Our 50th Year

flying SAFETY

Global Reach -Tanker Style

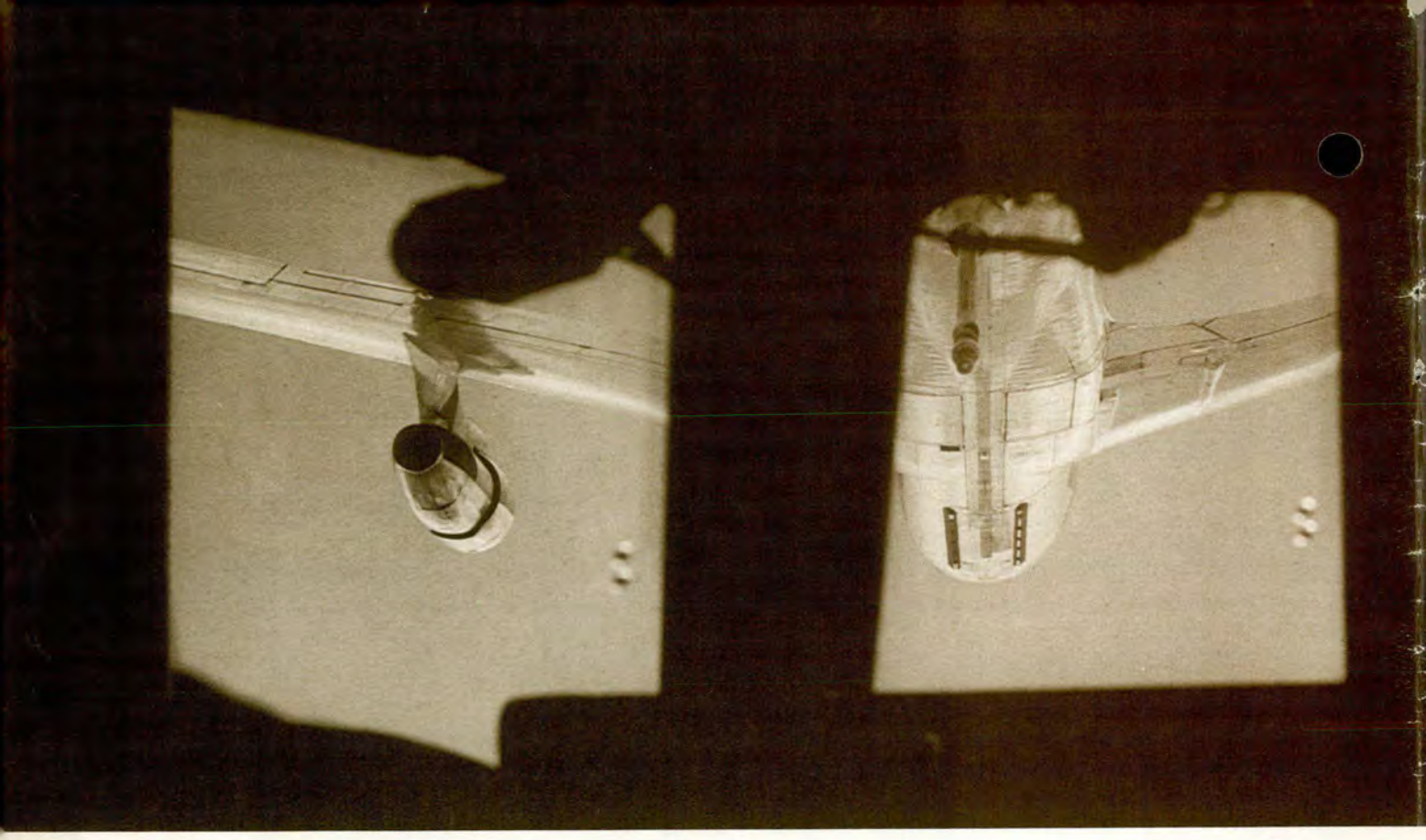
Night Air Refueling

Air Refueling & ATC

F.A.C.T.S. Team: Providing Maintainer Support

FEBRUARY 1994

SPECIAL AIR REFUELING ISSUE PART 1



In This Issue...

■ This month we depart from our normal format to focus on a topic which plays a major role in providing Global Reach for America — *Air Refueling*.

While there are some tragic air refueling mishaps in our past, air refueling operations in the Air Force as a whole remain relatively safe. The risk our aircrews and aircraft are exposed to is minimal because of proper training, proficiency, standardized procedures, and discipline. When one of these key ingredients is missing, however, the risk to all parties rapidly increases.

Coordination between tankers and receivers, and for air refueling training missions, is one area we sometimes gloss over. Perhaps it's because we've listened to hundreds of air refueling briefings and flown the same profile to the same AR track so many times we're positively sure the jet could get there on its own.

Or perhaps there is another part of the mission you are concerned with, and air refueling is just another event you need to get out of the way for currency. Just one more rendezvous or contact to keep us "current."

But what we sometimes forget is the reason we're doing all this training.

We practice air refueling procedures over and over again for the time when it's a dark and stormy night and *the mission is real.* When you're over nothing but a black abyss and every minute airborne equals another day's swim. When the St. Elmo's fire is so heavy on your windscreen it looks like a Kansas thunderstorm. And, even though its 40 below, the whole backside of your flight suit is drenched with sweat.

We practice all those many hours because as the nozzle light on the end of the boom passes over your head, or you line up on the drogue, *you know* with all that's going on you can *"get the gas."*

Back in November, we asked people from several key agencies (and most weapon systems) to write articles for *Flying Safety* magazine. This issue and the next will take a close look at air refueling from their perspective.

Our purpose is not to set policy or be the "last word" on the subject. We just want to give you a feeling for "what the other crew" is thinking. We also wanted to highlight scheduling and flight planning issues you may not be aware of or haven't thought about for a while. If you happen to know any of the people who contributed articles to this endeavor, take time to thank them for their contribution—we're all a lot busier these days.

Whether you found these articles helpful or not, we would like to hear from you. In the end, if everyone is a little more aware of the other crew's perspective and how important it is to coordinate with each other, *Flying Safety* magazine has served the mission of mishap prevention.

And remember, the next time you go out to fly that routine air refueling mission, take the time to call the other pilot or crew the schedule says you'll be meeting on the track. You'll be surprised how much smoother things will go.

Fly safe. Fly smart! ■

Our 50th Year

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SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE CHIEF OF SAFETY, USAF

PURPOSE — *Flying Safety* is published monthly to promote aircraft mishap prevention. Facts, testimony, and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in mishap stories are fictitious. The contents of this magazine are not directive and should not be construed as instructions, technical orders, or directives unless so stated. **SUBSCRIPTIONS** — For sale by the Superintendent of Documents, U.S. Government Printing Office (USGPO), Washington D.C. 20401; send changes in subscription mailings to the USGPO. Back issues of the magazine are not available. **REPRINTS** — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments. **DISTRIBUTION** — One copy for each three aircrew members and one copy for each six direct aircrew support and maintenance personnel. Air Force units must contact their base PDO to establish or change requirements.

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THERE I WAS.

■ The sky was crystal clear with scattered "puffies" from 4,000 to 10,000 feet. I couldn't believe the Air Force paid us for doing something I enjoyed so much. Having just passed 500 hours as an IP in the mighty "Tweet," I felt nothing could go wrong I couldn't handle.

My student was scheduled for his spin orientation ride, so after a thorough ground briefing, we leaped off (if you can say "leap" in a T-37) into the wild blue yonder.

The mission was normal, and the student was doing quite well for this phase of training. I started the spin instruction as we had briefed on the ground, and after the tell-and-show portion, I let the student have a go.

We all remember the apprehension each student has during his first spin in an aircraft. Today was no different. I took control of the aircraft a few times until he finally got it right.

When the student achieved the desired level of proficiency, I decided to finish up by showing him some aerobatics, then "head for the barn." Since the day was still VMC and I could see the base, I started the descent without accomplishing the "descent checklist."

The scattered "puffies" proved too good to be true. I started to whip in and out of the clouds, dragging a wingtip in the clouds during each high-G turn. The student was eating it up, and, before too long, he asked if he could try it. "No sweat, GI," and I gave him control.

The first few descending turns were a little meek, so I told him to G it up a little or we wouldn't get down in time to enter the VFR entry point. The next thing I knew, he pulled 4 Gs to the left, and into the clouds we went. I took control of the aircraft immediately and went to the instruments.

What I saw sent a cold chill down my back. All the instruments seemed to be spinning — nothing was right — I had forgotten to do the instrument checks after the spinning and aerobatic maneuvers (descent checklist).

When was the last time you had to use the turn and slip indicator for real? I couldn't get it to work right. "I'm in real trouble now!" I thought. I felt the aircraft shudder — airspeed falling off — altitude climbing — "when am I going to pop out of this cloud?" I froze the controls to let the aircraft settle down.

The next thing I saw was airspeed increasing and altitude rapidly unwinding. All I could think was "the cloud isn't that thick, and we're going to break out soon." Those few seconds seemed like a lifetime, and I had decided, if we reached 5,000 feet — still in an out-of-control condition — ejection was the next step. However, as luck would have it, we broke out passing 5,200 feet in a high-speed dive. I recovered the aircraft and headed for home.

The cockpit was very silent while I was thinking how stupid I had been. First, the use of checklists is always required in any type of weather. So use them! Second, I had violated the VFR rules, and that had almost caused me to "buy the farm." Needless to say, it hasn't happened again — I suppose this is what they mean by *experience*! ■

Global Reach-Tanker Style

MAJOR CLIFFORD M. SANCHEZ
HQ AMC/XOVK
Scott AFB, Illinois

Air Refueling Issues

■ "The ultimate USAF long-range goal is the establishment of a single tanker force equipped to provide support to all combat operations requiring air refueling. Our procedures should be simple and standardized to enhance safety."

Curtis E. LeMay
General, US Air Force
24 February 1959

These words were written in a time when the United States of America was committed to winning the Cold War. Bombers and their supporting tankers demonstrated their ability to reach destinations on a global scale. In Vietnam, the ability to sustain tactical aircraft over target areas for long periods of time was exploited.

Desert Shield and Desert Storm once again demonstrated to the world the global reach capabilities of air refueling. Forces were airlifted directly to the theater (nonstop) and fought the air war. From the Cold War to the sands of Somalia, we all share one common denominator, the air refueling tanker.

Thirty-five years have passed since General LeMay envisioned a single tanker force for combat operations. Now, every major exercise, deployment, contingency operation, and conflict including *Cope Thunder, Red Flag, El Dorado Canyon, Just Cause, Restore Hope,* and *Southern Watch* involve air refueling operations with the tanker fleet.

The USAF has obtained its goal for a tanker force but still faces the continuous challenge of standardizing "our procedures." The issues we face today are centered around air refueling procedures. I'll address how our procedures were written, maintained, and altered in today's environment. Finally, I will provide some insight on how air refueling issues are being solved.

In 1956, Boeing's new KC-135 air refueling tankers were being delivered in large quantities. The aircraft was fast, had a "flying boom" for probe refueling, and carried enough fuel to extend the range of bombers anywhere in the world.

Simplified procedures were written providing guidance to aircrews on the delicate maneuver of "midair refueling." Formations, radio communications, altitudes, airspeeds, limitations, checklists, and emergency procedures were covered. This was the beginning of modern air refueling procedures.

On June 1, 1991, the United States Air Force reorganized its forces to enhance the global reach-global power concept. Air Mobility Command (AMC) assumed the role of single tanker force manager. AMC's tanker fleet is composed of over 285 active duty KC-135s, 172 Air National Guard, and 47 Air Force Reserve aircraft.

