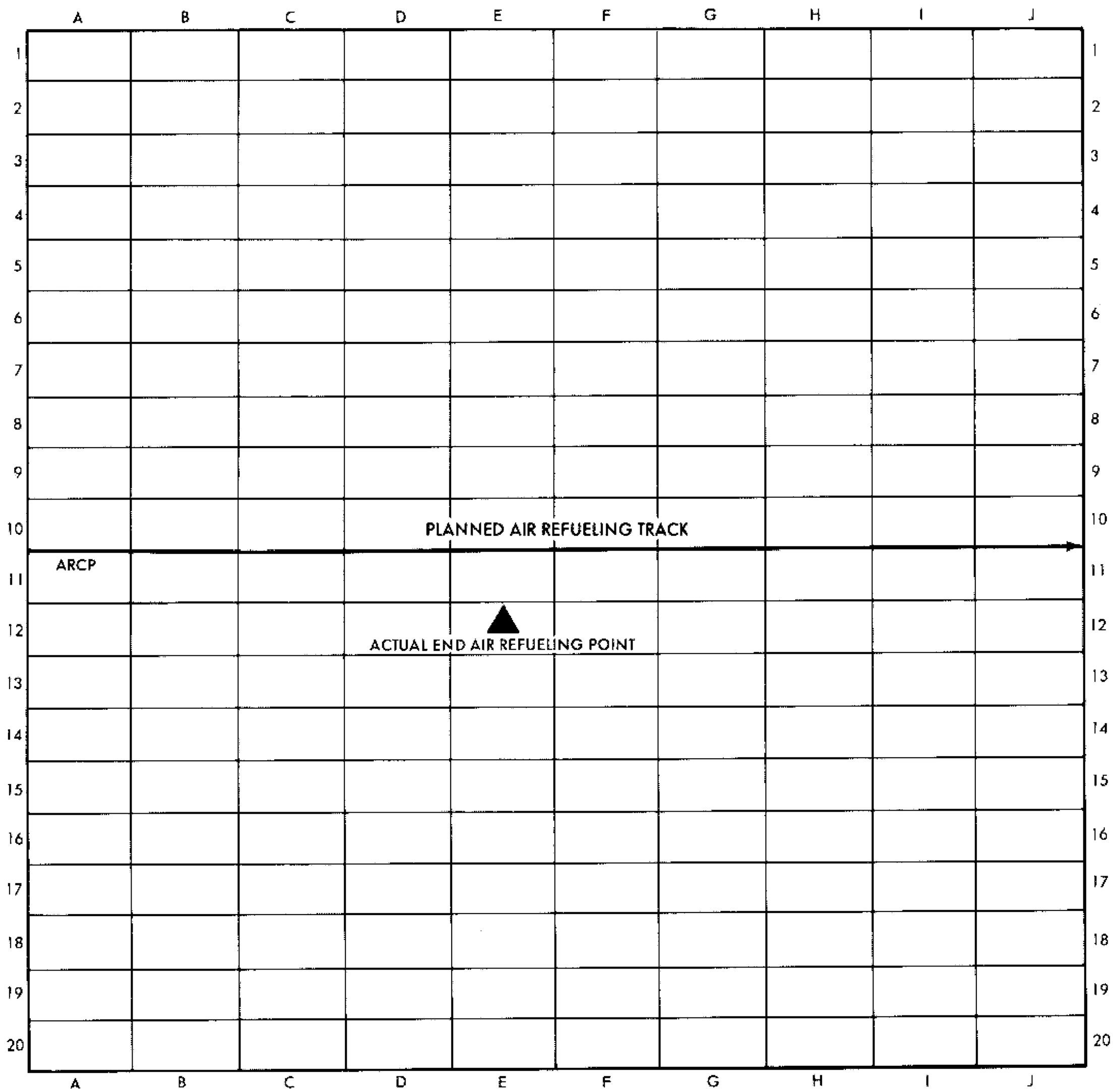

Figure 4–2

TANKER CRUISE / AIR REFUELING FORMATION

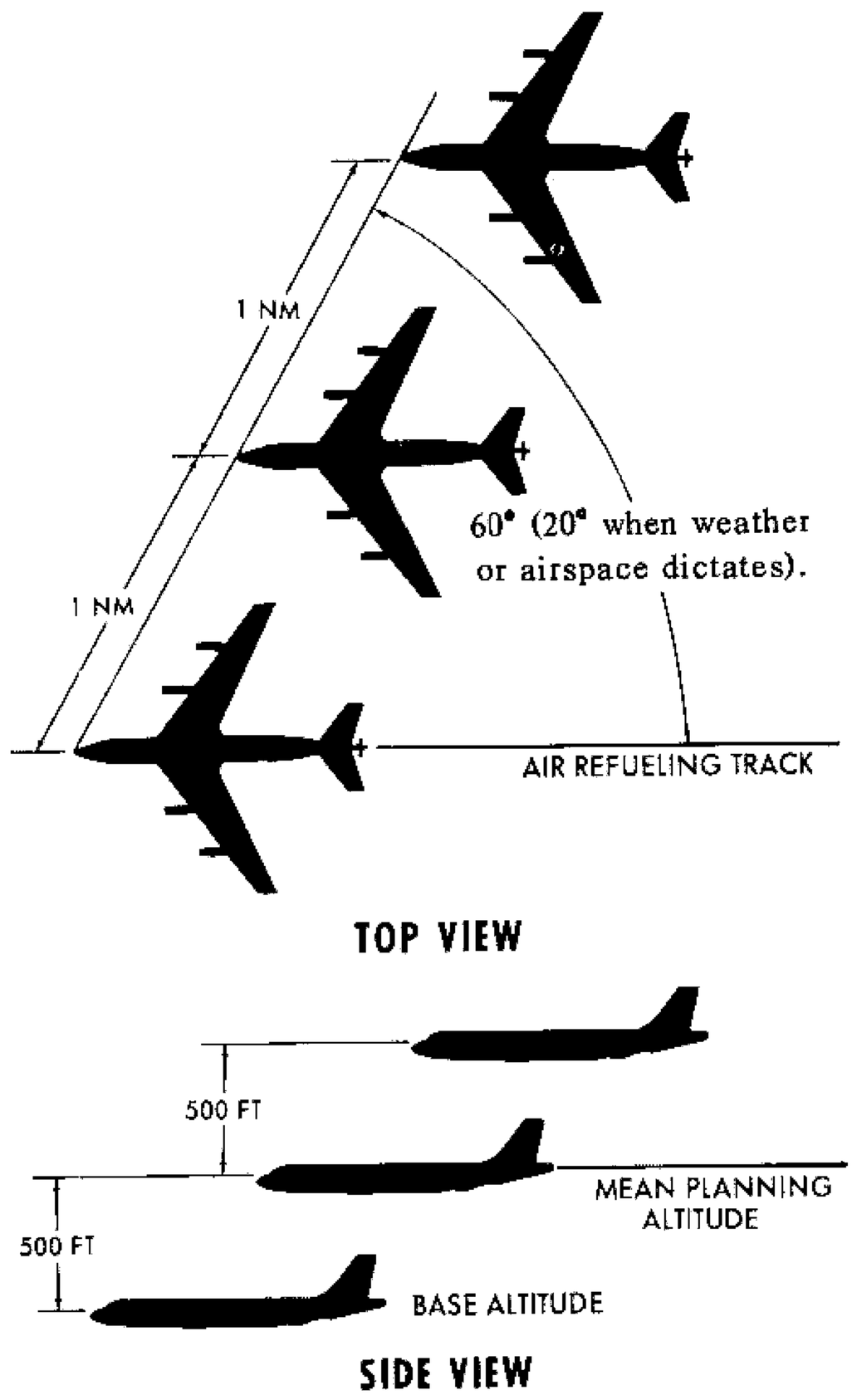

Figure 4–3

TERMINATION PROCEDURES

CELL TERMINATION PROCEDURES

Block altitude reservations designated in the operations plan will provide adequate airspace to perform cell termination procedures from the point of last filed route position to cell termination point or terminal approach fix, as applicable. The tanker leader will, at cell termination, advise the receivers of position, heading, distance, and ETE to receivers' next checkpoint or destination.

