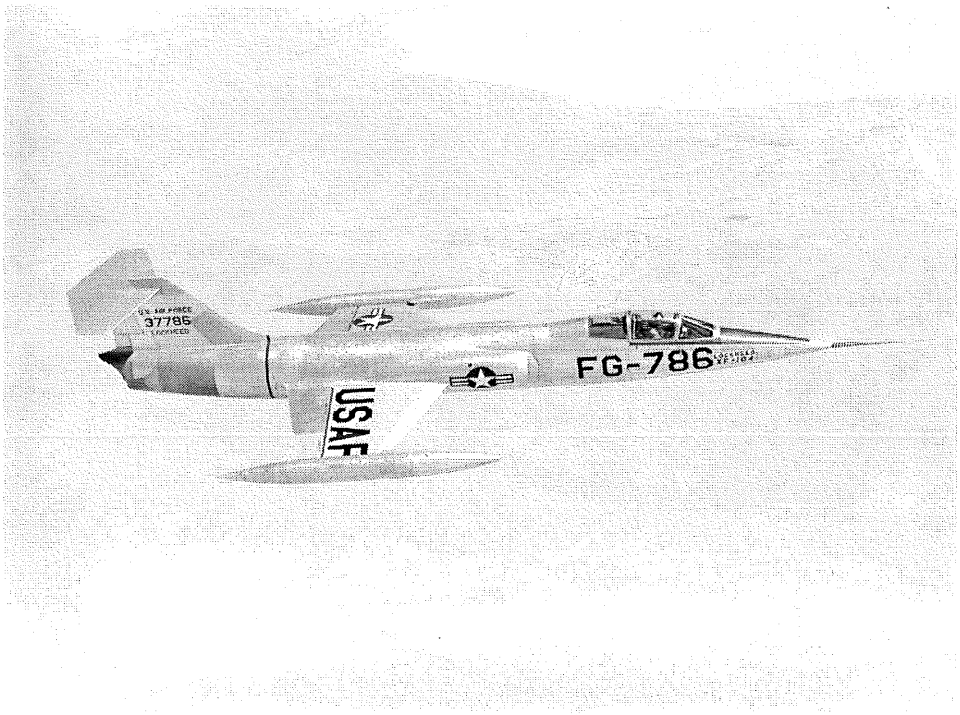
The SURE Project



Lecture – 9/10

STARFIGHTER UTILIZATION RELIABILITY EFFORT

LECTURE 9

LOCKHEED-CALIFORNIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION
BURBANK, CALIFORNIA 91520

25 January 1978

GREETINGS AND SALUTATIONS TO THE ROYAL ORDER OF STARFIGHTERS -

Even though I have not made any SURE visits to the worldwide F-104 Squadrons since 1972, I want to assure each of you that you are not forgotten. Your operational problems have been brought to my attention through the many letters and correspondence that I have received from you through the past years.

Recently, a former student of mine, B/GEN Hans-Ulrich Flade of the German Air Force requested that I visit Luke AFB and review the F-104G Emergency Procedures. Seizing upon this opportunity, I took pencil in hand and wrote the enclosed SURE lecture. Now, even though the procedures are for the G and TF models, many of them are applicable to emergencies in all F-104's.

Therefore, I am sending a limited number of copies to all F-104 units and the lecture can be reproduced to satisfy all those who desire to have a copy.

Sincerely,

LOCKHEED-CALIFORNIA COMPANY

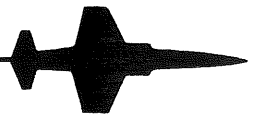
Glenn L. Reaves

GLR:clm

LOCKHEED
F-104

STARFIGHTER
UTILIZATION
&
RELIABILITY
EFFORT

LOCKHEED - CALIFORNIA COMPANY



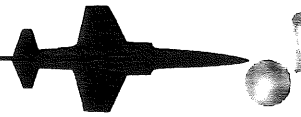
A
TEST PILOT'S COMMENTS
ON
EMERGENCY PROCEDURES

Written By

G. L. "SNAKE" REAVES

Lockheed-California Company

November 1977



References

1. T.O. IF-104G-1 dated 31 March 1975

2. Lockheed Report CA/ME 2301 dated July 1966

3. Lockheed Report CA/ME 2383 dated July 1967

4. Lockheed Report CA/GME 3044 dated June 1969

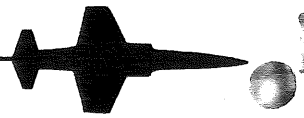
5. Itemized Flight Accident/Incident Reports for the F-104 Inventory Worldwide from 1958 to 1971 recorded by the Lockheed-California Company Flight Safety Department

6. Itemized Flight Accident Reports for the F-104 Inventory Worldwide from 1971 to 1974 recorded by the Lockheed-California Company Flight Safety Department

7. G.E. Aircraft Engine Group Report 7-HVL-2
J-79 Coastdown/Acceleration Characteristics for Aircraft Simulators, J-79 Series Engines, 29 July 1976

ATTACHMENTS

1. F-104G Takeoff Time History Summary - Power Loss at 90 Feet Altitude.
2. F-104G Takeoff Time History Summary - Power Loss After Liftoff
3. Estimated J-79 Engine Coastdown Characteristics
4. J-79 Typical Air Start Envelope
5. APC & Stick Shaker Operating Boundaries
6. Angle of Attack for Stick Shaker and APC Operation - Steady State Flight
7. APC and Stick Shaker Operating Boundaries vs. Airplane Angle of Attack - Maneuvering Flaps Down
8. Bird Watchers' Corner
9. Annual Accident Rate for the F-104 Fleet Inventory, 1961 - 1975



FOREWORD

In July of 1966, the Lockheed Report CA/ME 2301 was printed and distributed to F-104 pilots worldwide through the SURE (Starfighter Utilization and Reliability Effort) Project. Lecture 3 in that report was A CRITIQUE OF SELECTED F-104 EMERGENCY OPERATING PROCEDURES and covered:

Air Start
Forced Landing
Engine Fire
Nozzle Failure
Ejection

From the issue of CA/ME 2301 until now, many changes and improvements in the F-104 have modified or changed some of the emergency procedures. Also, during my annual visits to the 70 plus squadrons at 48 bases in 15 counties, during this elapsed time, it was brought to my attention that more detailed information about emergency procedures needed to be disseminated to you Tigers who are driving the Sliver. As the Manager of the SURE Project, I became a focal point of pilot knowledge concerning the worldwide operation of the F-104. Therefore, I decided to review each of the emergency procedures in Section III of the Dash One and give you my comments and tips based upon personal experience and background information from the SURE visits. I have also reviewed the statistics of the F-104 inventory from 1958 to 1974. This data is recorded by the Lockheed-California Flight Safety Department and from 1958 to 1971 both the Accidents and Incidents were recorded. From 1971 to 1974, only the Accidents were recorded. These statistics definitely back up the recommended procedures and my tips on operation. These comments and recommendations are in no way intended to supersede or contradict the Dash One. But as I've stated before, the Handbook is constrained by necessity and Mil Spec on what information is contained therein. Specifically, it does not tell you why for or how come?

With these thoughts in mind, I have attempted to record specifics of what I have learned in flying the Zipper during some 17 years and hopefully will be of use to you drivers of one of the greatest, all-time fighter aircraft -- The Lockheed F-104.

EMERGENCY PROCEDURES
Section III
T.O. IF-104G-1

GROUND EMERGENCIES
(Page 3-3, 4, 5)

EMERGENCY ENTRANCE

NO COMMENT

FIRE DURING START

COMMENT

The text before the procedure refers to the fire warning lights illuminating and being an indication of a broken or disconnected fuel line. Also, on Page 2-12 of the Handbook there are two caution notices that refer to a starter time limit of 1 minute operation and a critical overspeed rpm of 47% and a statement to disconnect the external air at 40% rpm. I have noticed many pilots nonchalantly giving the 4 finger signal to the ground crewman while they kept their eyes glued to the guages in the pit. Is anything wrong with this? I think so.

Back in 1958, when the first F-104A squadron was activated at Hamilton AFB, a spectacular fire drill occurred on the ramp shortly after the arrival of the Starfighters. A pilot jumped in and started his bird and the air cart kept pumping in air past 40%. About 60%, the starter disintegrated and seconds later a sizeable ball of flame was licking around the fuselage. By the time the fire drill was over, a badly burned Zipper required major repair. From that point, I began my procedure of watching the airhose from the cart and it it does not stop pumping air by 45%, I immediately stopcock the throttle and turn the fuel shut-off switch to OFF. The reason I do this is because

FIRE DURING START (Continued)

COMMENT (Continued)

of the statistics behind the caution notices on Page 2-12 of the Dash One. As research for this review, I have dug through the files in Lockheed's Flight Safety Department for the Accidents/Incidents from 1958 to 1971, and Accidents only from 1971 to 1974. These records show that seven starters have disintegrated by overspeed destroying three F-104's and inflicting major damage on the remainder. If the air is not stopped before the starter disintegrates, the saddle tanks are ruptured and the aircraft will probably be burned beyond repair. If the starter only throws off some pieces, then the engine usually suffers FOD. Therefore, it's worthwhile to mention,

Snake Sez:

"Better watch that airhose or it could blow your flight!"