In addition, 59 KC-10s are divided between AMC and Air Combat Command (ACC). Theater commanders in PACAF and USAFE have small groups of KC-135s to support local forces. Air Education and Training Command (AETC) assumed the overall training responsibilities for the KC-135 and operate 28 aircraft. AMC's Tanker Airlift Control Center (TACC) directs the execution of global air refueling and

continued

Global Reach-Tanker Style continued

acts as the single point of contact for tanker operations.

The marriage of airlift and air refueling has significantly enhanced the "global reach" capability of the Nation. However, five important issues have surfaced as a result of the reorganization.

Air refueling has significantly enhanced the "global reach" capability of our Nation.

First

MIL SPEC 38413 prescribes the format and, to a limited extent, the content of all air refueling flight manuals. The MIL SPEC calls for basic and supplemental manuals for all USAF aircraft capable of performing in-flight air refueling. The KC-135 manual is officially titled TO 1-1C-1-3 (Dash-Three).

When a new aircraft enters service, a new air refueling manual is drafted for the aircraft in conjunction with basic flight manuals. The new manual follows MIL SPEC 38413 format and prescribes information from in-flight testing and existing air refueling procedures. From the Dash-Three, receiver manuals are drafted. As a result, although the manuals (and procedural guidance) are similar, no two manuals are the same.

Aircrews (both tanker and receiver) carry "only the manuals that apply to their aircraft." Aircrews seldom have access to "other aircraft" manuals. This practice we refer to as "one hand doesn't know what the other hand is doing." Despite constant review, getting two receivers to change "the way they have been air refueling for years" is almost an impossibility. This is the major reason aircrew mission briefings are critical.

Action Taken A plan was conceived to revise MIL SPEC 38413. The plan recommends adopting a five-manual system. The five manuals will incorporate common information into a single manual everyone will carry.

Aircraft-specific information will be broken out into four separate supplemental manuals conceptually called tanker, heavy receiver, fighter receiver, and specialized aircraft procedures. The new MIL SPEC will require the critical "common" information be carried by all. When a procedure changes, it changes for all — simple and standardized procedures to enhance safety.

Second

The KC-135 and KC-10 fleet operate in eight MAJCOMs. Change or modification to procedural guidance (using AF Form 847, Recommendation for Change) must be coordinated through each MAJCOM's command channels. A single change to communication, formation, or safety procedures becomes a drawn out labor-intensive exercise in mailing, phone calls, negotiations, and screaming FAX machines. Unless the action affects safety, change affecting all air refueling manuals does not occur simultaneously. Minor changes can take up to several years and may or may not apply to other aircraft.

Action Taken Revise MAJCOM directives clearly defining command channels. Feedback from the aircrews performing the mission is critical. Exploit advanced technologies to process and coordinate change to flight manuals. Use advanced technologies including computer networks, CD ROM, color printers, and EMail to communicate receivers and tanker requirements efficiently.

Third

Fuel accounting has recently emerged as a major issue. For years, fuel accounting was controlled as a central fund for all Air Force units. Tankers would pump fuel to USAF receivers (in huge quantities) with little concern for who got the bill. Non-USAF receivers (Navy, NATO, or other foreign aircraft) were accounted by unit and eventually billed by the USAF.

Today, tanker units must account for all fuel transferred to all receivers. If the tanker fails to receive the information, the tanker unit pays the bill. Fuel accounting must be documented by unit and tail number before the mission or communicated in flight by the crews.

The additional communication requirements alter emission control procedures (in-flight radio communication restrictions) and cause

Users of this air refueling capability should have *full knowledge* of how it is done.

aircrews and planners additional labor to closely track receiver units by "tail numbers." In-flight tanker crews facing waves of receivers hungry for fuel must expend the labor to track and account for all offloaded fuel.

Action Taken Fuel accounting, unfortunately, will always be a part of air refueling. Once again, advanced technologies can quickly fix this problem. When fuel is transferred, a device can read the receiver's information, amount of fuel transferred, and make a printout available to crews.

The new device will automate fuel accounting. In the short term, a proposal to paint tail numbers near the air refueling receptacles is in the works. Until the initiatives are complete, unit and tail numbers will continue.

Fourth

Desert Shield and Desert Storm proved the utility of air refueling. Forces around the world realized the need for tanker support and are now building unique air refueling aircraft. In Europe, a new document prescribing air refueling for NATO aircrews took aircrews by surprise. For the first time, allied aircrews can look at a single document and find out how other countries are performing air refueling.

USAF and Navy tanker information was incorporated in ATP-56. The document (available to all DOD users) is listed as an Air Force Joint Publication (use Air Force Index 4, ATP56 NATO Allied Tactical Publication 56 to order). However, while ATP-56 establishes refueling procedures for NATO tanker and receivers, USAF aircrews use procedures outlined in USAF flight manuals. ATP-56 information has not been incorporated in USAF flight manuals.

Action Taken The next generation of air refueling manuals will incorporate ATP-56 information directly into the text of USAF manuals. After a careful review, procedural differences have been ironed out. Change one to the international air refueling document should be ready by summer of 1994. Just another case of "one hand not knowing what the other is doing."

Fifth

With the downsizing of the US military, many areas of training and testing are being performed by civilians. Civilian pilots, under DOD contract, are flying aircraft like NASA SR-71s conducting high-altitude research and the Navy's AEGIS training support F-4s. Each aircraft periodically requires air refueling to support mission taskings or operational deployments (training capacity).

The air refueling procedures used by the civilian aircrews are unknown. Normally, Memoranda of Understanding (MOU) are established outlining provisions for air refueling including aircrew qualification, proficiency, scheduling, fuel accounting, and safety responsibilities. As of this date, no formal agreements exist for these types of civilian-piloted aircraft.

Action Taken Education is the vital ingredient in this issue. This article is just one of many forums. It is critical for program managers to understand and account for the civilianization of many training aspects. The Air Force reorganization has taken everyone into uncharted grounds. General LeMay prescribed "Our procedures should be simple and standardized to enhance safety." In today's environment, all users of the Nation's air refueling capability should have knowledge of how we do it, for our safety and yours.

Summary

I've highlighted the major issues affecting air refueling tankers. We have charted a course of action, addressing each issue specifically, and will continue to work and to improve our procedures. Undoubtedly, many new issues will surface as we continue to enhance the global reach-global power concept. Air Mobility Command and our Air Reserve Component are dedicated to providing the finest air refueling services available to all DOD customers. But one fact is clear — the tanker fleet will continue to provide safe global reach air refueling capability for the Nation well into the next century. ■

Night

LT COL EZEQUIEL PARRILLA, JR.
B-1B Central Flight Instructor Course (CFIC)

■ Day air refueling in the B-1B is a rather easy and enjoyable task. The jet is so stable and responsive, it is not unusual for a recent UPT graduate to get a good contact on the first attempt.

At night, however, the combination of decreased depth perception, distractions due to lighting, and the boom on the aircraft's nose make air refueling as much of a challenge as it is in any other aircraft. We will address some important points that will help you the next time you accomplish a refueling.

Preparation

Just as in any other activity, crew rest will be a factor on how well you perform. It is not good enough to get a good night's sleep and then spend the rest of the day doing light yard work or rebuilding your engine. It takes discipline to get proper crew rest during the day when your circadian rhythm is not quite in sync. It would be great if we could always get our bodies adapted to a night cycle before a night flight, but this is not always possible.

Before the rendezvous, adjust your seat position and interior lights to where you want them. Place your seat forward so you can rest your forearm on your thigh while holding the stick. This will help prevent a "death grip" on the stick.

Turn down your visual situation display and instrument lights as much as you can while still being able to read the instruments. The center and side consoles can cause reflections on the windshield which could be distracting, so turn them down also. Do this in a step-down process, starting as early as possible to give your eyes time to adapt.

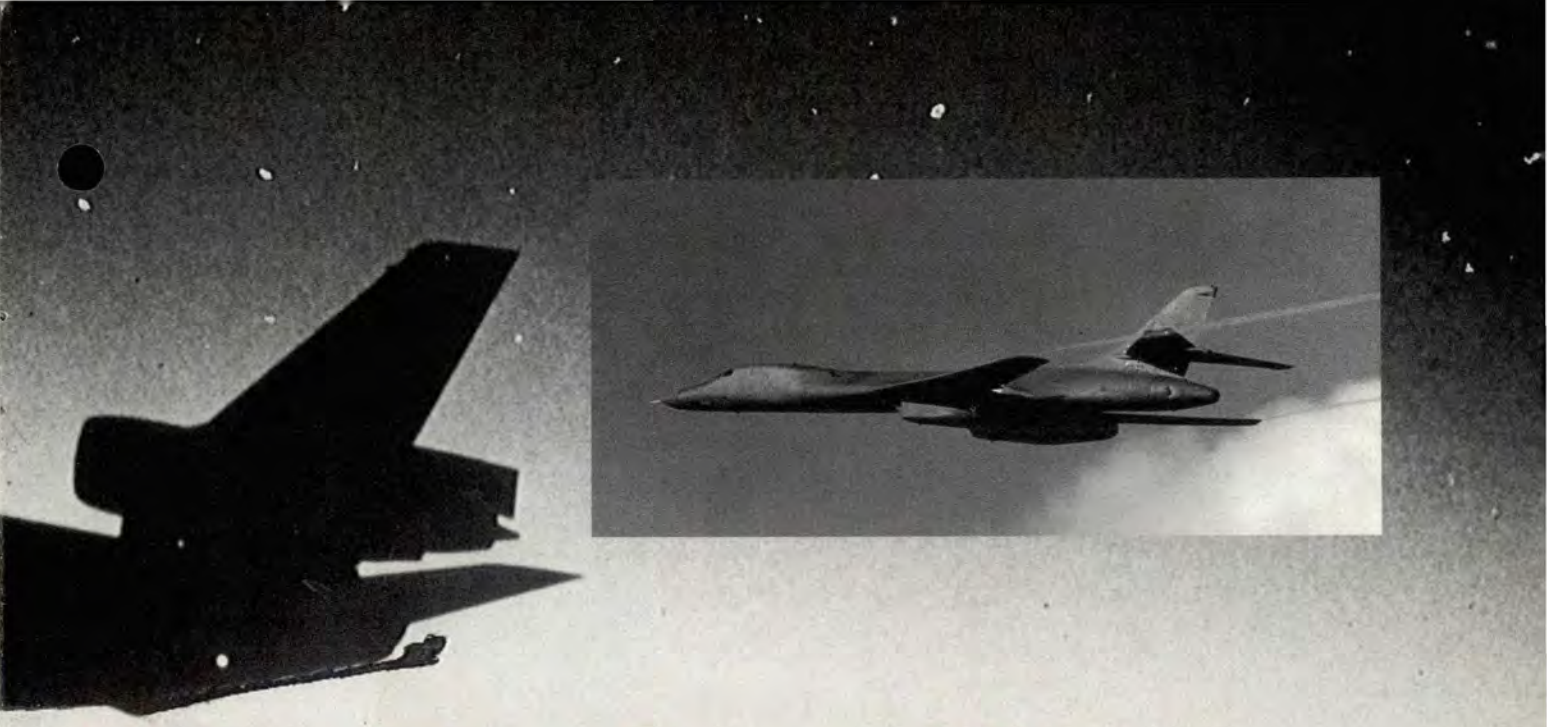
References

Depending on your seat position, the tanker will be approximately one-third of the way down the windshield, nearly level with the utility light on the canopy rail. If that does not work, look at the tanker's position in your windshield at 1 mile, 1,000-foot separation, then keep it in the same position until you can see the light on the boom shield.