CELL TERMINATION DURING CRUISE

Ten minutes prior to reaching the cell termination point (if the point is other than destination approach fix), the receivers will formate in left echelon on the left wing of the tankers. Upon reaching the cell termination point, the tanker(s) will climb straight ahead 3000 feet and then turn to the desired track, maintaining cell formation. Receivers will maintain heading, altitude, and airspeed for 3 minutes. At this time, if flight formation rejoin is impractical, number 1 receiver element will descend 1000 feet below base altitude, number 2 receiver element will descend 500 feet to the base altitude, number 3 receiver element will maintain altitude which will be 1000 feet above the base altitude, and number 4 receiver element will climb 500 feet to an altitude which is 2000 feet above base altitude. Receiver elements will then proceed with their mission independently. (See figure 4–4.)

CELL TERMINATION AT TERMINAL APPROACH FIX

Due to the many possible combinations of tanker/receiver formations, terminal destination weather, and terminal airfield penetration facilities, it is impractical to designate one optimum method for penetration at the destination.

The following methods should be applied as applicable:

a. When available, RAPCON should be used with enroute descents to obtain airplane separation.

b. The element (one tanker/two receivers) may penetrate as a unit. Weather minimums for this type approach are 2500 feet and 3 NM.

c. The tankers should be scheduled to arrive over the destination with adequate fuel to hold until all receivers of the cell have departed the high station.

d. From the final air refueling point, tankers and receivers can be scheduled at their individual optimum airspeeds to provide spacing for the penetration.

e. The following inbound recovery procedures for use during VFR/IFR weather when receivers and tankers are recovering at the same base under RAPCON may be utilized in certain areas.

(1) Plan Alfa – Destination VFR.

(a) Conditions: Receivers.