GROUND ABANDONMENT

COMMENT

Following an argument during a Flight Safety Meeting at Palmdale one day, a test was conducted to resolve the issue. Two pilots were strapped into their cockpits and then they were timed as to how fast they could 'abandon the office'. But one pilot had to use the recommended emergency procedure and the other had to use the normal or non-emergency procedure, i.e., the standard way we all un-strapped and left the pit. The pilot who used the method that he had gone through day in and day out -- handily won the race. Not only that, the other pilot got the lanyard from the survival kit hung up on the ladder and fussed and fumed for valuable seconds while he got his knife out and cut the line. We played this game until everyone had a shot at it and I came to a conclusion:

"If you ain't practiced it -- look out for the 'GOTCHA'!"

TAKEOFF EMERGENCIES
(Page 3-6, 7, 8, 9, 10)

ABORT/BARRIER ENGAGEMENT

COMMENT

The procedure is thoroughly presented, however, I would like to make some points. The Warning Notice after Step 1 that refers to a throttle off condition brings up the factors concerning the loss of nosewheel steering and anti-skid brakes. I would like to add that from my experience, you need a lot of leg power to get satisfactory braking action from the manual brake system. And without nosewheel steering, you are committed to differential braking to steer the aircraft into the barrier. Add in a crosswind and a slick runway and you can miss the barrier altogether. Too many pilots discovered this too late so I cannot stress how important it is to retain directional control until you are stopped by the barrier.

In regard to the sequence of Steps 1 and 2, I would like to point out to you that they could be reversed. This is because the position of the throttle in full A/B makes it very easy to stick out your finger and punch the external stores jettison button and then pull the throttle into idle. In fact, many pilots have complained that it is even too easy to hit the panic button while reaching forward to raise the landing gear handle after liftoff. In any case, my point is that you will save time and hand motion by flicking out that finger, punch off the stores and then retard the go lever. To make up your own mind, try both procedures in the flight simulator sometime.

Step 3 has turned out to be a 'Gotcha!' to some pilots. In the excitement of the moment and the onrush of the barrier and the end of the runway, they have determinedly pulled the drag chute handle -- right on to the end of the jettison stroke! To prevent this, the Canadian Air Force modified the drag chute handle so that it had to be rotated 90^{o} counter-clockwise (to the left) before it

ABORT/BARRIER ENGAGEMENT (Continued)

COMMENT (Continued)

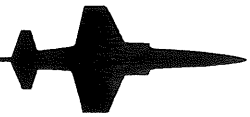
could be pulled through the jettison stroke. Great idea, you say. Not quite, say I. On a typical windy day at Palmdale, I came in to land after a test flight on a CF-104 that Lockheed had modified for the Danish Air Force under a development contract. This Zip was so unique that I called it the Danish Smorgasbord. Since the runway that the wind favored was closed, I was committed to the challenge of a gusty, crosswind landing. Utilizing my favorite technique of a crabbed approach, the touchdown, nosewheel steering engagement and initial rollout was right on. Then I pulled the drag chute handle, got a good chute -- good deceleration -- and a good swerve to pull the bird off the runway. Expecting this, I tried to rotate the drag chute handle to the right in order to dump the chute. And guess what? The Canadian 'Gotcha!' nearly got me. Finally realizing that I should rotate the handle 90^{o} to the left, I quickly got the Zip heading the proper way. So no matter how your drag chute handle is designed to work -- it behooves you to know it and practice it.

Step 4 sure sounds easy. But can you do it without looking for the button? The records show that pilots have missed it just when they needed it.

Step 5 can be a sneaky 'Gotcha!' if you have hot brakes, and a crosswind from the left. If you cut off the throttle with these conditions, the pressurizing and drain valve will drain the engine fuel manifold with a healthy squirt of JP-4 right in the direction of the hot brake. So remember,

Snake Sez:

"Drained fuel will inherently fall where it can start a fire!
This phenomena is known as the law of guaranteed combustion."



AFTERBURNER FAILURE DURING TAKEOFF

COMMENT

In my book, any engine problems prior to the go, no-go marker calls for only one decision -- abort. The afterburner has proven to be a reliable segment of the J-79 engine. The records show that A/B failures are caused by:

Oil System Malfunctions
Nozzle Area Control Malfunctions
A/B Nozzle Pump Malfunctions
Pilot Burner Malfunctions

On Pages 13, 14 and 15 of SURE Lecture 3 in Reference 2, I discussed the irreversible failure of the nozzles in flight to a full open position. With the incorporation of the ENCS (Emergency Nozzle Closure System) these incidents have diminished to almost nil. Other improvements for reliability have also helped to reduce A/B failures. A persistent, repeating malfunction concerns the coking up of the pilot burner and its inability to provide the positive afterburner fuel ignition for A/B lightoff. On Pages 20 through 23 of SURE Lecture 4 in Reference 2, I reviewed fatal accidents when takeoffs were attempted with no A/B operation and I included two photographs to show the instrument readings for the right way and the no-hope way. Even so, impatient pilots are still trying to do the impossible. In order to prevent these situations, early on in the SURE Program I started a campaign, on my visits to 104 bases, to get the pilots to use my procedure during engine start. Let me explain.

On Page 2-12 of the Dash One, Step 3 of the start procedure calls for throttle to idle at 10% rpm. Now as long as I can remember, beginning with the -3 engines in the F-104A, after actuating the start switch and getting 10% rpm, I have always smartly moved the throttle from cutoff to full afterburner and then back to idle. Why? Well, this procedure lights the pilot burner upon engine ignition and can be visually confirmed by a ground crewman before you taxi

AFTERBURNER FAILURE DURING TAKEOFF (Continued)

COMMENT (Continued)

out to the runway and there find out that the A/B won't lite-off. In any case, if you can't get an A/B lite-off you should taxi back to the flight line because even though it's feasible to make a Military Power takeoff, remember what I said about procedures you ain't practiced.

AFTERBURNER SURGE

COMMENT

For all unstable operations of the A/B, I recommend that, as soon as your flight condition permits, you bring the throttle to the mechanical schedule range which is just below 588°C EGT or below Military Thrust. This section of engine operation is very reliable because you are out of the electronic area and your go handle is directly connected to engine thrust.

CANOPY OPEN/LOSS/BROKEN DURING TAKEOFF

COMMENT

On Pages 26-31 of SURE Lecture 4 in Reference 2, I warned all you drivers about not locking your canopies before takeoff but believe it or not -- it's still happening! So far, the record is:

3 pilots have been killed
4 F-104 have been destroyed
9 canopies have departed the aircraft
36 canopies (approximately) have been damaged

The canopy on the Zipper proves that no matter how simple we design something to work -- with your cooperation, it will turn into a 'Gotcha!'

The records show that the odds-on safe procedure for a single place F-104 with an unlocked canopy during takeoff is to abort. Also, if you continue the takeoff in a single place F-104, the listed procedures are probably academic. Because the records show that in all probability, the canopy will be bouncing on the rails by 100 knots, lifting around 150 knots and flinging itself beyond

CANOPY OPEN/LOSS/BROKEN DURING TAKEOFF (Continued)

COMMENT (Continued)

the canopy full open lock around 180 knots. Beyond here, it will hit the IFR (Inflight Refueling) probe or continue on over and smash against the left fuselage thereby fully deflecting the APC vane. If you hadn't noticed before that the plexiglass bubble was no longer above your hard hat, you will now receive the message through the control stick grip in your right hand! (And you thought that the APC vanes were only for stall warning -- tsk, tsk.) The impact of the canopy will release hunks of plexiglass that will be eagerly sucked into the left inlet duct and another canopy loss indication will be the resultant rumble from the engine as it attempts to digest its unexpected appetizers. A real calamity can occur when you notice all your carefully placed articles above the glare shield taking an unauthorized leave and floating out the cockpit and into the left inlet duct. Such things as caps, maps, approach charts -- and maybe even your little black book! The rapidity of these actions right at a most critical part of flight -- liftoff -- practically precludes Step 1 of the procedure being accomplished in a timely manner. The other steps are predicated on an assumption that you will still have a flyable machine after this exercise. The records indicate that you won't.