To be on approximately the 30-degree line during approach to precontact, place the light on the boom shield level with or slightly below the two underwing lights underneath the aircraft. This approximates the daytime reference of placing the ruddervators on the wing's root.

If you are not the tanker's first receiver, the lights may have been dimmed during the previous refueling contacts. If the tanker lights are dimmer than usual, it will be a lot closer than it appears to be during closure to precontact. Ask the tanker to turn up its lights to help with your depth perception.

In the contact position, the lower edge of the ice shield should be barely covering the underwing light on the opposite side. The outboard nacelle on the opposite side should be just touching the air refueling nunciator light box for an "A" model, or the nacelle will be two-thirds in view above the top of the light box for "R" models.



Air Refueling

Patience

Patience is even more important for night air refueling than day. Once you start closing on the tanker, take your time in precontact and use slow closure rates. Make a small input, wait for it to take effect, and then adjust as necessary.

Judgment

If it's been a while since your last contact, keep in mind your personal proficiency may be degraded. Emission control (EMCON) is not sacred during a training mission. Many a boomer has talked an inexperienced receiver in to get the first contact.

Teamwork

Air refueling will work a lot smoother if you work as a team. The pilot not flying can help by pointing any tendencies (riding high/left, etc.), checking the fuel panel for main tank depletion and wing tank balance, and cross-checking engine instruments for asymmetrical thrust.

One of the best things a boom operator can do from our perspective is to leave the boom steady and not try to chase the receiver when moving left or right. This will remove one of the variables from the equation.

As a receiver, get your azimuth and elevation steady before you start moving to the contact position. Remember, the boom operator may draw the boom through the refueling floodlight to help determine your position. Be patient—don't chase the boom. The boom operator is merely trying to locate the aircraft.

Relax

Relaxing is another important aspect of air refueling. Staying relaxed will keep you from getting a "death grip" on the stick and from making large throttle/stick inputs.

The sage advice of "wiggle your toes" comes to mind here. Sometimes talking to yourself helps. Additionally, finding a "sweet spot" on the throttles so you can leave them in one spot and only need to move the stick helps also.

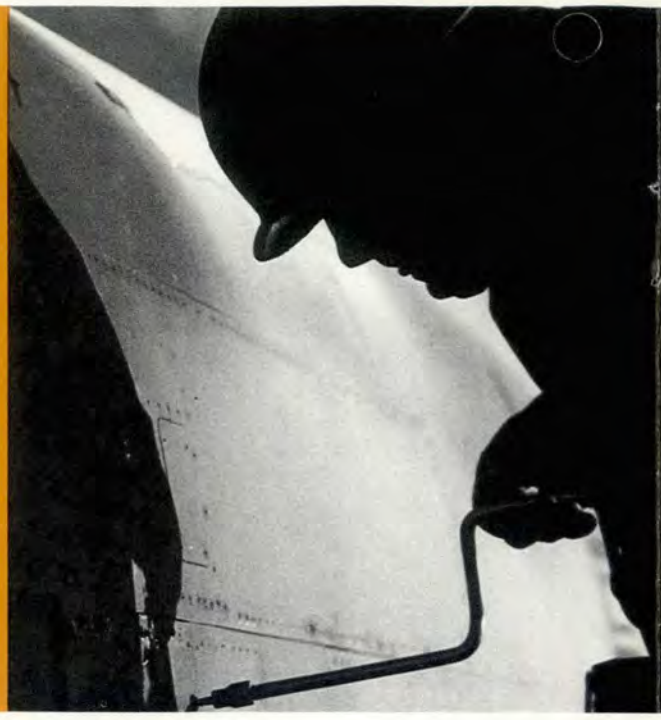
Generally, 5 minutes after contact, there is a tendency to start to flail for a minute or two before settling down, followed by another similar tendency to occur about another 15 minutes later.

Summary

Night air refueling is a vital part of our mission. It is also one of the most challenging aspects of flying the B-1B. However, proper rest, preparation, and teamwork will help make this a smooth operation which can give you bragging rights the next time you are at the club shooting your watch with your fellow aviators. ■

The F.A.C.T.S.* TEAM
Providing Maintainer Support

*Fasteners, Actuators, Connectors, Tools and Subsystems.



CMSGT DON A. BENNETT
Technical Editor

■ You've been there before ... more times than you'd like to remember. It's three-something in the morning, and crew show is minutes away for your jet's early launch. After hours and hours of troubleshooting, head-scratching, parts research, and repair action, all you have to do now is make a few connections, perform some ops checks, clean up your mess, and clear the forms ... right? Wrongo ... bucko!

I opened with "you've been there before" so you know something always seems to crop up to challenge your 3-digit on-time takeoff record. This time it's the ol' "system failed ops check" that rears its ugly head, and now your years of experience and expertise kick into overdrive to find the gremlin. With your assistant tending to the flightcrew and the line chief breathing fire down your neck, you finally come face-to-face with an old pain-in-the-bucket cannon plug whose reliability has always been highly questionable. There appears to be no rhythm nor reason why it fails and has been a source of frustration for so long that you've learned to "live with it ... that's just the way it is."

After you've gotten over the initial panic that you might have wasted many hours of hard work because you misdiagnosed the original writeup, you immediately lean forward again to remove and replace (all the while you're swearing and cussing) the troublesome cannon

Even though you know countless phone calls have been initiated over the years to correct the problem, it doesn't ease the agony of watching your jet make its late takeoff roll.

The little things in maintenance can become a huge burden in time, cost, and pure frustration. To fix it, you need

F.A.C.T.S.

...and they're just a phone call away.

plug. Even though you know materiel deficiency reports and countless phone calls have been initiated over the years to correct the problem, it doesn't ease the agony of watching your jet take its late takeoff roll. Just another day in the trenches, rolling with the punches, taking your lumps, etc., etc. Well, life does (and will continue to) have its ups and downs, but there is one way to eliminate some of the things that gnaw at you in the aircraft maintenance business, i.e., chronic problems with Fasteners, Actuators, Connectors, Tools, and Subsystems: FACTS.

Based on the results of a Scientific Advisory Board Study, the Air Force Chief of Staff issued a directive on 1 November 1989 establishing a combined Air Force Systems Command and Air Force Logistics Command function that would provide field service team visits to specifically identify and solve FACTS-related problems, emphasize process improvements, cut through the red tape for new FACTS technology, and be a sounding board for the maintainers in the field. There seems to be a black hole in the aircraft logistics community where unresolved, low-profile problems disappeared, therefore leading to greater frustrations for the aircraft maintainers and, in some cases, contributing to aircraft mishaps. It took a quality-enlightened Air Staff to finally bring FACTS-related problems to the surface and expend the resources necessary to solve them. Result: FACTS Project Office.

The FACTS folks are located at Wright-Patterson AFB, Ohio, and have a very distinct mission — to drive down costs due to FACTS-related deficiencies and improve FACTS reliability and maintainability. To accomplish this, there are six separate teams:

- CONNECTORS — focal point for hydraulic, electrical, mechanical, and fiber optic connectors (DSN 785-4226)
- FASTENERS — responsible for screws, rivets, latches, and other common or unique securing devices (DSN 785-0618)
- PROCESS — improves FACTS-related acquisition and support processes (DSN 785-7042)
- SUBSYSTEMS — improves accumulators, pumps, and ground equipment (gearboxes, braking systems, actuators, etc.) (DSN 785-9343)
- TOOLS — focal point for the commodity manager and the field customers in the management of FACTS tool projects (DSN 785-0601)
- ENGINEERING — provides engineering and technical expertise to the project teams (DSN 785-4712).

I know the FACTS folks can't help the hardworking knucklebuster above erase the late takeoff, but they can sure help put a stop to the chronic problem with the cannon plug. NO ... you don't have to continue to live with a known material, design, or performance deficiency that makes your job as an aircraft maintainer difficult. There is now someone who will listen to your problems and actively pursue a solution. "We will listen to every idea put to us," says SMSgt James Percy of the FACTS office. That promise is backed up by the boss, LtCol Sammy T. Saliba, and he emphasizes who the customers are that promise applies to: aircraft maintainers. He remarked during a recent interview, "We're looking from the maintainer's perspective ... from the ground

continued

There seems to be a black hole in the aircraft logistics community where unresolved, low-profile problems disappear. Now the F.A.C.T.S. team attacks that situation.

A F.A.C.T.S. Team project is typically a high volume, low cost item that causes frustration and falls below the cutoff of action items. The idea is not to replace other programs, but to resolve other problem areas.

The F.A.C.T.S. TEAM

continued

level up ... and our reception during field visits has been overwhelmingly good."

It is not within the FACTS team's scope of work to replace existing programs, i.e., quality and/or material deficiency reports, because those channels of problem solving do work. However, there are those problem parts that either fall to the wayside or do not fit neatly into a problem-solving category or program.

"A typical FACTS would be a high-volume, low-cost item that's causing frustration to the maintainers because it's usually ignored through normal channels, i.e., it falls below the cutoff of action items. Then it becomes an accepted way of life to the maintainer that this particular part fails," Colonel Saliba clarified. Several of many FACTS initiatives that have been successfully challenged:

1) C-130 Detent Latch: After coordination with Warner-Robins Air Logistics Center (WR-ALC), Robins AFB, Georgia, and the 317th Aircraft Generation Squadron, Pope AFB, North Carolina, the FACTS office identified a problem with the engineering drawing of the latch versus an actual machining problem with the detent latch assembly. Sample latches were found to be within the drawing tolerances, but mostly on the high side of the design specifications. FACTS engineering sent recommendations to clarify the drawing package which will prevent a recurrence of the vendor interpretation problem. Benefits: decreased maintenance man-hours and improved detent latch assemblies.

2) F-15 Chafeless Clamp: Again coordinating with WR-ALC, the FACTS folks tackled a problem with clamps chafing the titanium hydraulic lines used in the F-15 aircraft. Their research found a new clamp which was tested and found more suitable. The new clamp was stock listed, tech order updates initiated, and the new clamps were installed on F-15E production aircraft #51 and up.

3) A-10 Fuel Leak/Torque Wrench: Headquarters Air Combat Command was experiencing chronic fuel leak problems with the A-10 aircraft at pylon stations 4, 5, 7, and 8. The cause was determined to be

contributed to inadequate torque on pylon bolts due to severe space limitations to access the bolts. Working with Sacramento Air Logistics Center, McClellan AFB, California, a new torque wrench extension was designed, developed, tested, and approved. The results were significant fuel shop man-hour savings and a projected savings of $1.2 million over a 5-year period.

I talked with MSgt Dennis Moe, 92nd Maintenance Squadron, Fairchild AFB, Washington, in a phone interview about his experience with the FACTS Team. Sergeant Moe met the FACTS Team at Fairchild during one of the team's periodic field trips. As a Munitions Combat AGE Team Leader, he gave them a problem with the -86 Generator battery charger. When the charger was inoperative, Sergeant Moe reported, the manufacturer's tech data for the charger was inadequate or incomplete for troubleshooting purposes. He was surprised the team got back to him so soon after their departure from Fairchild. "My particular problem was handled very quickly. Within a week or so, I was contacted by the team that my problem met their program criteria and was accepted to work. Then within another week or so, they called again with a solution," said Sergeant Moe. His interview was characteristic of the other satisfied customers I've talked to about the FACTS program.