1. TACAN Lock-On 100-125 NM.

2. Receivers will depart tanker.

3. Establish formation (flights of four).

4. Retain Mach 0.78.

CELL TERMINATION PROCEDURE

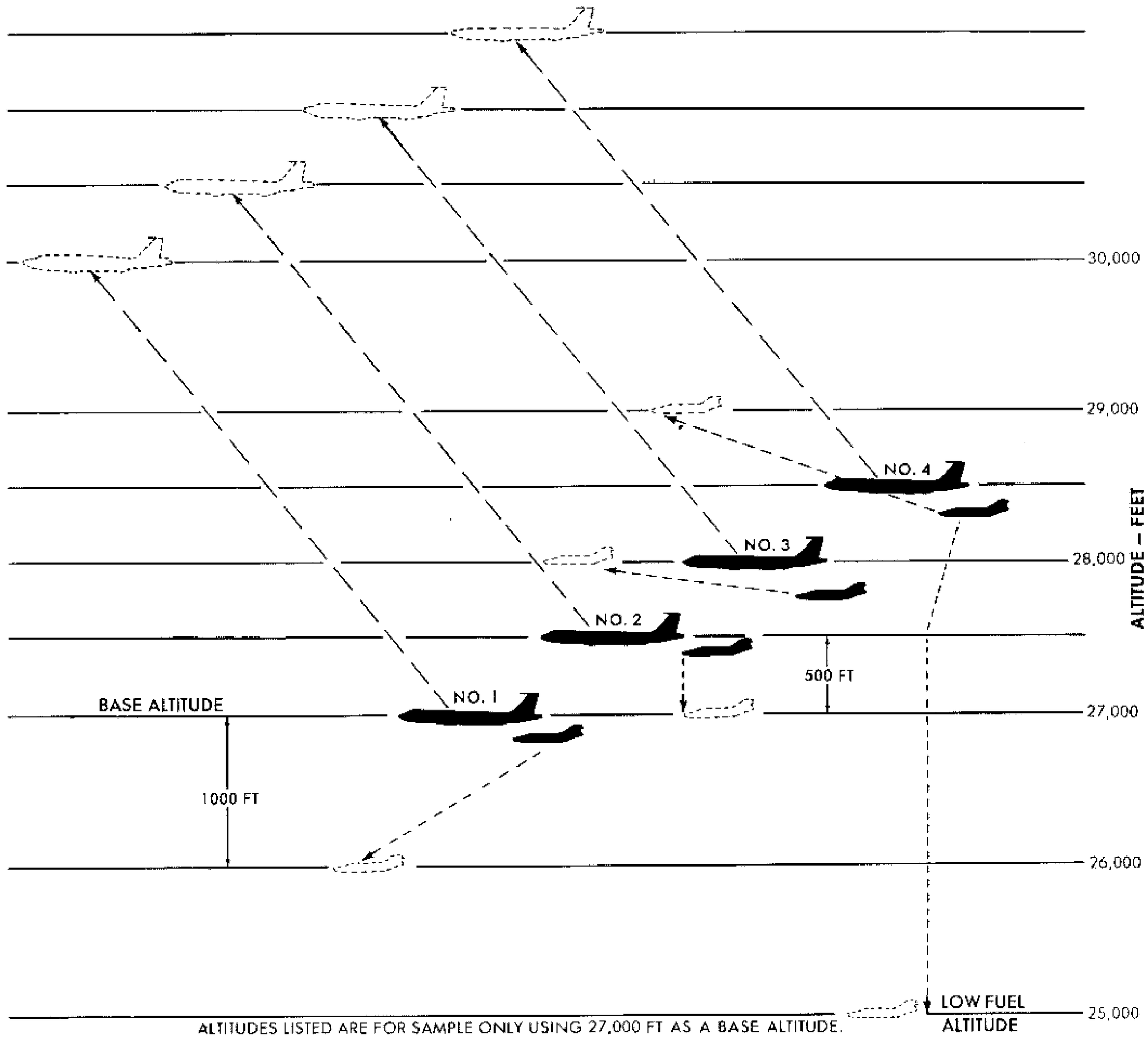

Figure 4–4

5. Establish radio contact with appropriate traffic controller.

6. Penetrate to destination as directed by appropriate traffic controller.

(b) Conditions: Tankers.

1. Subsequent to receiver departure and under RAPCON, assume 1000 feet separation beginning at 24,000 feet (base altitude), or as directed, and establish a 10-mile separation.

2. Reduce airspeed to 220 knots, gross weight permitting.

3. Proceed as directed by appropriate traffic controller.

(2) Plan Bravo – Destination IFR.

(a) Conditions: Receivers.

1. TACAN Lock-On 100-125 NM.

2. Receivers will depart tanker.

3. Establish formation (flights of four).

Note

Should IFR prevail at altitude, elements of two receivers will proceed to 19,000/20,000/21,000/22,000 feet respectively, or as directed.

4. Retain Mach 0.78.

5. Establish radio control with appropriate traffic controller.

6. Proceed as directed by appropriate traffic controller.

(b) Conditions: Tankers.

Same as plan Alfa – Tankers.

SEPARATION (UP TO FOUR TANKERS AND EIGHT RECEIVERS)

At 10 minutes out from the terminal approach fix, the tankers will (on signal from the tanker leader and acknowledgement from each element leader) climb 3000 feet. Three minutes later, the receivers will take separation as described in CELL TERMINATION DURING CRUISE, this section. This will provide altitude separation over the termination fix and in the holding pattern. Approach times will be controlled by the appropriate ATC agency. When possible, the lead (lower) receiver element will be given a descent enroute from that position to the approach fix. A low fuel altitude will be designated 2000 feet below base altitude for immediate descent of receivers with low fuel or an emergency condition. Receiver altitude changes will be coordinated by the receiver cell leader with the ATC agency. All airplanes of the cell will note individual altimeter errors at the cruise altitude with 29.92 inches Hg set on the altimeter and fly their assigned altitudes after cell separation with these errors applied.