The two place F-104's have a history of a sneaky 'Gotcha!'. It invariably happens when the rear seat is unoccupied. Add a strange airpatch, a transient alert crew that is unfamiliar with the canopy locking mechanism, a night preflight and -- sure as shootin -- shortly after takeoff, the rear canopy will mysteriously depart the aircraft. In my book, it pays to be extremely alert and cautious when flying a two-place aircraft with the rear seat empty. You have to watch out for:

CANOPY OPEN/LOSS/BROKEN DURING TAKEOFF (Continued)

COMMENT (Continued)

Unsecured ejection handles
Uninstalled pins
Unsecured straps
Incorrect switch positions
Loose objects

And, of course --
Unlatched canopies

You might have heard that losing the rear seat canopy only results in an embarrassing incident to report. Tain't so. On May 28, 1964, a USAF pilot took off alone in an F-104D at night and shortly after takeoff the rear canopy departed the aircraft. And very shortly after that, the pilot departed the aircraft. It seems that the canopy did not really want to leave the aircraft permanently so it picked the handiest place to relocate itself -- smack in the middle of the tail. Since this is typical of the hundreds of cases where equipment unexpectedly leaves the aircraft, it leads me to the following:

Snake Sez:
"All objects that make unplanned departures from your aircraft will invariably display a magnetic homing instinct."

ENGINE FAILURE DURING TAKEOFF

COMMENT

I wrote about this problem in 1970 and covered the subject rather thoroughly in a SURE Lecture titled GO FOR THE ODDS. In that lecture, I pointed out the problems of stopping your hurtling mass if you have a sudden loss of power. Also, I drew out a nomograph to show you the areas where you should abort and the crossover areas where your successful abort odds plummet like

ENGINE FAILURE DURING TAKEOFF (Continued)

COMMENT (Continued)

a greased safe. In that area, I told you to -- jettison -- zoom -- eject. And I told you that the term Zoom is a gross misnomer. In order to understand more clearly the problem and the driving factors behind the actions you should take, I am attaching to this lecture two time histories of F-104G takeoff parameters. These time histories come from the IBM computer program that we utilized for SURE Lecture 7 in Reference 4, which verified the excellent accuracy of the computer in predicting F-104G flight paths. Let's now look at Attachment 1 which is an F-104G Takeoff Time History Summary with a power loss depicted at 90 feet and 245 knots equivalent airspeed (for Standard Day, Sea Level this is basically IAS). You will note from this time history that if you drop the tips and pylons and retain the Center Line Mounted MK 84 Store, it is possible to "glide" up to about 470 feet. If you retain all stores, your "glide" will peak out at 390 feet. And now -- look at the descent paths for both birds after they peak out. What does this tell us? Maybe it explains those accident reports where all went well with the ejection sequence but the jock in his chute faced a "warm" welcome as he floated to the ground. Now let's look at Attachment 2 which is a "worst" case study. This is an F-104G Takeoff Time History Summary with a power loss immediately after lift-off at 222 knots equivalent airspeed. In this case, no stores are dropped and the pitch angle is smoothly increased to stick shaker and the F-104G zooms to the staggering height of 50 feet. Has this "worst" case ever happened? Yes -- in spades. On May 21, 1967, Major Bill Worthy of the Canadian Air Force was taking off from Cold Lake AFB in a CF-104 with Tip Tanks. Major Worthy was Nr.2 in a formation takeoff and just as the flight became airborne, his engine encountered severe compressor stall from FOD and the thrust became non-existent. As Bill dropped back and down from his formation position, he uttered the standard comment about the situation, grabbed the D-Ring

ENGINE FAILURE DURING TAKEOFF (Continued)

COMMENT (Continued)

with both hands and pulled. The CF-104 continued on down the runway and crashed ahead of Bill as he floated down beside the runway very near to his ejection point. Later, Bill told me that his standard comment was a little bitter because this was his second ejection in less than a year. Bill's statement about his power loss was that basically he felt a strong urge to immediately leave the aircraft. After looking at those plummeting curves on Attachment 1, I agree with Bill that it's important to eject while the aircraft still has a healthy forward velocity and will give you lateral separation between you and its final resting place.

In summary, I recommend you give advanced thought to the point where you plan to pull the ejection handle. Don't let that euphemistic misnomer of "zoom" stop you from ejecting immediately.

EXTERNAL LOAD EMERGENCY JETTISON

COMMENT

If you preset the external stores rotary selector switch prior to takeoff, you can eliminate Step 2 when you have to use the bomb button for jettison of the stores.

FIRE DURING TAKEOFF

COMMENT

A review of the records indicate that from 1958 to 1973, there were a total of nine Fire Warning Lights after takeoff. Four of the warnings proved to be false and five were true warnings of fire which resulted in three ejections and two emergency landings. I would like to direct your attention to Page 23 of SURE Lecture 5 in Reference 3. There you will see a sketch depicting airflow through the J-79. Of importance to note, is that the by-pass airflow and the airflow between the primary nozzles and the secondary nozzles gives an effect

FIRE DURING TAKEOFF (Continued)

COMMENT (Continued)

of constraining any engine fire to the combustion section of the engine. There have been no reports, during the operational history of the F-104, of a pilot reporting Fire Warning and then the aircraft exploded. So follow the procedure and use calm judgement.

LANDING GEAR LEVER DOWNLOCK MALFUNCTION

COMMENT

I would like to relate a tale of how this innocuous appearing malfunction resulted in a fatal 'Gotcha!'.

A NATO pilot took off from his base one day with tips and pylons aboard his F-104G. Weather was overcast at 1500 feet and intermittent rain showers (as usual). The NATO pilot was scheduled to chase another pilot who would practice instrument procedures. After takeoff, the chase pilot fell behind the lead and reported that he could not retract his landing gear. Shortly after this, the chase pilot reported that he had an APC problem because when he retracted the landing gear, the APC kicker would actuate. Shortly after this, the chase pilot ejected and struck the ground, just after the F-104G crashed. In the wreckage, it was determined that the throttle was 81% rpm, flaps were up and the landing gear down. An analysis of the sequence of events indicate that the chase pilot tried to raise the landing gear after takeoff and the lever would not move. The airspeed was increasing so the chase pilot raised the flaps from takeoff to up. He retarded the throttle from A/B and slowed down to 260 knots and the APC shaker started buzzing. He pressed the landing gear lever override button and raised the landing gear handle. Presto! The kicker fired immediately when the main landing gear doors closed. The pilot now lowered the landing gear and the kicker relieved. But about this time the ground was rapidly coming up and the D-Ring was pulled.

LANDING GEAR LEVER DOWNLOCK MALFUNCTION (Continued)

COMMENT (Continued)

Now don't ask me why he didn't leave takeoff flaps down, the throttle in full grunt and climb up through the overcast until he was at a safe altitude to slow down and use the procedure to get his landing gear up. And don't ask me to explain this 'Gotcha!' because if you don't know -- you need to study the APC system and its operation in conjunction with landing gear and flap settings. This tale is the direct reason for the Note immediately under the heading.

LANDING GEAR RETRACTION FAILURE

COMMENT

Same as above.

NOSEWHEEL SHIMMY

COMMENT

The records show that from 1958 to 1973 there were 55 reported cases of nosewheel shimmy which resulted in 12 104's running off the runway and encountering major damage such as broken nose gear struts, blown nosewheel tires which threw rubber into the engine intakes, busted shock struts and missing pitot booms. The various reasons given for the simmy were:

Air in the nosewheel steering system
Nose tire out of round
Unbalanced nosewheel

After the air-oil separator and high pressure hydraulic return line was installed in the nosewheel steering system, the incidents decreased dramatically. But you should be aware that nosewheel shimmy can be violent enough to make you lose directional control -- if you don't use the proper procedure.

NOZZLE CONTROL SYSTEM FAILURE DURING TAKEOFF

COMMENT

If the nozzles try to go closed during an A/B takeoff, you will encounter A/B surges as the nozzles will be flung back to open by back pressure from the high discharge airflow and then back to closed again by the malfunction. If this occurs, you should follow the Afterburner Surge procedure. If the nozzles drift to the full open position during an A/B takeoff and you cannot abort, I recommend that you leave the throttle in full A/B, climb to a safe altitude, extend the speed-brakes, pull g's to remain subsonic and burn out the fuel until you have normal landing weight -- then execute the procedure for Nozzle Fails to Open Position During Flight.