It took a Scientific Advisory Board Study with direction issued by the Air Force Chief of Staff to fight a longstanding battle for the down-in-the-trench aircraft maintainers. It was time to deal with those fall-through-the-crack, and seemingly insignificant, issues that caused a lot of grief and frustration for the maintainer over the past years. More importantly, the FACTS office provides a viable means to immediately address FACTS issues as they develop in the future.

With tongue in cheek, Colonel Saliba states they're prohibited in their charter from accepting action items that are strictly safety. "We do not want to interfere with the established procedures for reporting and working safety issues," expressed Colonel Saliba. However, I sensed the obvious pride the colonel and his staff have in their quest to continually enhance quality maintenance throughout the Air Force, which we all know directly contributes to safe ground and flight operations. ■

AIR REFUELING &

CAPTAIN KEVIN JONES
Advanced Instrument Flight Course
KC-135 Instructor
Castle AFB, California

■ With all of the changes which have taken place in the military during the last 2 years, it's comforting to know one aspect of the tanker business has remained constant. The rules for air refueling haven't changed. The only problem tanker crews have now is finding out where those rules are written down.

During the reorganization, our regulation binders slimmed down considerably, but one of the good regs, SACR 55-3, *Airspace Management*, is noticeably absent. Although 55-3 is dead and gone, all of the valuable information it contained (including the pictures) hasn't been lost — it can be found in Chapter 10 of FAA Order 7610.4, *Special Military Operations*. If you don't have a copy at your unit, your local base ops or approach control should have a copy.

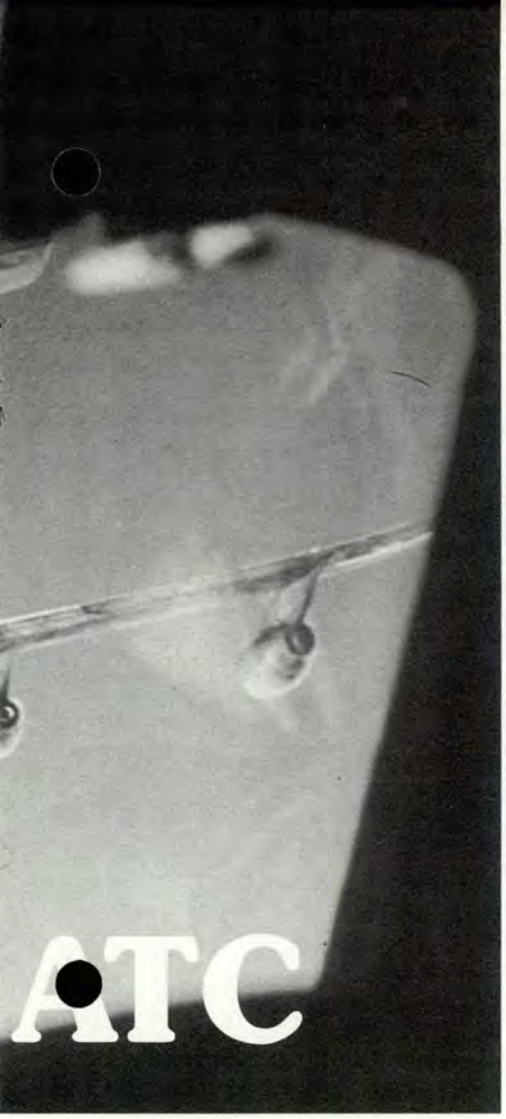
Almost all of the answers to the air refueling questions we field here at the Advanced Instrument Flight Course can be found in 7610.4. In this article, I'll go over some of the most common questions and answers.

Most of you are familiar with the nuts and bolts of filing flight plans because FLIP General Planning covers filing air refueling tracks and anchors very well. There are a couple of items which are worth mentioning though. Here are some of the most commonly asked questions about filing.

Filing

"If we are refueling in an anchor area, can the tanker file directly to the anchor point?"

The answer, of course, is "It depends." AP1/B says when "either FAA Center Radar or Ground TAC Radar is operative, a tanker may proceed to the Anchor Point without crossing an Entry Point." FAA Order 7610.4 states the "tanker entry point (track/anchor) will be the ARCP/anchor point and should be located to permit direct routing." Since the vast majority of anchor areas require radar to be operational in order for



the anchor to be used, in most cases, the tanker can file directly to the anchor point. If you're not sure, contact the ATC facility that controls the airspace. The center controlling the airspace also must have the anchor point loaded into their computer as an entry point or the computer won't take your flight plan.

"How do I file to refuel in a military operating area (MOA) or a Restricted Area?"

FLIP General Planning gives pretty good guidance on how to file special use airspace delays. The instructions are a little generic, mainly because most of the filing procedures for special use airspace are outlined in letters of agreement between the unit who owns the airspace and the ATC agency controlling it.

If there is no letter of agreement (or you don't have a copy of it), follow the instructions in General Planning which basically tell you to determine an entry point for the airspace and enter that fix as the last item in your route of flight. Don't put anything in the "TO" block, and enter the time it takes to fly to your last fix in the "ETE" (estimated time en route) block. Explain the delay as a remark on the next line. Do not make entries in any other blocks on this line. Precede the delay remark with a circled "R" to indicate the information should be transmitted as a remark. After the circled "R," indicate the time of the delay, the location of the delay (use plain English if you have to), and then your final destination.

"When I refuel in an anchor area, should I subtract the delay time from my ETE?"

For all you old guys out there, the rules found in FLIP for computing the ETE have changed. For tanker crews, the time planned for en route delays associated with air refueling is always included in the ETE, no matter where you plan to refuel — random, track, or anchor.

"What should I put in the 'remarks' section of the flight plan?"

This section of the flight plan always generates a big "fur ball" because there are so many opinions on how the remarks section should be filled out. Bottom line: The flight plan is a form used to convey the pilot's wishes to the controller, and there are only a few remarks *required* by ATC. According to 7610.4, one bit of information required in the remarks is the altitudes you'll be requesting for refueling. Your local agencies (ATC, squadron policy, etc.) may direct you to include other information.

One good thing to keep in mind is the fact as few as 21 characters of your remarks may print out on the controller's strip, depending on how his center's computer is configured. Therefore, put the most important remarks first, and abbreviate them to the shortest recognizable form. All of the standard abbreviations we used to have in SACR 55-3 can be found in FAA Order 7340.1. Your base ops should have a copy.

Those are just a few of the questions we hear about filing. Let's get airborne now and try to answer some of the questions which come up concerning air refueling clearances and air refueling airspace.

Air Refueling Clearances and Airspace

"What clearances am I required to get in order to air refuel?"

FAA Order 7610.4 says the tanker commander has to receive specific clearance from ATC for the following situations:

- Altitude blocks to conduct air refueling operation,
- Routings for each aircraft or formation flight if different than the

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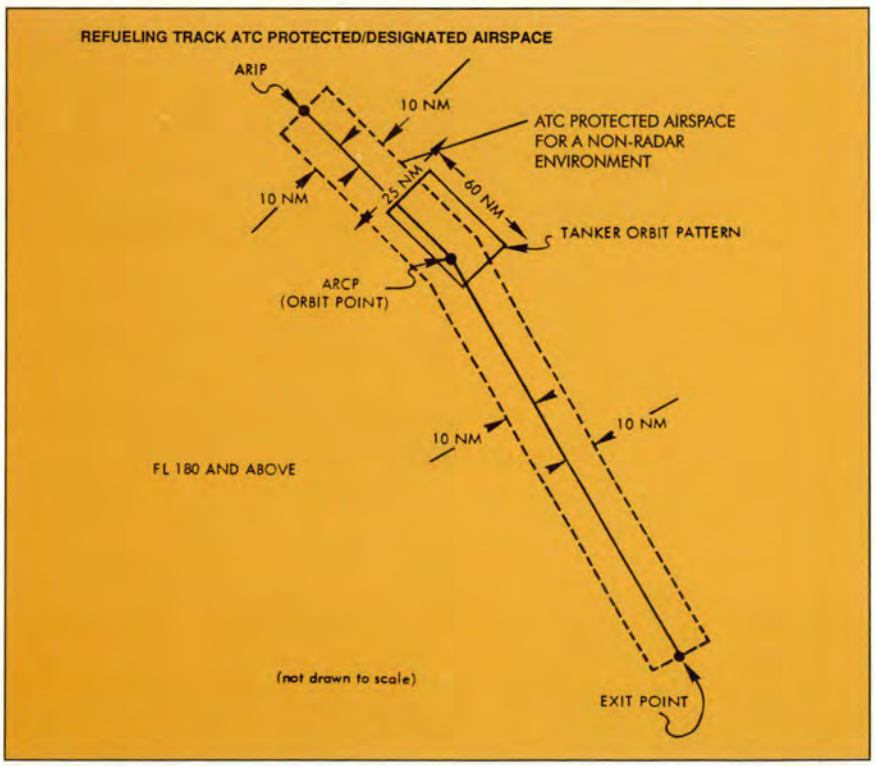



The mission
began as a...


Routine
Training
Mission

AIR REFUELING & ATC continued

flight plan routing,

■ Extending the refueling operations beyond the defined track/anchor exit point, and

■ Additional altitudes in excess of those for which specific clearance has been granted.

The old acronym "DBAM" still works great. The "D" is for *delay*. If you filed a delay in your flight plan, and you were "cleared as filed," then you don't have to ask for permission to delay. However, it's a good idea to request it anyway just to give the controller a heads-up. It also gives you an opportunity to tell ATC how long you expect to delay waiting for your receivers. It's a courtesy call, and ATC expects to hear it.

"B" is for *block*. Request the block altitude you need to accomplish air refueling. Remember, 7610.4 directs tankers to "give back" any portion of the block no longer needed.

"A" stands for *air refueling clearance*. When conducting a point-parallel rendezvous, "cleared to conduct air refueling" is the magic phrase which clears the tanker to leave its orbit area and proceed as far towards the air refueling initial point (ARIP) as necessary to pick up the receiver. Tankers are required to notify their receivers when air refueling clearance has been obtained.

"M" stands for *MARSA* (military assumes responsibility for separation of aircraft). MARSA is the magic word ATC is waiting to hear in order to clear us to air refuel. MARSA begins when the tanker advises ATC it is accepting MARSA with its receiver. MARSA ends when the tanker advises ATC the tanker and receiver aircraft are vertically positioned within the air refueling airspace and ATC advises MARSA is terminated. Once the rendezvous is complete, the tanker is required to keep its receiver(s) within 3 miles until MARSA is terminated.

Once we finally get cleared for all the actions necessary to complete the rendezvous, our next concern is the airspace we're required to remain within.

The orbit airspace is contained in a rectangle 60 miles long (48 nm uptrack and 12 nm downtrack from the ARCP) by 25 miles wide oriented longitudinally along the ARIP to air refueling control point (ARCP) line. It provides 18 nm of protected airspace on the holding side and 7 nm on the nonholding side. The pattern is normally designed for left-hand turns. (See Figure on page 13) from 7610.4.

The "clearance to conduct air refueling," unless otherwise restricted by the controlling ATC facility, authorizes the tanker to extend the orbit pattern and proceed toward the ARIP as far as necessary to effect the rendezvous. During the period the tanker is proceeding toward the ARIP to conduct the rendezvous, the lateral protected airspace is the same width as the orbit assigned airspace (18 nm on the holding side and 7 nm on the nonholding side).

"Don't we have 10 miles either side of centerline to work with on an AR track?"