ELEMENT PENETRATION

If conditions exist which necessitate a more expeditious recovery (fuel shortage, emergency, etc), a basic cell penetration may be made in the following manner:

a. Holding airspeed will be 300 KCAS. When descent is to be commenced, the tanker will inform the receivers that he is decelerating to 260 KCAS to lower landing gear. After landing gear is down, he will accelerate to 300 KCAS and start penetration, maintaining 4000 FPM rate of descent.

b. Upon completion of the penetration, and when VFR, the receivers will break off and enter initial for a VFR landing.

NORMAL FLIGHT CREW PROCEDURES (AMPLIFIED CHECKLISTS)

REFUELING PROCEDURE (PROBE AND DROGUE)

PRECONTACT

Note

- Do not extend the probe for extended periods of time when not actually refueling, since fuel in number 1 fuselage cell will drain into the external tanks and wing tanks when the probe is extended.
- If practice or simulated hookups are to be made, the refuel switch should be placed to the EMERG position, to prevent possible siphoning and maintain normal operation of the transfer pumps.

1. IFR Probe – CYCLE.
   Several minutes prior to tanker rendezvous, cycle the IFR probe.

   Note

   Any difficulty experienced may be due to moisture freezing on the probe doors. Therefore, when difficulty is experienced, descend to a lower altitude to dissipate any ice that may have formed in the probe doors.

2. Pusher Switch – OFF.

   Note

   Approach the tanker from the rear and slightly below the refueling drogue. Maintain a position approximately 100 feet aft and 50 feet below the drogue until airplane is trimmed and formation speed is determined.

3. Flap Lever – AS REQUIRED.

PRECONTACT (Cont)

4. IFR Probe Switch – EXTEND.

CAUTION

- The rain clearing blower will normally not be used during probe refueling, prolonged use of this system in flight causes cracking and failure of windscreen left quarter panel. The rain clearing blower may be used if fuel spray is causing visibility restrictions.

- If a delay is encountered in hooking up with the tanker after the probe is extended, the wing tanks could become full of fuel drained from number 1 fuselage cell. The surge created by initiating the refueling cycle could start a siphoning action resulting in the loss of wing fuel and the possibility of collapsing the wing tanks. When an extended delay is encountered with the probe extended, the pilot should transfer fuel from the wing tanks to fuselage cells before a hookup is attempted. This is accomplished by placing the IFR probe switch to EMERG and the wing transfer switch to NORMAL. Upon illumination of the empty tank light, place the IFR probe switch to EXTEND and proceed to hook up.

Note

Maintaining a 2 to 3 knot rate of closure, fly the probe nozzle into the drogue cone. After contact is made, slowly fly drogue forward and to the left within the envelope shown in figure 4–1. Maintain a steady position after hookup. Smooth and precise pitch and bank control is essential to safe refueling operations.

5. Fuel Quantity Gage Selector – TOTAL
   With fuel quantity gage tank selector knob in the TOTAL position, note refueling progress by observing the airplane's fueling quantity gage. The refueling progress of the wing and external tanks can be checked by observing the full fuel indicators.

Note

Fuel flow from the tanker is automatically shut off when the receiver tanks are full.

6. Probe Light Switch – AS REQUIRED.

POST CONTACT

1. Probe Light Switch – OFF.
2. IFR Probe Switch – RETRACT.

CAUTION

After the refueling cycle is complete and the probe is retracted, the pilot should immediately transfer some fuel from wing tanks to stop any siphoning action that may have started during the refueling cycle.

3. Flap Lever – RETRACT.
   If wing flaps have been extended, retract flaps
4. Pusher Switch – ON.
5. Fuel Quantity – CHECK.
6. Airspeed – CHECK.