In my opinion, the procedure titled Nozzle Fails to Open Position During Military Thrust Takeoff is mistitled. Military Thrust Takeoffs, per se are just not made. If the A/B doesn't lite - you don't go. Of course, we made Military Thrust Takeoffs during the F-104 flight tests in order to establish the handbook curves. Also, Military Thrust Takeoffs have been made on rare occasions when there were extremely cold runway temperatures. But I think this procedure should be titled Nozzle Fails to Open Position During a Military Thrust Go-Around/Touch and Go. In fact, this identical procedure is repeated in the IN-FLIGHT EMERGENCIES SECTION under NOZZLE CONTROL SYSTEM FAILURE. As for the procedure - I recommend you make your decision to stop or continue based upon the aircraft position at the time of the nozzle failure. If you continue and obtain full A/B, observe the WARNING. This means that you must balance the excess thrust against the drag of the landing gear, flaps, speed brakes and if necessary pull some g's in order to maintain the proper pattern speeds. It's not all that difficult Ace, and it has been done.

TIRE FAILURE DURING TAKEOFF

COMMENT

Don't be dismayed if you have a main gear tire failure at less than 150 knots and you follow the recommended procedure to abort and later find out that the Zipper has leading and trailing edge flap dents and rubber in the engine. It just can't be helped, Ace. When the main gear tires start throwing rubber, it will hit on the bottom sides of the leading and trailing edge flaps and

NOZZLE CONTROL SYSTEM FAILURE DURING TAKEOFF (Continued)

COMMENT (Continued)

as you decelerate to abort, some of the rubber is usually flung up past the wing root and gets sucked into the engine. Even though this happens, it is still the wise thing to do. For if you don't, you are faced with a bigger problem by persisting on flying. The Warning Notice very adequately illustrates the point.

IN-FLIGHT EMERGENCIES

(Pages 3-10 through 3-39)

AIR START

COMMENT

Aerodynamic Engineers refer to all jet engines as induction and exhaust systems. To you and me, it means a machine that sucks and pumps. Early on, I learned when the J-79 stopped sucking and pumping, there are many positive indications of the flameout. Of course, you have the main sensation of a loss of thrust but it is also usually accompanied by:

- Rapid loss of cockpit pressurization (which can be accompanied by a fogging of the cockpit making it difficult to see the guages).
- A noticeable forward stick pulse as the pitch damper loses electrical power, if the rpm drops below 66% (except TF-104G).
- A loss of tone in the headset as the Comm System loses electrical power, if the rpm drops below 66%.
- A loss of the Inertial Navigator and PHI if the rpm drops below 20%.
- An inner sensation that will cause you to mutter the standard comment for these moments in flight.

AIR START (Continued)

COMMENT (Continued)

On Pages 1 through 4 of SURE Lecture 3 in Reference 2, I critiqued the Air Start procedure that existed at that time. I explained what you are accomplishing with each step of the procedure and also discussed the Air Start envelope that John Fritz of General Electric had established on test flights at Edwards AFB. An examination of the Lockheed Flight Safety records indicate that from 1958 to 1973, there were 48 reported flameouts in the F-104. Now these were flameouts from fuel flow interruption, throttle misrigs, etc. These flameouts were not caused by compressor stalls, which I will discuss later. From these flameouts, there were 34 ejections with seven fatalities, where the ejections took place too low, too slow and at too high of a sink rate. From what I can analyze from the reports, about one-third of the flameouts were irreversible, such as a sheared spline in the main engine driven fuel pump, the other two-thirds were curable -- but the proper procedure was used in only half these cases. This tells me that maybe there is an inadequate emphasis on studying and practicing the Air Start procedure. To assist you in this, I have attached some graphs to answer two questions:

- How fast will you lose the suck and pump in different areas of the flight envelope?
- How fast can you expect to regain the suck and pump after you execute the proper Air Start procedure?

Let's look at Attachment 3 which is a plot of estimated J-79 engine coastdown characteristics at different simulated flight conditions in the sub-sonic regime of flight. Here, you see that under all subsonic conditions that when the engine flames out, it will rapidly stop the sucking and pumping and automatically revert toward a windmill operation. It will do this so

AIR START (Continued)

COMMENT (Continued)

fast, you will probably not be able to react before the rpm has dropped below 60-70%. However, you can see that it takes a goodly amount of time before the rpm drops down to the critical areas of 20-40%. So this answers the first question. Now you may wonder -- is it profitable to attempt the Air Start procedure before the rpm drops to a stabilized windmill rpm at the recommended glide speed of 245 knots IAS? Damn right, Ace. And that query leads us to the answer of our second question. Let's now look at Attachment 4 which is a J-79 Typical Air Start Envelope with divided areas of the subsonic regime depicting the time from lightoff to idle. Here, you see that the times for lightoff to idle rpm range from as fast as two seconds to as slow as 40 seconds. Basically, the message is that for a given altitude, the faster the speed of the aircraft, the higher the windmill rpm, therefore, the less rpm recovery back to idle is required which results in less time to regain the suck and pump. But the reverse of this message is the 'Gotcha!' in trying to get back the suck and pump. You might be wondering if any other Air Start tests were done by Lockheed or the USAF in order to prove the correctness of the Air Start procedure. The answer is that no other tests were made, however, as I pointed out to you on Page 14 of SURE Lecture 2 in Reference 2, that on all zoom flights, the engine has to be shut down around 75,000 feet in order to prevent excessive EGT. This means that for every zoom above 75,000 feet, there is a requirement for an Air Start on the way back down. From the years of 1962 through 1972, the Test Pilot's School at Edwards AFB had a flight curriculum that required each student to make nine zoom flights during the course. There were 15 students per course and two courses per year. This equates to 270 zooms per year for the students. The IP zoom proficiency flights totalled 40 per year. With 310 zoom flights for 10 years, there were 3,100 Air Starts made -- without a single failure! Their procedure was simply to fly an angle of attack of 8^{o} during the re-entry and gently level off at 43,000 feet with around Mach 1.1 and then they executed their Air Start procedure.

AIR START (Continued)

COMMENT (Continued)

In summary, I recommend that you study and practice the Air Start procedure at every opportunity -- it works!

AUTO-PITCH CONTROL SYSTEM FAILURE

COMMENT

The APC system operation description and stall characteristics discussion in the Dash One are thorough and detailed. If you know all the ins and outs of the APC system you will be able to evade the 'Gotchas!'. It's come to my attention, however, that maybe more information is needed for the critical missions such as low altitude range operations. It is also of interest to note that from Lockheed's Flight Safety records there were 26 reported pitch ups that resulted in 20 ejections with eight fatalities during 1958 to 1973. Since the APC system was designed to prevent pitch up and assist you in maneuvering the Zip, it appears that the system has been misused (kicker deactivated during maneuvering) or that pilots have inadvertently forced the aircraft into pitch up. On Page 1 through 7 of SURE Lecture 2 in Reference 2, I described the low speed pitch up maneuver and the limited, accelerated stall approaches that were flown at high, transonic speeds. These pitch up tests were all that the USAF required of Lockheed and remain the only quantitative data base for details of pitch ups. Since there continues to be some misunderstanding on how to operate the APC, I want you to look at some more data on the APC system.

First, let's look at Attachment 5 which are plots of the APC and stick shaker operating boundaries. This shows you the vane angle boundaries for shaker and kicker versus Mach No. for the clean and takeoff flap settings. Also, you see why the aero people call the left vane the subsonic vane and the right vane the supersonic vane. Now, let's look at Attachment 6 which plots true angle of attack versus Mach No. and shows you the curves

AUTO-PITCH CONTROL SYSTEM FAILURE (Continued)

COMMENT (Continued)

for computed angle for neutral stability and shaker and kicker operation. Of interest are those points where the kicker line is close to the computed neutral stability line. There's two places, one at Mach .6 to .8 and one at Mach 1.2 to 1.25. Could these areas hide a 'Gotcha!'? Let's examine them.

The area of Mach 1.2 to 1.25 has not produced any pitch ups. Why not? The best answer I can find is that the aerodynamicists say that the 104 stabilizer is control power limited in this supersonic regime. What they mean is that in full A/B and full aft stick, you will not be able to pull the nose up to a true angle of attack of 15^{o}. This is because the supersonic airflow over the horizontal stabilizer does not give you the same nose up force as in subsonic flight. On Pages 18 and 19 of SURE Lecture 5 in Reference 3, I explained about the Aerodynamic CP (Center of Pressure) shift from subsonic to supersonic flight and the resultant decreased control power. Therefore, you're protected at this Mach area. Oho -- you say. Then how about the subsonic area? Is there a 'Gotcha!' there? Could be. I think it depends on how smooth you are. In order to demonstrate this area to the IPs of the Cold Lake AFB, 417th O.T.S., I would accelerate the CF-104D to about Mach 1.3 and there start a steady-state turn, pulling about 2½ g's with the throttle reduced back to Military. The Mach Number would start smoothly bleeding down with the APC indicator at a steady setting around 3. When we would encounter the reverse Mach jump, the Zipper would immediately start heavy buffeting while simultaneously the control stick would rattle and kick forward. The student could notice a quick jump on the APC meter from three to five while this happened. What's my point? Just this. If you make a supersonic pass at a target and then pull the throttle to idle and honk on a basket full of g's -- watch out! Your deceleration combined with your wind-up turn could really be a 'Gotcha!' -- at the second you become subsonic. So watch it, Ace.