This question is referring to the mythical "10-mile corridor." There is no such thing as a 10-mile corridor. We are given some latitude during the rendezvous, but once the rendezvous is complete, FAR 91.181 requires pilots to maintain centerline. ATC expects pilots to be on the black line. If you need to deviate from course for whatever reason, just ask. More than likely, your request will be approved.

"Is the air refueling airspace protected from other aircraft?"

Only during the rendezvous. After air refueling clearance is received and until rendezvous is completed, air refueling airspace from the ARIP to the ARCP is sterilized. After the rendezvous is completed and the tanker/receiver(s) proceed downtrack, other nonparticipating aircraft may be cleared through the refueling block airspace with proper separation. (In the airspace we normally refuel in, "proper separation" is usually either 5 nautical miles or 1,000 feet vertically.)

"Does the tanker have to coordinate route and altitude clearance prior to the end of air refueling?"

Here's what 7610.4 says the tanker's responsibilities are at end AR: "Coordinate altitude and route clearance from the ATC facility for both the receiver and tanker at least 5 minutes prior to refueling completion or through the radar controller when operating in refueling anchors with military ground radar."

Other tanker responsibilities include vertically positioning the aircraft to the maximum extent practical prior to reaching the end AR point and providing each receiver, upon request, with the aircraft's position at the completion of the refueling operations.

What is the bottom line? If you were "cleared as filed" to your final destination in your initial ATC clearance and you have no changes to your route of flight, then all you have to do is tell ATC what altitudes you are requesting. AP1/B clarifies this question further: "The tanker aircraft is responsible for requesting altitude clearance and routing (if different than flight plan routing) for the receiver and tanker aircraft beyond the AR exit point. If clearance is requested and not received, all aircraft will proceed on flight plan routing at last assigned altitude."

Communication, as always, seems to be the key. If there's any doubt you and the ATC controller aren't on the same wavelength, just key the mike and clarify the situation. "An ounce of prevention is worth a pound of cure."

Hopefully, this article has helped reinforce what you already knew about air refueling and its relationship with ATC and the national airspace system. If you have any additional questions or concerns about any instrument-related topic, feel free to call ACC's Advanced Instrument Flight Course at DSN 347-4571. We'd love to hear from you! ■

Tanker Power Management

CAPTAIN DAVE CANTOR
Central Flight Instructor Course
KC-135 IP
Castle AFB, California

■ Three hours of night refueling in IMC conditions — this is not the best of scenarios, but the receiver has several pilots on board who need to update night air refueling currency. Two hours into the refueling, pilot no. 4 is finished and the receiver backs out for another seat swap. Due to limited visibility, the receiver only backs out to 300 feet.

Meanwhile, the tanker pilot realizes his airspeed is 5 knots fast. The receiver will never notice a slight power change, so the tanker pilot reduces power 1/4 knob width on all four throttles. Nothing happens at first, but 15 seconds later, the distance between the two aircraft starts to decrease.

The closure is not recognizable at first, but as the receiver aircraft approaches 200 feet, the boom operator notices what appears to be a normal closure to the precontact position. The tanker airspeed has decreased 2 knots, but the receiver pilots are still busy with their seat swap and do not notice the closure. At 100 feet, the closure rate looks higher than normal but not unsafe, so the boom operator assumes the receiver will slow the rate of closure momentarily.

The receiver pilots now notice the decreased distance between the two aircraft and make a slight power reduction. At this point, *a midair collision is unavoidable.* At 50 feet, the closure rate becomes enormous, but there is nothing either plane can do to overcome the momentum. Total decrease in tanker airspeed: *5 knots.*

Air Refueling Incidents

What do you think is the most common cause of air refueling mishaps? Turbulence, clouds, and darkness are among the causes cited by many pilots and boom operators. At CFIC, we believe poor power management by the tanker pilot is a common, but not easily recognized, cause of many problems during air refueling operations.

The following discussion will cover some recommended techniques for tanker power management during air refueling along with a review of some *CFIC-only* demonstrations we use to support our recommendations.

Mission Planning

When should crews begin to prepare for the air refueling operation? How about during mission planning! This will be easier for those crews who mission plan the day before the flight, but the point is for the tanker crew and receiver crew to talk directly with each other about the mission.

Among the topics of discussion: When is the best time to make tanker power changes, which Emission Control (EMCON) option will be used, and under what circum-

continued

Tanker Power Management
continued

stances will the tanker break radio silence to announce changes in power?

The bottom line is the tanker and receiver do not refuel *against any other* aircraft. The tanker refuels *with* the receiver, and any prior coordination which can take place to make the operation easier is worth the effort.

When to Make Tanker Power Changes

So when is the best time to make tanker power changes? Obviously, the best plan is to have the airspeed and power stable before the receiver closes inside a quarter of a mile, but after that point, most receivers would prefer tanker power changes be withheld until the receiver is in the contact position. If the tanker is off the planned airspeed, a radio call will allow the receiver to adjust the closure rate.

There are at least three reasons why this is much easier for the receiver to deal with than a tanker whose power setting is constantly changing. First, from 1/4 mile into 100 feet, the closure rate is very difficult for the receiver to judge (especially at night or in the weather). The receiver is counting on a constant platform while trying to judge the closure. If the tanker is slowly accelerating or decelerating, it does not matter as long as the relative rate of closure is not changed by the tanker.

Second, when closing from 50 feet, the receiver plans on making the power changes required to set up the desired closure rate and to overcome the downwash from the tanker. Any changes in the tanker power setting simply adds more variables to this already difficult part of the operation.

Third, once the receiver is stable in the contact position, it is much easier to recognize small changes in the relative position of the aircraft. Visual references on the tanker and the pilot director lights both contribute to the receiver's ability to make small power changes to maintain position.

When Not to Make Tanker Power Changes

What are some additional times to avoid making tanker power changes? Think about manual boom latching and reverse air refueling operations. During KC-135 manual boom latching, the boom operator is exerting extend pressure with the boom against the receiver prior to toggle engagement. The receiver has to add power to overcome this pressure.

How much power? There is no way of knowing since each boom operator exerts a different amount of extend pressure. This maneuver is difficult enough without the tanker pilot adding more complications. During reverse air refueling, a slight amount of retract pressure is held by the KC-135 boom operator to open the tanker bypass valve (this allows fuel to pass from the receiver to the tanker). Although not as significant as manual boom latching, this does require a slight reduction in power by the receiver and would not be a good time for power changes by the tanker.

Minimize Tanker Power Changes

Once the receiver is in the contact position, it is still advisable to minimize tanker power changes. The reason is the receiver has to make three power changes for every power change made by the tanker — the first to reverse the adverse trend once it is recognized, the second to overcome the momentum built up during the correction, and the third to stabilize back in the appropriate position. We use a CFIC maneuver entitled "tanker power management" to demonstrate this concept.

With the receiver stable in the contact position and the receiver's throttles locked, the tanker adds a quarter knob width of power on two throttles. Within 15 seconds, the tanker pulls 4 feet away, leaving the receiver at the aft limit of the envelope. It then takes two power changes by the tanker to stabilize the receiver. We then reduce the power on two throttles to bring the receiver back to the middle of the envelope (once again using two power changes to stabilize the receiver in the middle of the envelope). The lesson to be learned from this maneuver: Use of known target power settings by the tanker can help to minimize these power changes, thus making life

much easier for the receiver.

Air Refueling in the Climb

A maneuver which could happen in the tanker community is air refueling in the climb. What does the receiver care about when the tanker approaches a level-off altitude during air refueling? Some tanker pilots think the pitch change is the important factor, but receiver pilots will tell you they do not even notice pitch changes if they are accomplished smoothly.

The big factor for them is *power changes*! Being able to anticipate the power change makes the level off much easier because the receiver can make a power reduction along with the tanker, thus preventing a closure from developing when the tanker pulls back the power. The same concept applies when departing a level-off altitude for a newly assigned altitude. We recommend the power change be called, with the receiver's acknowledgement being used as the command of execution.

Engine Failure

What should the tanker do if an engine fails during air refueling? KC-135 tech orders tell us to execute a breakaway, but is it necessary to add a lot of power immediately (particularly asymmetric power)?

During a CFIC maneuver entitled "engine failure series," we demonstrate, with one engine pulled to idle, it takes up to 5 seconds before the receiver even notices a significant change in position. The point is the loss of an engine is not a life-threatening event.

We recommend the breakaway be called but the tanker only add symmetric thrust (if any thrust is added at all). Allow the receiver to use reduction in thrust to gain separation between the aircraft.

There should be no hesitation to do this since the receiver is the aircraft which causes lateral separation to occur during the first few seconds of a breakaway. (Due to momentum and engine spool-up time, it takes much longer for the tanker to accelerate than the receiver to slow down.) Using this technique will make the recovery from the engine failure much easier for the tanker while getting the receiver away in case engine parts are falling off the tanker. ■

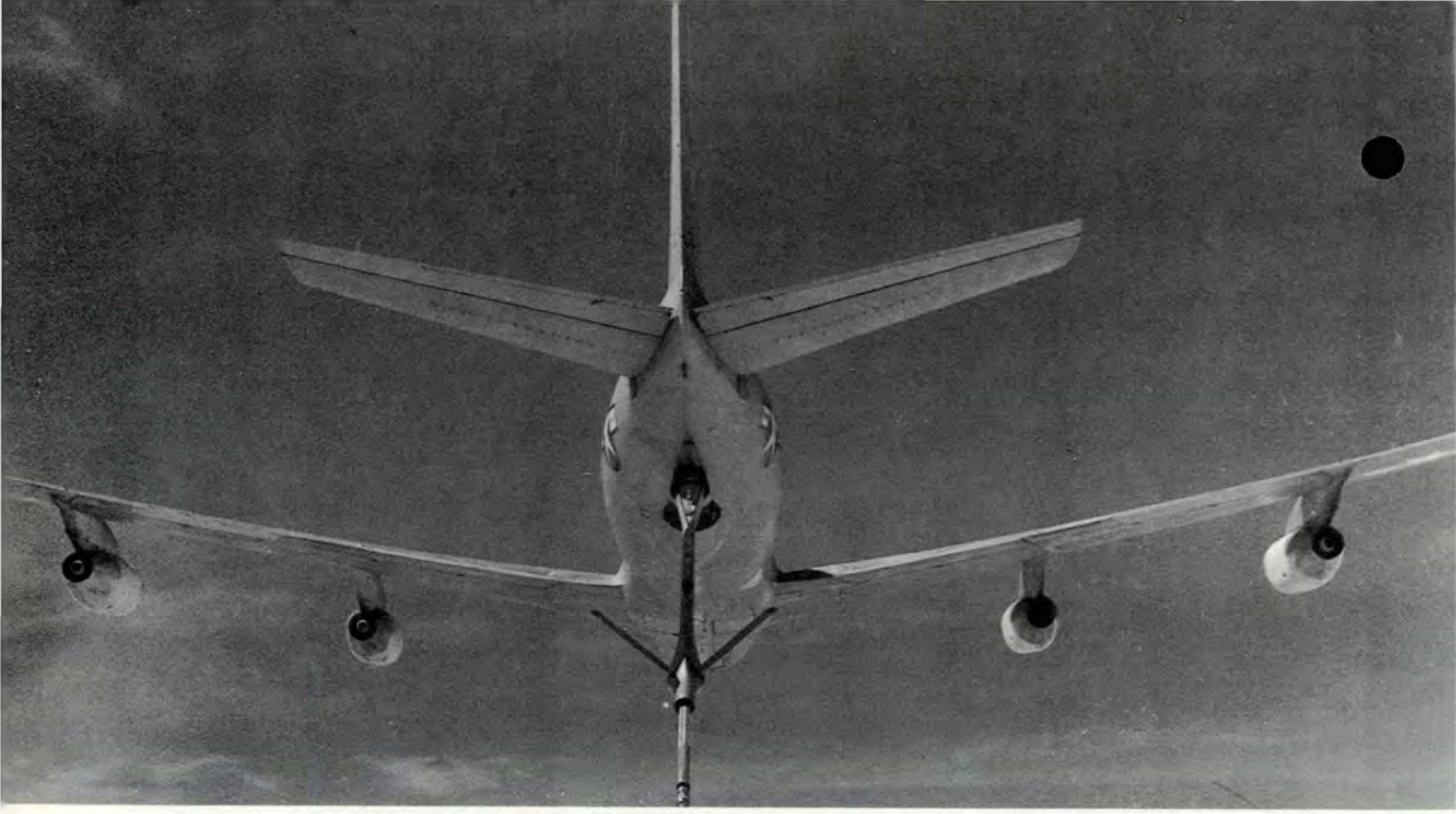
Talk to Each Other

■ **The most important thing we can all do to improve safety during air refueling is to talk to each other.** This means before, during, and after the mission.