REFUELING PROCEDURES (BOOM)

PRECONTACT

Note

Do not extend the receptacle for extended periods of time when not actually refueling, since fuel in number 1 fuselage cell will drain into the external tanks and wing tanks when receptacle is extended.

1. Air Refueling Receptacle – CYCLE.
2. Pusher Switch – OFF.

PRECONTACT (Cont)

3. Flap Lever – AS REQUIRED.
4. Boom IFR Switch – EXTEND.
5. Fuel Quantity Gage Selector – TOTAL.
6. Ready Indicator (Green) Light – ON.
   Ready indicator (green) light on indicates receptacle extended.

CAUTION

If a delay is encountered in hooking up with the tanker after the receptacle is extended, the wing tanks could become full of fuel drained from number 1 fuselage cell. The surge created by initiating the refueling cycle could start a siphoning action resulting in the loss of wing fuel and the possibility of collapsing the wing tanks. When an extended delay is encountered with the receptacle extended, the pilot should transfer fuel from the wing tanks to fuselage cells before a hookup is attempted. This is accomplished by placing the IFR probe switch to EMERG and the wing transfer switch to NORMAL. Upon illumination of the empty tank light, place the IFR probe switch to NORMAL, and proceed to hookup.

Note

- Ready indicator light off indicates boom is locked in receptacle.
- Fuel from the tanker is now transferred to the receiver. Check the refueling progress by observing the airplane's fuel quantity gage. The refueling progress of the wing and external tanks can be checked by observing the full fuel indicators.

If disengaged light (amber) illuminates before refueling is complete:

7. Reset Button – DEPRESS.
8. Ready Indicator (Green) Light – ON.
9. Boom Electrical Disconnect Switch – DEPRESS.

   When the required amount of fuel has been transferred, initiate electrical disconnect.

CAUTION

If making an outer limit disconnect, high rate of separation should be avoided to prevent damage to the boom or the receptacle.

POST CONTACT (BOOM)

1. Disengage Indicator (Amber) Light – ON.
   Disengage indicator (amber) light on, indicates boom and receptacle disengaged.
2. Boom IFR switch – RETRACT.
   Disengaged light will go out when the receptacle is retracted.

CAUTION

After the refueling cycle is complete and the receptacle is retracted, the pilot should immediately transfer some fuel from the wing tanks to stop any siphoning action that may have started during the refueling cycle.

3. Flap Lever – RETRACT (IF REQUIRED).
4. Ready Indicator (Amber) Light – OUT.
5. Pusher Switch – ON.
6. Fuel Quantity – CHECK.

SECTION V
EMERGENCY AIR REFUELING PROCEDURES

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BREAKAWAY PROCEDURE

When a crewmember aboard either the tanker or the receiver determines that an emergency exists, he will transmit, on air refueling frequency, the tanker's call sign and the word "Breakaway" three times. Example: "Chevy 2, breakaway, breakaway, breakaway." For KC-135 boom and all KC-97L air refueling the boom operator will turn the receiver directors lights OFF and ON rapidly. This call is used to notify the tanker and receiver of any abnormal condition which would require an immediate vertical and horizontal separation of the aircraft. This will include, but not be limited to, excessive rate of closure, closure overrun and engine failure. The airplanes do not necessarily have to be in contact-made to call a breakaway. Relative position of both airplanes must be monitored closely by the tanker and receiver crewmembers during all phases of air refueling. If the tanker desires a breakaway while operating with loss of interplane communications, the crewmember will state on interphone, "(Tanker call sign), breakaway, breakaway, breakaway," and the boom operator will turn the receiver director lights OFF and ON rapidly for KC-135 boom and all KC-97L air refueling. Should the receiver initiate a breakaway during loss of interplane communications the tanker crewmember observing the breakaway will state on interphone "(Tanker call sign), breakaway, breakaway, breakaway," and the pilot will initiate the breakaway procedure. The following action will be taken simultaneously by the indicated crewmembers:

a. Tanker pilot-Increase power, if available, to obtain forward separation. When clear of the receiver, climb straight ahead with wings level. Direct copilot to return beacon lights to BOTH ON and position lights to BRIGHT.

b. Receiver pilot-Actuate disconnect switches as applicable. Retard throttle(s) and establish a definite rate of descent, using drag devices if necessary. If possible, drop aft of tanker until entire tanker is in sight and monitor flight instruments.