AUTO-PITCH CONTROL SYSTEM FAILURE (Continued)

COMMENT (Continued)

Another phase of APC operation that, unfortunately has been a fatal 'Gotcha!' has been the inadvertent kickers on the gunnery and bombing ranges. So that you will better understand the override capability of the kicker and the technique to use, let's look at a plot of pitch rate signal in Deg./Sec. versus true angle of attack in degrees and showing the shaker and kicker boundaries. Since your weapons range work is done with takeoff (or maneuvering) flaps, I had our aerodynamicists draw up Attachment 7. Now, what does this plot tell us? Well, let's briefly reconstruct the accident of a pilot on a gunnery range. The pilot was making a 15^{o} angle strafing pass and upon gun firing, the APC kicker actuated. The range officer reported that the kicker appeared to actuate two more times and then the pilot ejected. Why did the pilot eject? Obviously, he came to the conclusion that he could not stop the aircraft from impacting the ground. This accident is a real "bummer" in my book and I'll explain why. The aircraft on the strafing pass was probably at a true angle of attack of 1½ degrees and a zero amount of pitch rate. Note that point on our plot. Now go up to the pusher boundary and you find that any constant pitch rate under 20^{o} per second will be below the kicker operation. If the pilot had pulled the stick at only a pitch rate of 15^{o}/Sec., he would have been 15^{o} nose up in two seconds. And he would not have been anywhere close to encountering a pitch up. What's the analysis? The pilot encountered a spurious kicker on gun firing, then a quick pull on the stick probably induced cyclic rate kickers. One smooth, steady pull -- bracing yourself against further kickers -- will recover the aircraft. Once your flight path is in the upward direction -- ease off the aft stick and don't override yourself into a pitch up. Smoothly does it -- Ace.

BLEED AIR DUCT SEPARATION/FIRE WARNING LIGHTS/INADVERTENT T_2 RESET

COMMENT

When this 'Gotcha!' first reared its head, there were pilots clanked up from Taiwan to Norway. With stronger BLC ducts and improved BLC clamps, the problem has seemed to disappear. However, I recommend you closely study this procedure because when it happens -- it's tricky.

CANOPY OPEN/LOSS/BROKEN DURING FLIGHT

COMMENT

No further comment.

COCKPIT PRESSURIZATION MALFUNCTION

NO COMMENT

STALL CLEARING PROCEDURE

COMMENT

Here's a case where you lucked out, Ace. You don't have to learn this procedure -- all you gotta do is Air Start the ailing suck and pumper. Now in case you're scratching your head and muttering about "who'd want to shut down an engine instead of just putting the throttle in idle?" -- the answer is that the Air Start procedure will definitely keep you away from an insidious 'Gotcha!' because for the suck and pumper that can only gasp and wheeze and give you no more push -- the Air Start procedure will tell you that immediately and that greatly assists the decision making process in your headbone. Let me give you a little background about compressor stalls and explain the whys of the procedure.

A review of Lockheed's Flight Safety records shows that there were 68 reported cases of compressor stalls from 1958 to 1973. These were all cases of the engine going into a steady state stall until the pilot took corrective action. Of the 68 stalls, there were 44 cases of the stalls being cleared and 24 ejections.

STALL CLEARING PROCEDURE (Continued)

COMMENT (Continued)

Of the 24 ejections, it was determined that 16 engines had encountered extensive FOD, three engines had corrosion, three engines had ingested flying feathered objects, one engine had misrigged IGV's and one pilot had used the improper procedure -- first he pulled the nozzle closure handle and then he pulled the ejection handle.

Also, it is of interest that numerous stalls were reported to be encountered right after takeoff as the pilot brought the throttle out of A/B. In every case, the pilots performed the Air Start procedure which cleared the stalls and in many cases, they continued the mission. The primary cause of these stalls was corrosion on the variable stator vanes. One reported stall was cleared by the pilot on an ILS approach between the outer and middle markers!

From looking at the records, they seem to be telling us that the most critical type of compressor stall is the one caused by FOD. These cases are generally encountered on weapons ranges at low altitudes and weapon delivery speeds. In all cases of compressor stalls at low altitude -- it is imperative that you immediately initiate the Air Start procedure for the following reasons:

1. You positively break the stall. No suck and pumper can stall when you put in the windmill mode.
2. By breaking the stall, you put the suck and pumper in the best of conditions for restart.
3. You save precious time and airspeed as I described for you in the Air Start procedure envelope discussion.

STALL CLEARING PROCEDURE (Continued)

COMMENT (Continued)

Now, let's discuss the procedure:

1. Throttle-Off
   a. Clears stall
   b. Fully closes the IGV's and variable stator vanes
   c. Eliminates any hysteresis in the throttle rigging.

2. Start Switches - START (Hold momentarily)
   a. Provides approximately 45 seconds of continuous ignition
3. Throttle - IDLE
4. Monitor Air Start
   a. If engine stalls during the start or at idle rpm -- use the available time and airspeed to obtain a favorable ejection position.
   b. If the engine starts and then stalls during throttle advance -- check the rpm of the stall. If this rpm cannot maintain flight -- use Step a. If the rpm is enough to maintain flight put throttle at a stall free rpm and land ASAP. And don't jockey the throttle!

The first Note under the procedure makes a valid point. If you have the altitude to spare, you might desire to inform someone of your difficulties, i.e., 'Look out below!'. Therefore, an initial retard of the throttle to idle is in order. But if your suck and pumper does not recover upon throttle advance -- use the Air Start procedure.

Since we all have a vital interest in preventing FOD, I am enclosing Attachment 8 for your study.

EJECTION

COMMENT

On Pages 16 through 21 of SURE Lecture 3 in Reference 2, I presented to you the results of a mathematical study of all parameters affecting the ejection envelope of the C-2 seat. A large amount of the study is applicable to all ejection seats and will give you good background information.

As for the information in the discussion of Ejection versus Flame-Out Landing, I am in complete agreement. Also, I have no further comment on pages 3-14 through 3-23.

SMOKE OR FUMES IN THE COCKPIT

COMMENT

The records show that you might get smoke or fumes in the cockpit from the following:

- The 120 amp Transformer/Rectifier in the E-Compartment overheats and dumps smoke and fumes into the cockpit. In this case, the DC PRIM BUS OUT light will illuminate on the peek-and-panic panel.
- A flap drive motor overheats and burns the wiring in the motor. Here, you might smell light fumes.
- The auto-transformer on the cockpit light control panel on the right console overheats. There will be no warning light but strong fumes will be present.
- The radar blower motor overheats and some fumes will come into the cockpit but the smoke will dissipate out through the cooling ducts in the radome.

ELECTRICAL FIRE

COMMENT

The records are bare on this failure so that's why the procedure is in small type -- but that doesn't mean it can't happen.

ELECTRICAL SYSTEM FAILURE

Single AC Generator Failure

COMMENT

I want to point out that you can still fire the gun but the gun motor will only turn over at half the normal rate.

Dual AC Generator Failure/Automatic Bus Transfer System Failure

NO COMMENT

Hydraulically Driven Fixed-Frequency Generator Out

NO COMMENT

Primary DC Bus Failure

COMMENT

Covered under Smoke and Fumes in Cockpit.

ENGINE FAILURE DURING FLIGHT

COMMENT

Step one sure sounds reasonable.

EXTERNAL LOAD EMERGENCY JETTISON

COMMENT

There have been numerous cases when the pilots have encountered emergencies above or in the clouds and they have nursed the sick birds down through the murk -- still carrying all external stores. So often, there has been the question from the non-flying types of, "Why didn't the pilot jettison the stores at the onset of the emergency?" My answer to them has always been:

Snake Sez:

"Stores jettisoned above an overcast will always fall where they can do the most harm. This phenomena is known as the Law of Selective Gravitation."

In regard to the stores jettison limits and how they were determined, I refer you to Page 19 of SURE Lecture 1 of Reference 2.

FIRE DURING FLIGHT

COMMENT

Merde!

FUEL SYSTEM FAILURE

COMMENT

I don't need to remind you that fuel system management is important. It's the lifeblood of your suck and pumper -- so make sure you feed it properly.