EMCON procedures are important in tactical situations, but the mission will also be stopped by an inability to accomplish the air refueling. Do what you have to do to maintain security, but do not sacrifice aircraft safety in the process. Discuss all possible contingencies prior to the mission, then talk when necessary during the flight (using the boom interphone if it is available).

Talking after the flight can be very helpful if the crews honestly discuss whatever problems were encountered. If your refueling partners do something to make life hard, they will continue to make the same mistake unless you tell them about the situation.

It may require some effort to communicate with noncollocated crewmembers, but the effort will be worth it if we can improve the performance of all crewmembers involved in air refueling operations. ■



Aerodynamic Effects on the Air Refueling Platform

MSGT GREG CONRAD
Control Flight Instructor Course
KC-135 Instructor Boom Operator
Castle AFB, California

■ All of us (tanker pilots, receiver pilots, and boom operators), at one time or another, have either experienced a rough day on the air refueling (AR) track or even, perhaps, an air refueling mishap. We can't help but wonder why things happened the way they did. Receiver pilots often question the tanker pilot's abilities or even their own. The boom operator comments on how much of a cowboy the receiver is and to be ready for anything to happen. But, how many of us really stop to analyze the platform and understand the variables involved?

The variables I'm going to discuss are the tanker and receiver aerodynamic effects and boom effects. In discussing these variables, I'm hoping to give you a better understanding of what happens to the airflow around two aircraft during air refueling and how the position of the boom affects the air refueling platform. With the help of the KC-135 and B-52 instructor pilots from our Combat Flight Instructor Course (CFIC), I hope you receive some valuable information.

I'd like to start out with some excellent information I found when researching this article. In a *Combat Crew* magazine (February 1985), I found an article entitled "Those Interrelated Aerodynamic Effects," dealing with our very subject. The information it presents is just as critical today as it was then.

Upwash, Downwash, Bernoulli

To understand what's happening during air refueling, we need to understand a little about upwash, downwash, tip vortices, and some of old Hormel Bernoulli's theory about pressure differentials. As an aircraft produces lift, it affects the airflow around it. Relatively speaking, the airflow produces an upwash ahead of the aircraft and a significant downwash behind it.

Remember last summer when you were whistling down the highway and you noticed a butterfly about to become a hood ornament on your

fresh wax job, but that young butterfly was mysteriously lifted over your car? If you had looked in your rearview mirror, you would have noticed the said butterfly, on the outer edges of maneuvering flight, as he suddenly returned to his original altitude.

What caused this phenomenon? Your car was acting as an airfoil. The airflow directly in front of your car was directed upwards and back, creating a backwash. Additionally, as the airflow passed over the rear of the car, downwash returned the butterfly to his original altitude.

When a wing produces lift, a pressure differential exists between the upper and lower surfaces. At the wingtip, this pressure differential creates components of spanwise airflow. On most large aircraft, the lateral flow developed at the tip is quite strong, and a rather strong vortex is created.

For conditions of positive lift, this vortex has a twisting component toward the aircraft centerline as it moves relatively down and aft of the wing. According to Bernoulli, the above-mentioned pressure differential is due to the velocity differential above and below the wing.

By now, you're thinking, "All this is really fine, but how does it affect air refueling?"

Normal Closure

Consider first the normal air refueling closure from precontact to contact. We all know what happens to our airplanes, but why does it happen? Ask any tanker driver why his plane is affected, and he will tell you, "Receiver bow wave (upwash)," and he is right, partially. Ask any receiver pilot why his airplane is affected, and he will tell you, "Tanker downwash." He is also right, partially.

Actually, as the aircraft come in close vertical proximity, the upwash, downwash, and, to a lesser extent, the tip vortices of both airplanes are affected. From the tanker viewpoint, a receiver closing to the contact position causes a change in the vertical component of the upwash and downwash which is not unlike ground effect.

The tanker wants to pitch down as it does when entering ground effect (nose-up trim is required). Induced angle of attack is reduced just as it is in ground effect (thrust required is reduced). In fact, it has been shown in some conditions of flight (climb, for example), the increased parasite drag of boom extension is more than compensated for by the reduction in induced drag due to the receiver in contact, causing "ground effect."

From the receiver point of view, tanker downwash causes the airplane to want to pitch down and slow its rate of closure. The magnitude of these effects depends primarily on the rate of change of the upwash and downwash on both airplanes. This rate of change depends on the speed and relative angle the receiver takes.

The receiver closing very rapidly will obviously have a more rapid and dynamic effect on the tanker. The receiver who closes very low and then tries to pop up to contact, as well as the pilot who tries to close very high and level, causes a more rapid and dynamic change on the tanker because the receiver bow wave (upwash) and tanker downwash are entered suddenly rather than gradually.

Slow closure is a very wise technique. As the receiver achieves contact, he notices the pitching moment caused by tanker downwash has dissipated considerably. If the receiver should continue on beneath the tanker, he will then notice the pitching moment begin to increase again, only this time in the NOSE UP direction!

Centerline Underrun

If the receiver continues to underrun the tanker, the aerodynamic effects of the downwash will continue to change. Downwash will not affect the tanker or receiver significantly until the receiver aircraft fuselages and wings near vertical overlap.

At this time, the Bernoulli effects begin to lower the pressure between the two aircraft and will actually draw them together. The tanker autopilot altitude hold feature, if engaged, will sense this decrease in pressure at the static ports as a climb and will command a pitch down in an attempt to maintain a constant pressure altitude.

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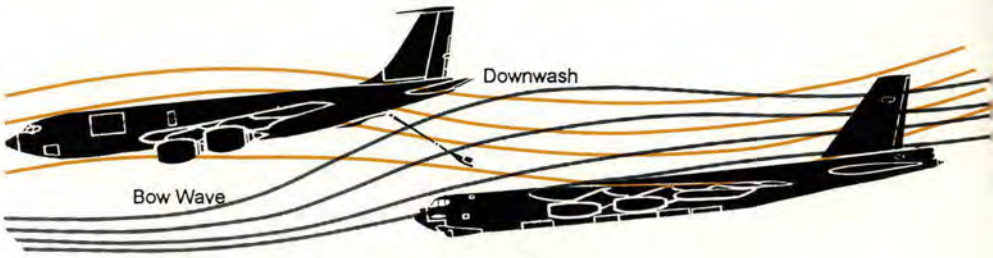
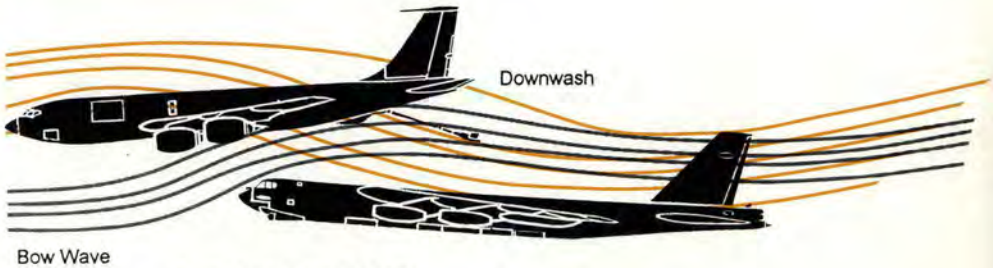


CENTERLINE APPROACH:
As the receiver aircraft closes the tanker downwash and the receiver bow wave influence both aircraft causing the nose to drop and the tail to rise on each of them.



CENTERLINE UNDERRUN:
As receiver aircraft undershoots the tanker the downwash moves aft causing the receiver's nose to pitch up while the receiver's bow wave pushes the tanker's tail up.

Aerodynamic Effects on the Air

This situation will almost invariably result in a midair collision since the only way to separate the aircraft vertically would be for the receiver to lower his nose while the tanker raises his nose in an attempt to compensate, resulting in the tail sections rapidly moving towards each other.

Lateral Underrun

Let's consider next what would happen if the receiver noticed a centerline underrun developing and attempted to offset himself laterally to avoid the adverse effects noted under the centerline underrun. As the wing of the receiver moves out of the downwash effect created by the tanker, the local angle of attack of the wing in the clean air will increase and generate more lift, attempting to roll the receiver toward the tanker. As more of the wing enters the undisturbed air, the forces build at a rapid rate.

Without immediate action on the part of the receiver pilot, the receiver aircraft may actually turn into and strike the tanker or possibly accomplish a barrel roll-like maneuver over the top of the tanker.

Breakaway

A properly executed breakaway (anybody can initiate one) is a good remedy for conditions leading to the above situations. However, an improperly executed breakaway may serve only to compound the problem. Remember, separation is the objective!

BOOM TURN:
Swinging the refueling boom 8 degrees to the left or right of the centerline with the controls neutralized causes the boom to act as a rudder and will turn the aircraft towards the side the boom is moved.

Tank drivers, don't be in a big hurry to increase your pitch attitude. Increased pitch can lower your tail and decay airspeed. Receiver drivers, don't be in a big hurry to dump the nose. Your tail will come up, and even with the power at idle, airspeed can increase. Booms, make sure your "Cleared to climb" call is not automatic.

Although it is really not important to know Venturi and Bernoulli developed these theories, an understanding of the principles involved can help recognize a potentially hazardous situation soon enough to recover. An understanding of these principles can also help us to visualize what "Fred Boeing" is talking about when he tells us, "It is unsafe to fly two aircraft in close vertical proximity because of the magnitude of interrelated aerodynamic effects."

Lastly, I'd like to discuss boom effects. I found some excellent information while researching in another *Combat Crew* magazine (January 1987). The article, "Boom Effects," explains the last variable of the air refueling platform.

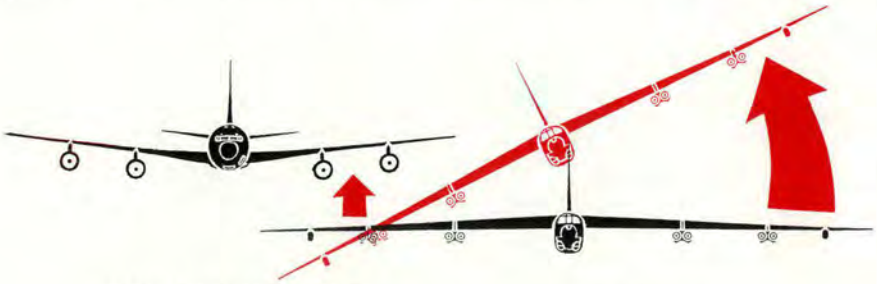
Boom Effects

Now, everyone knows what a primary flight control surface is, right? Ailerons, spoilers, elevators, rudders, etc. But did you know the KC-135 comes equipped with a secondary flight control known as "the boom"? If you think about it, the boom is really just another rudder, and in some ways, it can even act as a throttle control!