SYSTEMS MALFUNCTIONS

When any system malfunction or condition exists which could jeopardize safety, air refueling will not be accomplished except during fuel emergencies. At any time fuel syphoning is noticed, fuel transfer will be stopped and the receiver notified. The requirement to continue fuel transfer will be at the discretion of the receiver pilot.

Note

A small amount of fuel spray from the nozzle and receptacle during fuel transfer does not require fuel transfer to be terminated. The receiver pilot should be notified if this condition exists and the air refueling operation will be continued or discontinued at his discretion.

If tanks fail to take fuel, the following procedures may be accomplished to correct the situation:

a. While air refueling with probe and drogue:

(1) Check probe switch to insure that it is in EXTEND and not EMERGENCY position.

(2) Recycle probe.

(3) Pull transfer pump circuit breaker.

(4) Extend air refueling receptacle to insure that air refueling system is alerted.

(5) Make a more positive contact with drogue.

(6) Try another tanker if available.

(7) If all of above fails, request boom operator to retract boom and extend halfway. Make contact with drogue and request boom operator to slowly extend boom to fully extended position.

b. While air refueling with boom and air refueling receptacle:

(1) Recycle receptacle.

(2) Depress reset button after depressing disconnect button.

(3) Pull transfer pump circuit breaker.

(4) Extend probe to insure that air refueling system is alerted.

(5) Use another tanker if available.

INOPERATIVE BOOM/RECEPTACLE LATCHING

When all other recognized means of fuel transfer have failed, and a bona fide fuel shortage emergency aboard the receiver aircraft exists, fuel can be transferred by maintaining boom/receptacle contact using a slight extend pressure on the boom telescope lever.

CAUTION

Prior to attempting this method of transferring fuel, the boom operator will brief the receiver pilot and thoroughly coordinate the procedures to be used. Both tanker and receiver crews will monitor the refueling with extreme caution.

The boom operator must apply only the minimum required extend pressure to maintain adequate boom/receptacle seal, preventing excessive fuel leakage. Unusual and varying trim changes may be required of both tanker and receiver aircraft. Excessive pressure may push receiver aircraft outward and place undue stress on the boom telescope mechanism

The boom operator must anticipate receiver relative movement to maintain contact during receiver deceleration and must be especially alert to relieve extend pressure during sudden receiver closure.

CRASH LANDING, DITCHING, OR BAILOUT

If an emergency occurs which necessitates a crash landing, ditching, or bailout, an airplane designated by the leader will accompany the disabled airplane or will cover personnel at a safe distance above the surface. The designated airplane will render all assistance possible, orbiting the area until aid arrives or until fuel supply requires leaving the area.

BRUTE FORCE DISCONNECT

CAUTION

A brute force disconnect is a last resort. When all normal methods of disconnect fail, a tension (pull-out) force on the nozzle will effect a disconnect.

CAUTION

It is not necessary to jerk the boom out with IDLE power and speed brakes. This method has caused serious structural damage. A gradual reduction in power will suffice to disconnect.

EMERGENCY OPERATION (PROBE AND DROGUE)

If the probe is damaged during refueling and cannot be retracted, the IFR probe switch should be placed in the EMERG position which will establish emergency continuity to the fuel control panel, stop the rain clearing system, relieve utility hydraulic pressure against the probe, and prevent further damage to the airplane.

EMERGENCY OPERATION (BOOM)

If the receptacle is damaged during refueling and cannot be retracted, leave the boom IFR switch in the EXTEND position and place the IFR probe switch to the EMERG position. This will establish emergency continuity to the fuel control panel, extend the probe, stop the rain clearing system, and prevent further damage to the airplane.