HYDRAULIC SYSTEM FAILURE

COMMENT

On Pages 38 through 42 of SURE Lecture 6 in Reference 3, I discussed the disengage (or push-over) maneuver for ACM tactics. I have flown the "0" g disengage path numerous times with USAF, Chinese, Canadian, Pakistani, Saudi Arabian, Belgian and Jordanian pilots. During this training, I always alerted the student to the possibility of losing a hydraulic system at supersonic speeds. The message has always been:

- Throttle - Idle
- Speed Brakes - Out
- Pull maximum g's to stick shaker
- As soon as subsonic flight is reached -- pull more g's to stick shaker

No. 1 System Out

NO COMMENT

No. 2 System Out

COMMENT

I would recommend that you consider extending the RAT after a failure of the No. 2 hydraulic system. I recommend this because the RAT will bypass the hydraulic fluid from the No. 1 hydraulic system pump so long as the No. 1 pump is discharging normal pressure. The benefit that you will gain is that the RAT will be up to speed and ready to immediately supply hydraulic pressure at the instant the No. 1 pump fails.

No. 1 and No. 2 Hydraulic Systems Out

COMMENT

This is the failure I recommended you get ready for with the preceeding comment. Aircraft response, with this situation, is very slow so plan ahead for maneuvering to land.

IGV CLOSURE

COMMENT

This used to be a real 'Gotcha!'. If the throttle was in Military, the rpm would be 100%, EGT would be around 600^{o} and the nozzles would be about normal. Everything would seem fine -- except you would be falling out of the sky! But a sneaky peek at the fuel flow would show about 2500 LB/Hr. This tells you that the IGV's are closed. The closures were caused by the teleflex feedback cable in the throttle linkage doing a 90^{o} flip-flop. This was remedied by a T.O. and appears to have faded away. I must alert you, though, that obtaining an A/B lite is very chancy, so don't assume that Step 1 will work -- it only did so one time out of all the cases.

NOZZLE CONTROL SYSTEM FAILURE

NO FURTHER COMMENT

OIL SYSTEM FAILURE

COMMENT

From day one, this has always been a critical system for the suck and pumper. Without lube oil to the bearings, the bearings will disintegrate, the engine physically shifts down and the turbines grind to a low rpm of 3-5% while gouging into the shroud lines. After losing far too many Zips, constructive changes were made to the oil system to prevent this failure. Before the oil quantity guage and the ENCS was installed, I used to tell the pilots that the Warning Light on the peek-and-panic panel was mislableled. Even though the light read-engine oil level low -- it really meant,

"Ha! Ha! You just lost your nozzles!"

OIL SYSTEM FAILURE (Continued)

COMMENT (Continued)

The records show that the improvements to the system have paid off. Let's hope it stays that way.

NUCLEONIC ENGINE OIL LEVEL LOW CAUTION LIGHT

NO COMMENT

ENGINE OIL LEVEL LOW WARNING LIGHT

If Light Illuminates in Flight

COMMENT

By definitely checking the ENCS and the nozzle handle during your after start checks, you will be assured that the handle works. The Note reference to airspeed and altitude means supersonic flight where the bypass airflow between the primary and secondary nozzles will exert too great of an airload for the ENCS to overcome.

OXYGEN SYSTEM FAILURE

NO COMMENT

RAT EXTENDED FLIGHT

COMMENT

I have extended the RAT at various altitudes and speeds and recommend that you follow the envelope of operation as described.

SPIN RECOVERY

COMMENT

On Pages 8 through 20 of SURE Lecture 2 in Reference 2, I described the normal spin mode and the flat spin mode (called stable spin in the Dash One). Those of you who have viewed the Lockheed Pitch Up and Spin Test Film, know that the normal spin is a rough ride and if you've also seen the film of "Chuck" Yeager in the NF-104A you know that the flat (stable) spin is a very smooth

SPIN RECOVERY (Continued)

COMMENT (Continued)

ride. Also, the NF-104A film definitely shows that you must deploy the drag chute in order to effect recovery. I'm happy to report that two pilots have personally told me of deploying the chute as the Zip got into a horrendous attitude -- and the chute popped them nose down and they recovered. So, don't be timid about using the drag chute -- it's your umbrella for those nose high, speed low, mushy stick conditions.

STABILITY AUGMENTATION SYSTEM FAILURE

NO COMMENT

TRIM FAILURE OR RUNAWAY TRIM

COMMENT

On Pages 53 and 54 of SURE Lecture 5 in Reference 3, I told you about the parameters of stick movement and stabilizer deflection with full trim shift. During the Lockheed Flight Tests, I have landed the Zip with full trim shift both ways. That's where the procedure comes from, Ace.

AIRSPEED SYSTEM FAILURE

COMMENT

This procedure works because we developed it at Palmdale during the Lockheed Flight Test Program.

APPROACH END ARRESTMENTS

COMMENT

Many pilots have landed the Zip with a blown main tire and did not even know the tire condition until slowing down to turn off the runway. The Note makes this point and is correct.

ASYMMETRIC EXTERNAL TANK FUEL LOAD

COMMENT

If you land with a left crosswind and a right, heavy tank -- look out for the 'Gotcha!'. There is a Caution Notice on Page 3-38 that says any aircraft that do not have 2011 C/W, nosewheel steering and power/anti-skid brakes will not be available -- if the left main gear is not down. In this case, the weight of the right, heavy tank will lighten the weight on the left gear and the ground-air safety switch might not close. Got it, Ace?

BARRIER ENGAGEMENT

BOUNDARY LAYER CONTROL MALFUNCTION

COMMENT

I hope that you don't get the idea from this procedure that a takeoff flap landing equates to a barrier engagement -- cause it don't. Any experienced 104 driver will confirm this statement.

FLAP FAILURE

COMMENT

Now this failure puts you into the category of a potential barrier engagement if some of the factors are against you -- wet runway, crosswind, drag chute failure -- you know what I mean. But all students that I have checked out in the Zip were shown how to make a no flap approach and touchdown -- it was in our checkout curriculum for students at Lockheed.

IF TRAILING EDGE FLAPS FAIL

COMMENT

As I stated before, no flap landings are definitely OK -- if you fly the final at the right attitude and airspeed as recommended. From my experience, you will encounter the stick shaker just prior to touchdown -- but don't sweat it, Ace -- you're about to kiss the runway.

EMERGENCY WING FLAP OPERATION

COMMENT

The reason that the trailing edge flaps are sequenced to operate first, when you're on RAT power, is that they are the important flaps.

ASYMMETRIC FLAPS

COMMENT

This 'Gotcha!' can be a bummer. Before we installed the asymmetry detector, we lost some drivers. The condition that really causes loss of lateral control is when one trailing edge flap travels beyond the 30^{o} down position -- where BLC airflow begins to take effect -- and the other trailing edge flap stays takeoff (15^{o}). Be alert for this one and keep your hand on the flap lever so that if you begin to feel it -- you can snatch the flap lever back to the previous position.

LANDING GEAR EMERGENCY EXTENSION

COMMENT

The reason that the procedure calls for landing gear lever - up, before pulling the manual landing gear release handle is that all of the 2,500 + F-104's that have been built around the world underwent a flight check of manual gear release in just this manner. And except for the two place nose gear -- they all worked perfect. With the landing gear lever up, the wheels are held up from contact with the doors and not pressing down on the doors. So the system works better with this procedure.

MAIN GEAR FLAT TIRE LANDING

COMMENT

I would not emphasize trying to touch down on the good tire -- just make a normal touchdown and you'll be OK, Ace.

MAXIMUM GLIDE

NO COMMENT

NOSE GEAR FLAT TIRE LANDING

COMMENT

My experience has been that minimum speed for holding the nose up is around 140 knots. Your best control is from touchdown speed to about 145 knots and I recommend you lower the nose before 130 knots.

NOSE GEAR UP LANDING

COMMENT

The way this 'Gotcha!' operates has been when drivers in a two-place had to make a manual gear release. Then, because of lack of spring servicing or improper rigging, the nose gear couldn't overcome the airload and wouldn't extend to down and locked. It grabbed me, back in 1965, while flying a Spanish TF-104G. The tower visually confirmed that the nose gear was down only at a 45^{o} angle. I tried everything from stick pulls, yaw angles and very slow speeds. All to no avail. Then, I landed -- and upon touchdown, held the nose up and pulled the drag chute. The chute deployed, I pulled full aft stick, and at 140 knots there was a 'glunk', the horn stopped honking, the red light went out, the indicator showed down and the nose wheel hit the runway. In those cases where the drivers couldn't get the nose gear down, they made normal landings, smoothly let the nose down and the aircraft suffered only minor damage.

ONE MAIN GEAR UP OR UNLOCKED LANDING

COMMENT

In Vol. VII, No. 1 of the Hangar Flying Magazine printed by Lockheed in February, 1967, there was an article written by Maj. Hunt, USAF Acceptance Pilot. He described how the right main gear hung up on a QF-104A drone aircraft.