Don't believe me, huh? Well, I'll explain a couple of the air refueling demos we do at Control Flight Instructor Course and, hopefully, show you how these "boom effects" can affect your performance during air refueling operations.

Boom Turn

Earlier, I said the boom is just another rudder. To prove this, we do a simple maneuver called a boom turn, in which we turn the tanker with the boom. The boom is then lowered to 30 degrees elevation and then flown to 8 degrees left or right (depending on which way you want to turn). The tanker pilot simply maintains a neutral yoke. With the



LATERAL UNDERRUNNING:
Because of the changing angle of attack caused by the downwash off the tanker's wing, the receiver's wing under the tanker generates less lift while the receiver's wing in the free air generates more lift. The receiver aircraft will, unless corrected, roll up towards the tanker.

boom positioned at an azimuth limit, the tanker will roll into a turn without any problem. Then to roll out, you just fly the boom in the opposite direction.

So what's this got to do with refueling? Not much, if the tanker has its autopilot on, because the autopilot compensates for the boom's effect. However, if the tanker has its autopilot off, there can be some complications.

If the receiver comes in off centerline, and the boom operator keeps the boom at 0 degrees azimuth until the receiver closes to the contact position and then swings the boom over to make contact, the tanker pilot had better be ready to counteract the rolling motion induced by the boom. Don't forget, the receiver is going to be reacting to the tanker's movements while the boom operator is trying to make contact.

Night Air Refueling

What about night refueling? The Dash-Three, the AR manual for KC-135 operations, tells boom operators to "maintain the boom in a position that will prevent the boom nozzle light from distracting or blinding the receiver pilot." By swinging the boom to one side to keep the nozzle light away from the receiver pilot, the boom could destabilize the tanker's platform, which, in turn, causes the receiver to destabilize prior to getting a contact.

So what's the answer? First, for receiver pilots, try to come in on centerline as much as possible. Second, for boom operators, if the receiver does come in off centerline, tell your pilots so they will be ready to correct any changes caused by the boom. If you're flying at night, ask the receiver where he wants the nozzle light (emission control permitting). If he has no preference, try to keep it on centerline. Most heavy drivers really won't be distracted if you keep it right up the middle.

Limit Demonstration

Now, let's talk limit demonstrations. The boom is going to have the same effect whether there is a receiver hooked up or not. Receiver pilots can destabilize the tanker's platform by moving out to an azimuth limit too quickly. Keep your rate of movement slow and steady when going to the azimuth limits, and keep it slow and steady when coming back to center.

Everybody knows unannounced power changes during AR cause problems, right? Did you realize the receiver's position in elevation can cause the same effect as a small power change while in contact?

One of the demonstrations we do to show this is called a "receiver no-power limits" demo. Both tanker and receiver have autopilot on, in contact with the received stabilized at 0 degrees azimuth, 12 feet extension, and 30 degrees elevation. The receiver then moves up to 22 degrees elevation. This reduces the amount of the boom hanging in the slipstream, which, in turn, reduces the amount of drag on the tanker. As a result, the tanker increases airspeed slightly, and the receiver moves aft.

Night air refueling creates some unique circumstances for the receiver pilots and boom operators.

When the receiver reaches 15 feet, he moves down to 30 degrees elevation and stabilizes at 16 feet. The receiver will then go down to 38 degrees elevation, putting more of the boom in the slipstream, which, in turn, puts more drag on the tanker. Yes, you guessed it, the tanker slows down and the receiver moves forward. When the receiver reaches 9 feet, he will move up to 30 degrees elevation and stabilize at 8 feet. All of this movement was accomplished without any changes in throttle position on the tanker or receiver.

So, what's this got to do with "real" refueling? How many receiver pilots tend to come in low during night refueling? It's a tendency many receiver pilots have because there are fewer visual cues available at night to aid in recognizing the effect of the tanker's downwash. The problem with this situation is it could set you up for trouble.

If the receiver comes in low, the boom operator may have a tendency to start lowering the boom in anticipation of the receiver reaching the contact position. To make things worse, the receiver may stagnate somewhere between 10 to 20 feet and add just "a little bit" of power to get through "the downwash." The result is a fast closure rate hard to see at night. How many times have you gotten a contact at night and almost immediately received a "back 2, back 4" correction from the boom operator? Sound familiar?

This same effect could affect our limits demos when demonstrating the upper and lower elevation limits. If you stay at an upper or lower limit for any length of time to point out references, don't forget what the boom position is doing to you, especially on lower limits!

The secret to staying ahead of these effects is realizing they exist and what they are trying to do to you. Booms, keep your pilot informed of the receiver's position, both prior to and during contact. Receiver pilots, realize it may not be all your fault! Some of the problems you may be experiencing during AR may be a combination of these effects. Tanker pilots, be aware of what "secondary flight control" can do to you and be ready to correct for it. **Fly safe.** ■

Weather or Not ...

Photos courtesy of Lt Col John Kerl, Det 1, 458 OPG/DOV.

CAPTAIN DANIEL P. STENSON
KC-10 Stan/Eval IP
Barksdale AFB, Louisiana

■ Standing in front of the weather desk, looking at the infrared satellite shot, we knew it was going to be a long day. Dwayne's weather forecasts were always on the money, and the worst of it had to be right over *our* air refueling track.

The fighter drag had already been slipped 24 hours, and Lt Col Bell, the 2ADG representative, had spent most of the previous day on the phone recoordinating the altitude reservation (ALTRV) approval. He and Maj Pike, the F-16 flight lead, were now a bit concerned another 24-hour slip loomed on the horizon. Approaching the aircraft, I became painfully aware that not only was our force extension* going to be hampered by weather, but the departure as well.

Light rain started falling on our KC-10 as the boom operators worked feverishly to load the remaining pallets of cargo. The fighter squadron's support personnel were already on board, and we had little time to finish our preflight before check-in. I updated the crew on the weather and mission changes as the copilot loaded the appropriate modes and codes, as well as our waypoints, into the three inertial navigation systems.

Check-in time came, and Maj Pike reported the no. 5 fighter was working an emergency power unit problem, and it didn't look good. About 15 more minutes passed, and I began to get anxious. The estimated time of departure for the ALTRV was quickly approaching, and there were still no final words on whether we would have four or six fighters with us for the crossing.

Finally, with 20 minutes until the ALTRV void time, Falcon Ops made the call: Launch with four! Well, that was that. The decision had been made. Scott, the copilot, called "SNAP 51 flight of five, taxi with yankee" on the radio. We followed the -16s on the parallel and got launch approval with 5 minutes to spare on the ALTRV void time.

The light rain coming from the 3,500-foot overcast now started to come down more heavily. The flight was cleared for takeoff, and the fighters launched first in two-ship

*A "force extension" is the term commonly used for KC-10 receiver operational air refuelings.

An F-16 gets a "disconnect" from the KC-10's boom.

formations about 10 seconds apart. We lined up on the runway and waited for fighter lead's 12-mile initial call. We launched on his call and, as advertised, at 3,500 feet, we went into the soup.

We climbed out at 290 knots and 1,500 fpm as the fighter's TACAN slowly clicked off the distance remaining. We climbed through the layered cloud decks and popped out VFR on top at FL230. We continued our climb to the final level-off altitude blocking FL250 to FL270. With the fighters, now two on each wing, we prepared for air refueling (AR) #1.

The fighters had done a good job staying on our wings through the weather, and I knew they were as glad we broke out. The sky was dark and ominous, but our weather radar didn't show any buildups extending into our flight planned route, for now. We slipped across the dark sky with the clouds below us at 450 knots true air speed (TAS) and completed AR #1 without a glitch.

Checking the ARCT against our ALTRV timing, I noticed we needed to push the airspeed up a bit. I informed Maj Pike, and we pushed it up to 480 true as the engineer calculated our extra fuel burn as well as the fighters' increased fuel requirements due to the faster speed.

ARs #2 and #3 came and went, and aside from the usual fuel spray with fighters on the boom, everyone had done really well — no inadvertent disconnects so far. I was beginning to regret the bet I'd made with Lt Col Lundquist, the F-16 Operations Officer. I told him for every disconnect we got behind the KC-135, I'd cancel five of the fighters' disconnects. He readily agreed, and whatever difference accrued when all was said and done was to be paid in beers.

With only four more fighter refuelings and one receiver refueling for me, I was beginning to remember what Dwayne had said about the weather between fighter ARs #4 and #5. My hands started to sweat, so I got a piece of gum from the boom to ease my nerves. He had been doing a great job with the fighters and was now sitting behind me with the en route weather sheet in his hands, taking every opportunity to get me worked up. We joked about who should actually buy or receive the beer when the engineer spoke up, "You both buy it, and the co and I will drink it — no problem."

As I glanced down at the INS, AR #4 was almost upon us. We had just flown into some cirrus and watched the weather radar as some really strong cells started appearing about 240 miles ahead. Great! Right in the middle of my force extension.

During AR #4, we turned the autothrottles off so the engines would not cycle back and forth due to the bumpy weather we were now in. Moisture was starting to hit the front clearview windscreen, and the temperature necessitated the use of anti-icing. I told the boom to inform the fighters of the upcoming weather and the temperature.

The boom informed the fighters, and Maj Pike asked us what the weather looked like up ahead. The copilot told him a line of buildups perpendicular to our route was straight ahead at about 210 miles. It looked like some level-three cells but, hopefully, we'd be able to pick our way through the worst of it.

The fighters had started having some problems with their AR because the weather had been getting worse. We were also getting bumped around pretty good. We paid close attention to the radar and the cells ahead, but the stuff we were in now was just unstable air and moisture. The engineer and the

continued

Weather or Not

continued

boom spoke back and forth on the intercom and worked perfectly in unison to get the proper offloads to the fighters as I kept an eye on the autopilot and the KC-10 on speed.

With the third F-16 on the boom, it was time for us to run the rendezvous check as a receiver. We put the fighters in TACAN 1, and TACAN 2 was set to identify the -135. The rendezvous beacon was also set to pick up our tanker. We had attempted contact at least three times before over the HF with our tanker, but no answer. We did manage to get a phone patch through "Mainsail" — AMC Global HF — and verify our tanker, SNAP 52, had taken off on time and was in the green.

Sixteen minutes prior to our ARCT, we had just finished with the last fighter. We finalized the checklist for the receiver rendezvous, and I made a 15-minute call to the tanker, "SNAP 51 FLT of 5, blocking 250 and 260, on time." No reply.

The boom had just sat down and told me the disconnect status — they owed us seven beers. But at this point, with the weather getting worse and with no tanker on frequency, the beer bet had definitely taken a back seat to my thought processes.

I repeated my call over UHF-2 — again, no reply. We continued ahead in the dark clouds with the rain coming down, all the while getting bumped around. Another crewmember entered the cockpit to inform me three of the duty pax were actively airsick, and "Could we get this crate back on the road?" The boom spoke up, "He's keeping it 'tween the ditches as best he can. Now git back there and tend to them passengers!"

With only 5 minutes left to the air refueling control point (ARCP), I could tell everyone was getting a bit tense. I continued to make the calls, but with scratchy radios, due to the static electricity in the clouds, I could barely hear myself going out. St Elmo's fire had been crackling across our front windscreen for the past 10 minutes. Maj Pike called on UHF-1, "Hey, where's your tanker?"