ONE MAIN GEAR UP OR UNLOCKED LANDING (Continued)

COMMENT (Continued)

His experience was very unique -- it's the one and only case. That's because the drone 104's had a lot of funny circuits and were completely different than the standard F-104 landing gear system. While his experience was unique, it is worthwhile to note that he made a successful landing and proved it can be done with the right conditions and pilot technique. However, the only way I think this may happen to you would be the unlikely event of combat damage.

POWER BRAKE/ANTI-SKID SYSTEM MALFUNCTION

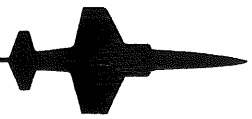
COMMENT

I recommend that you practice "no drag chute" landings so that you will develop a good technique with the brakes. Also, practice with the manual brakes so that you will respect the pedal pressure that's required.

PRECAUTIONARY PATTERN

COMMENT

On Pages 5 through 11 of SURE Lecture 3 in Reference 2, I described the SFO pattern and gave you a detailed breakdown of the flight path parameters. Also, I included the impact on the flight path when you've dropped the landing gear at the hi-key. I recommend that you practice the pattern in order to recover from the 'Gotcha's!' such as dropping oil pressure, nozzle malfunctions, compressor stalls, etal. It will pay off!



SUMMARY

I hope that you find this information useful and I wish you the best of success in the great, little Zipper. As to how you've been doing, take a look at Attachment 9. And remember this:

Snake Sez:

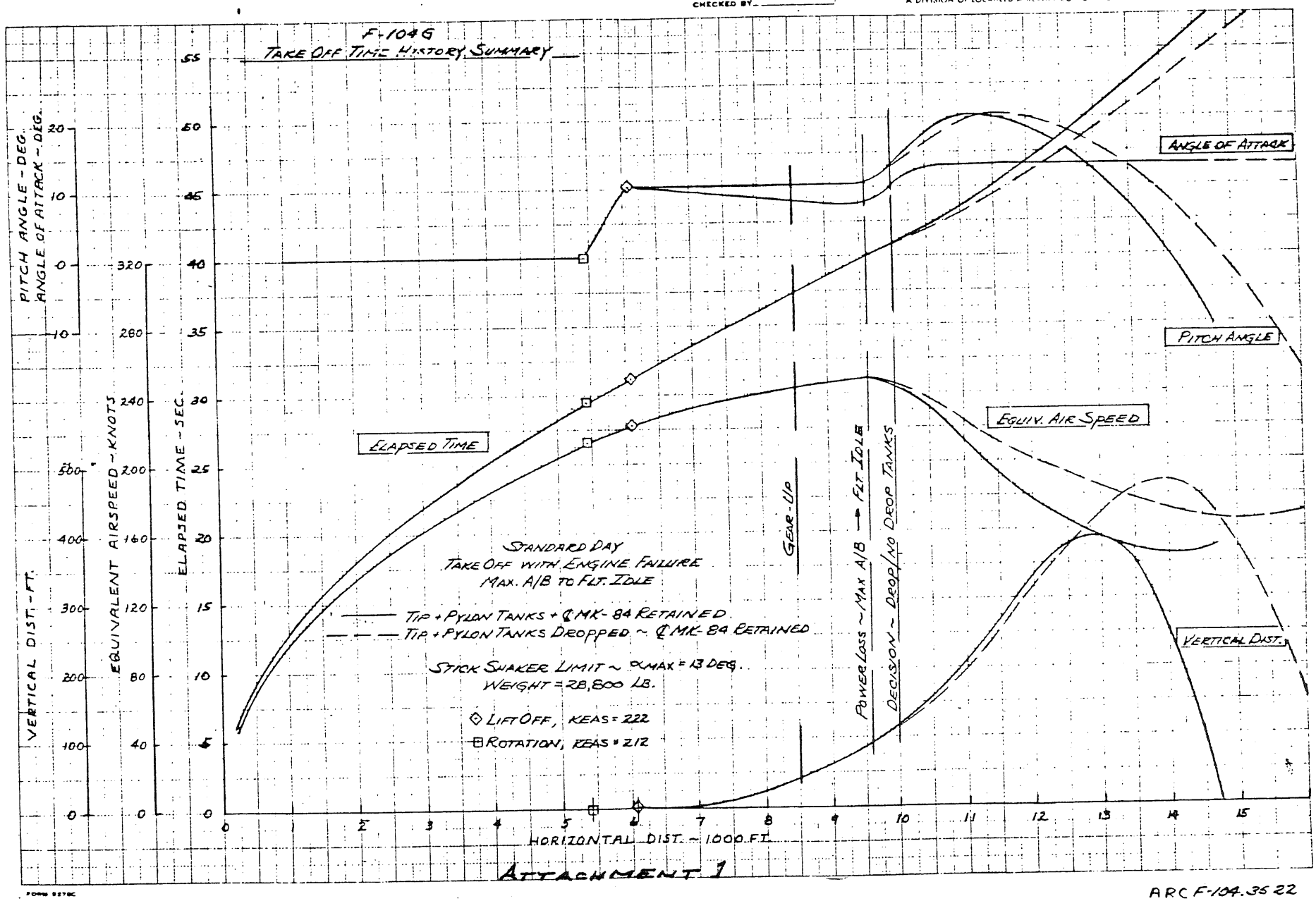
"By studying and practicing the emergency procedures -- you can evade the 'Gotcha's!"

PREPARED BY [illegible]
DATE 6 [illegible] 70
CHECKED BY

LOCKHEED-CALIFORNIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PAGE
MODEL
REPORT NO.

ATCH 1



ATTACHMENT 1

FORM 9276C

ARC F-104.35 22

PREPARED BY PEGGY
DATE 6-9-70
CHECKED BY [illegible] 6-9-70

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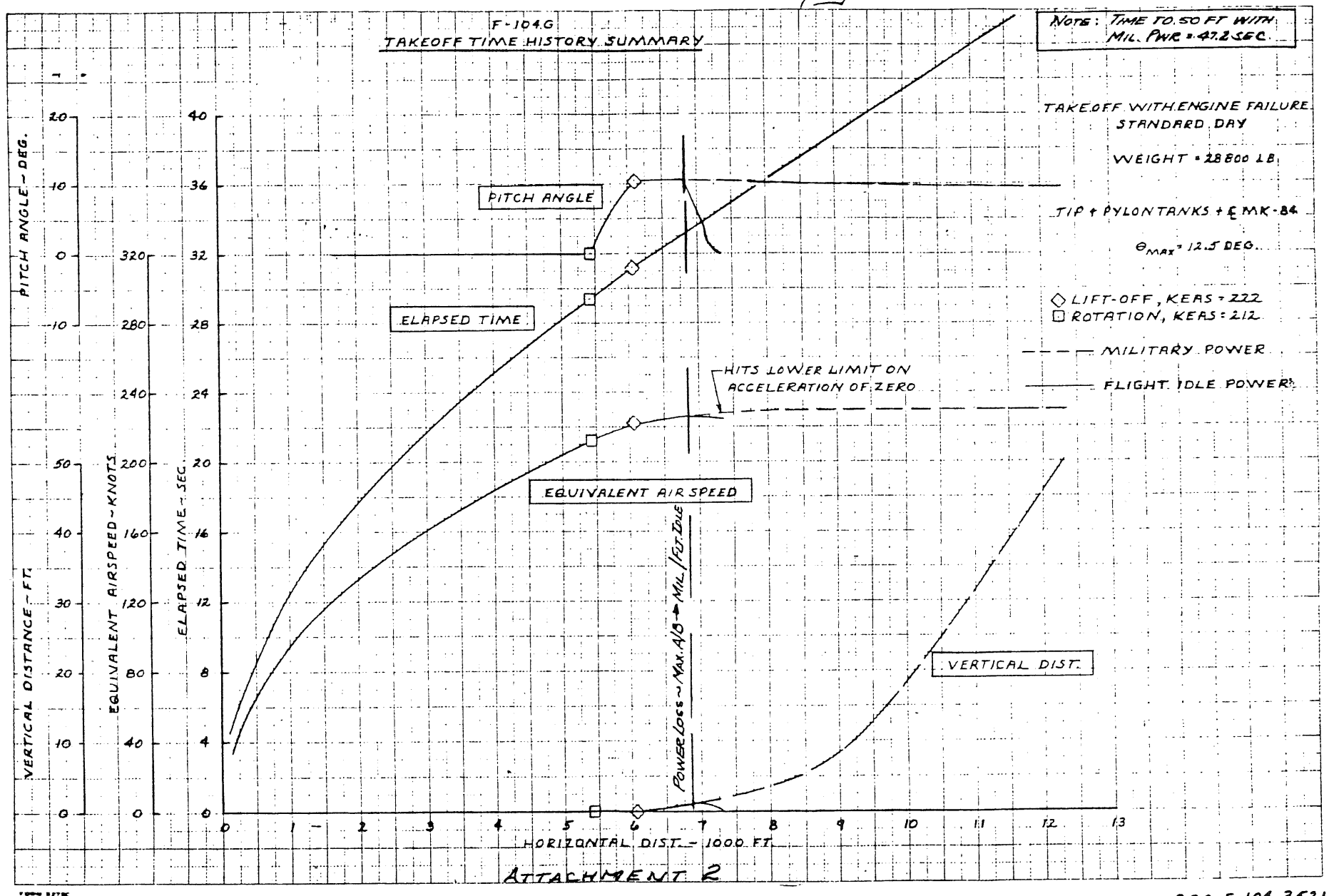
MODEL F-104G
REPORT NO