Suddenly, on the 50-mile rendezvous beacon scope, a set of blips appeared about 18 miles at our 11 o'clock position. I heard, "SNAP 51, SNAP 51, verify FL250 block FL260. I'm at FL270 in the turn. SNAP 51, how do you read?"

As I called in the block with the flight of five, TACAN 2 came to life with 11 miles to go. The -135 rolled out in our 12 o'clock position on the radar with a little more than 3 miles to go. The copilot informed me of a pretty big cell which would pass off our right wing within 15 miles if we continued on this heading. I asked SNAP 52 if he showed any weather buildups 30 degrees right at 37 miles. He confirmed the cell and turned left.

The fighters were bobbing up and down on our wings as we turned and closed on the tanker until, finally, with 1 mile to go, I stopped the closure.

No KC-135 in visual range. The clouds were too thick. I informed 52 I didn't have visual and was holding 1 mile back until I could get him in sight.

After 7 more minutes of getting bounced around in the dark clouds with rain and St Elmo's on the windscreen, I saw a glimpse of the -135's outline ahead. I asked Maj Pike if he had the -135. He confirmed "visual" and started the first two fighters on our left wing up to the -135. Once confirmed in place, Maj Pike called for #3 and #4 to join on the tanker.

The -16s left our right wing and slowly disappeared into the soup just as lead and 2 had done. Once all the fighters were in position, SNAP 52 called, "52 ready — all fighters in position." "Copy that, but I've lost visual on you again."

Scott checked the routing and timing to start AR #5 for the fighters. We were about 25 miles north of

course and had only 22 minutes until we had to start pumping the -16s again. Getting the 75,000-pound offload from the -135 would take 19 minutes and about another 10 to do a full IMC lead swap and get the fighters back on our wings — that's pressure!

I wiggled my toes and got another piece of gum from the boom, put my left armrest down, and wiped my forehead. A fleeting thought came to mind. "Thanks, Dwayne." Why did he have to be right on the mark with all his weather forecasts? My momentary distraction was quickly removed as the engineer yelled, "Visual!" Indeed!

I told 52 I was visual and on my way up. He confirmed that and told me he was going to be autopilot off due to a maintenance problem. Wonderful! How very terrific! I thought to myself, "What next?"

I started up, and we ran the "Preparation for Contact" checklist. Scott verbally assisted with the reverse PAR (800 feet to go; .8 miles back, indicating 320). He kept them on radar until 1/2 mile and then went to standby. I closed to precontact, stabilized, and went in. We had to refuel at 310 KIAS to stay on ALTRV timing, 20 knots faster than normal for the KC-10, but this wasn't a problem as the engineer had given me a forward center of gravity. The aircraft was very stable except for the turbulence and St Elmo's distracting me.

"Contact," the copilot called. As I verified the light, the engineer informed me we were taking fuel, and I reported "contact" to the KC-135 boom over interphone. He confirmed the contact and then proceeded to tell me what *they* had been through.

They took off with 1,600 runway visual range (RVR), picked their way to us through the weather, and hadn't heard any of our calls. I told him I was just glad they were where they were supposed to be and on time with the gas. That was the important thing. He added, "And by the way, we're the airspare. Lead aborted due to an engine problem."

I took the gas on one contact, asked for a disconnect, and slowly backed out. You never want to back out too quickly or get low behind a -135. It will cause their aircraft to sense a low pressure and it will start a descent into you. We went down to FL260. Once there, we passed the -135 2 miles off their right wing and took the lead.

The fighters went down to FL250 in elements of two, as we were still in IMC conditions, and joined on our wings. By the time all this was accomplished, we had already passed start AR #5 by 9 minutes. The boom was in the back and ready to go. He informed me the fighters had called us on their interplane frequency during my contact and said they could afford to do AR #5 as late as 12 minutes past schedule.

"Damn!" I thought. How could I have missed that call? But with the weather, tanker autopilot off, and the St Elmo's, I was definitely concentrating on one thing — getting the gas!

The rest of the fighter drag went off as scheduled. It was, without a doubt, an exciting mission which only succeeded due to the combined "team effort" of not only the people in my jet but in the -135 and the fighters as well.

CRM — whether the "C" means "cockpit" for the single-seaters or "crew" resource management for us heavy drivers — when used properly, can make the difference in completing the mission or aborting with fighters — something no one in SNAP 51 flight wanted to do.

Upon landing at our destination, the F-16 squadron commander came on board to welcome the support troops home and thanked the crew for getting his planes and people home from the deployment safely. I said, "No problem, sir. That'll be seven beers!"

He knew all about it. He smiled, patted me on the shoulder, and said, "Dan, here's a twenty. You guys earned it!"

Life is good! ■

FSO'S CORNER

Chiefs of Safety and FSOs

We need your HELP!

■ We need your help getting Flying Safety magazine to all fliers, aircraft maintainers, flight surgeons, and others who directly support USAF flying operations. With all of the turbulence resulting from organizational changes and base closures, we need you to go to these folks and make sure they are still getting *Flying Safety.*

Every month we get magazines returned from units which have moved or have been deactivated. Many tell us their base PDOs have never heard of the magazine, and they don't know how to order it. *So, here's what we need you to do.*

Flying Safety magazine is designated as a special Air Force publication (AFSP). Therefore, you won't find it listed in the AFIND 2. It can be found in the Publications Bulletin (PB) update which goes to PDOs and your squadron orderly room.

Flying Safety magazine used to be designated AFSP 127-2. Because the Air Force is reducing the number of regulations and is switching from Air Force Regulations (AFR) to Air Force Instructions (AFI), the regulation giving us the authority to distribute the magazine (AFR 127-2) is changing to an AFI (AFI 91-1).

Your base PDO can find all this information in PB 26, dated 17 December 1993. All you need to do is go down to the squadron, count the number of fliers, and divide by 3. Then count the number of maintainers and divide by 6. Add the two figures together and put the total number of magazines you need for that squadron on an Air Force Form 764a, as shown below.

FSOs, we'd like the magazine to also go to flight surgeons and be put in their waiting rooms for our aircrews and maintainers to read. Please check with your flight surgeon's office and help them with paperwork for their orderly room to send to the base PDO. With the current tempo of operations in the Air Force, there's a lot less time for our people to sit down and read. We'd like to use every possible opportunity to get a message across to those working on the flight line.

If you're wondering about *Road & Rec* magazine and *The Nuclear Surety Journal* (which we also publish), the same procedures apply. Formerly AFSP 127-1, *Road & Rec* magazine has been redesignated AFSP 91-2. Published quarterly, the distribution is *1* copy for every *5* people in the Air Force. *The Nuclear Surety Journal,* AFSP 122-1, is now designated AFSP 91-3. It is also published quarterly, and the distribution is *1* copy for every *10* readers.

Thanks for your help!

Use the Air Force Form 764a to make sure you're receiving *Flying Safety* magazine.

(PRESS HARD WHEN USING BALL POINT PEN)

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DON'T HAVE TIME TO WRITE YOUR MOST RECENT "THERE I WAS"?

Many fliers we've talked to say they really enjoy reading "There I Was" stories in the magazine. They also say they just don't have time to sit down and bang out a story for us on the computer. *Starting to see a problem?*

Well, a recent Flying Safety Officer class here at AFSA came up with a solution we think we can work with. The next time you experience a "significant emotional event" in the aircraft, get out your tape recorder and tell us what happened. Tell your story like you were at the bar (or the soda fountain) *"shootin' down your own watch."*

If you want to remain anonymous, just don't tell us where you are from or your name. Or you can tell us you want the story to remain anonymous, but tell us where we can send you our official *Flying Safety* magazine coffee mug. We'll keep quiet about where the story came from, and you'll get a "belly washer" size coffee mug sure to make you the most "way cool" person in the squadron.

Of course, if you want everyone to know it was you who displayed the most awesome flying skill ever demanded of an Air Force pilot — skill which will surely identify you as a member of the "right stuff" club for life — that's okay too.

Either way, send your tape to: The Editor, Flying Safety Magazine, 9700 Avenue G, SE, Ste 282, Kirtland AFB NM 87117-5670. We'll take your standard or mini cassette tape, type up your story, and put it in the magazine for all to read. If you want your tape back, be sure to tell us, and we'll send it back. If you don't have access to a tape recorder, call

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OPS TOPICS

■ One of the nice things about being the Editor for *Flying Safety* magazine is that you get to interact with all of the major decision disciplines in the building here at AFSA. You also get a glimmer of what's going on with the other services.

Sometimes the things you get involved with, or you hear about, are pretty slick. Like new stuff the Air Force is bringing on line, or new programs they are implementing to prevent mishaps (which we hope to report on this year in the magazine). At other times, such as when you get a look at the daily mishap reports, you read about things that make you weak in the knees. Tragic Stuff. Preventable stuff.

Right now the Air Force mishap rate is doing pretty well compared with other service rates. But there have been some setbacks for us as a service.

We're seeing categories of mishaps pop up that give cause for concern. You've heard about some of the big ones — the mishap investigations are under way as of this writing. Although the final reports aren't in yet, many have to do with a loss of concentration or proficiency on the job at hand. The other incidents we get that don't make the headlines also point to the same thing. Most involve training missions or the kind of maintenance we do every day. The routine stuff.

There's a lot going on in the Air Force today. It's an exciting time to be in the military. However, some of our folks who have visited with you in the field report there is apprehension in the ranks. Apprehension about things in our personal lives and how future Air Force decisions will affect them. The kinds of things everybody knows about, but many may not be expressing personal concern over — fliers and maintainers alike.

A comment like "I do pretty good most of the time, but every now and then ..." isn't an uncommon remark I've heard on a person's ability to stay focused. While commanders and supervisors have done a great job keeping people focused on the mission, sometimes all we're able to do is hold on to the rails until the train we're riding runs out of steam. And somehow, in all the turbulence, we're still getting the mission done.

But we have to do more. We have to watch out for each other. Commanders and superiors can't be everywhere. We each have to be our buddy's keeper. Be proactive. Stay focused. Don't cut corners. Follow your tech data. Think things through. Watch your partner's back.

We seem to be doing real well at the operational stuff — the adrenaline gets in our blood, and we're pumped to do the mission because it's important. Our country depends on us — it's what we live for. But it's the routine things that are getting us into trouble. For many, they present the greatest danger in this time of reorganization and change.

Most things are *routine* in the Air Force because of training, concentration, and adherence to standards. Letting your guard down in any of these areas can cause things to get exciting pretty fast.

Stay focused, folks. You're important to us. You're important to your families. Be where you're at! — The Ed. ■

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us on the *Flying Safety Hotline* at DSN 246-0936, and we'll work something out.

AFSA SPEAKER'S LIST

Recently we have had many requests to develop a list of speakers which units can use for wing safety days and special unit events. We have a lot of "experts" on our staff familiar with almost any subject dealing with flight safety. Additionally, you may know of someone who is an excellent flight safety or aircraft maintenance operations speaker.

If you think you have stumbled across speakers other units would benefit from, please send us their name, address, phone number, and the subjects they specialize in. We'll contact them and see if they would like to be added to our "Speaker's List." We'll publish the list from time to time in the magazine. Send your input to *Flying Safety* magazine, AFSA/SEDP, 9700 Avenue G, SE, Ste 282, Kirtland AFB NM 87117-5670. You may also phone the *Flying Safety Hotline* at DSN 246-0936. ■

Q. How do you turn a Quality Wrench?

A. Go back to BASICS...

LOOK IT UP!