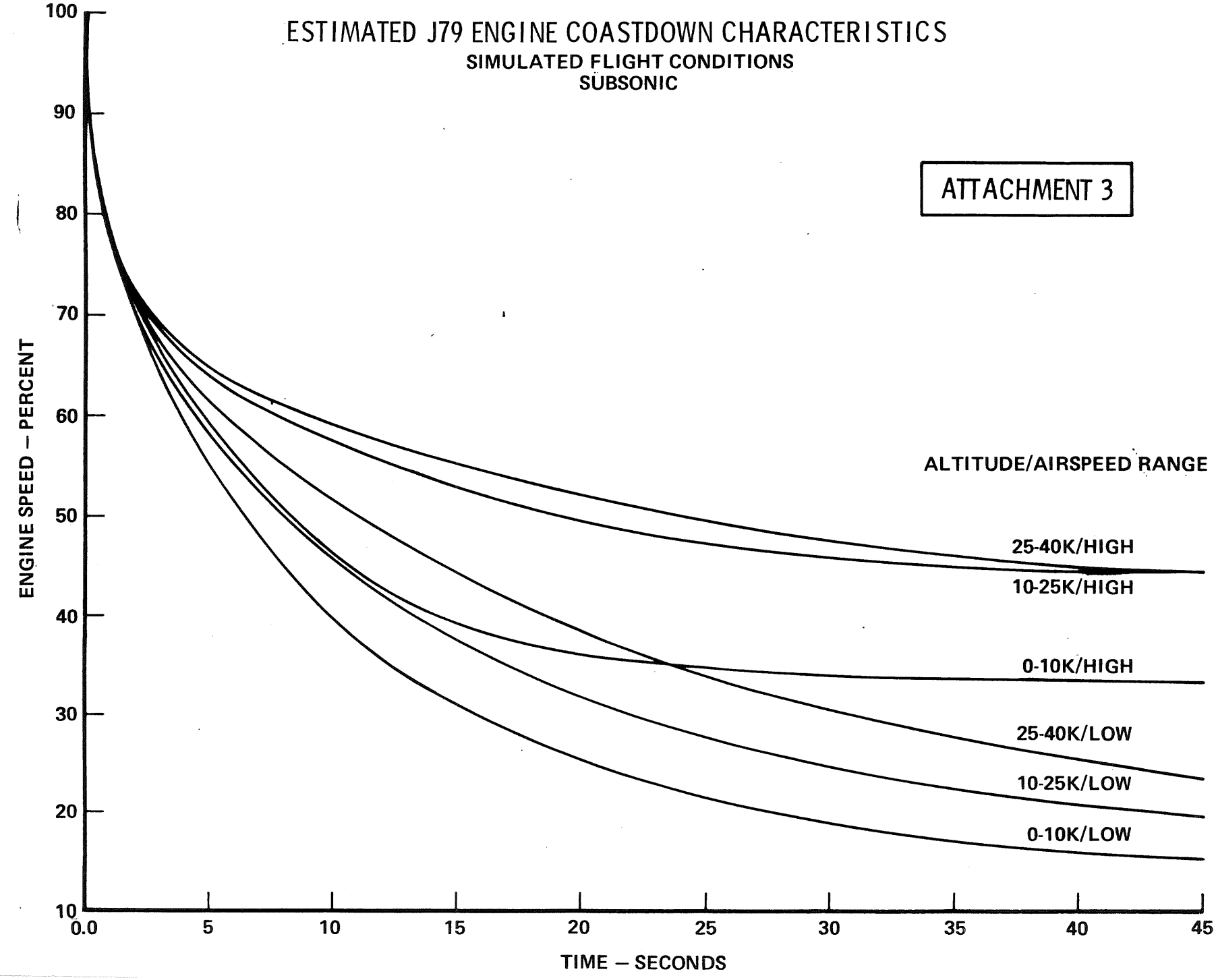
ATTACHMENT 2

ARC F-104.3521

ESTIMATED J79 ENGINE COASTDOWN CHARACTERISTICS

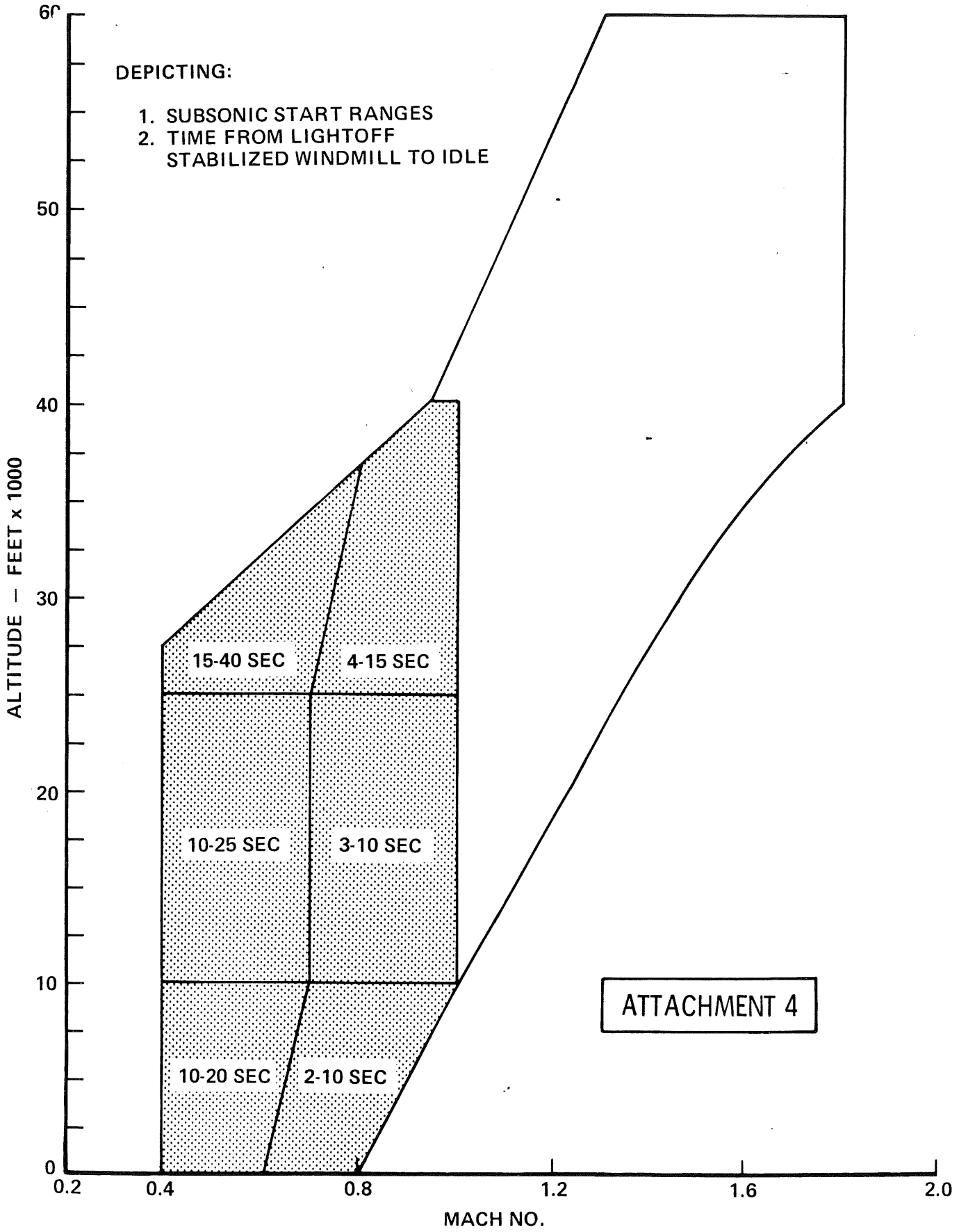
SIMULATED FLIGHT CONDITIONS
SUBSONIC

ATTACHMENT 3



ATCH 3

J79 TYPICAL AIRSTART ENVELOPE



APC & STICK SHAKER OPERATING BOUNDARIES

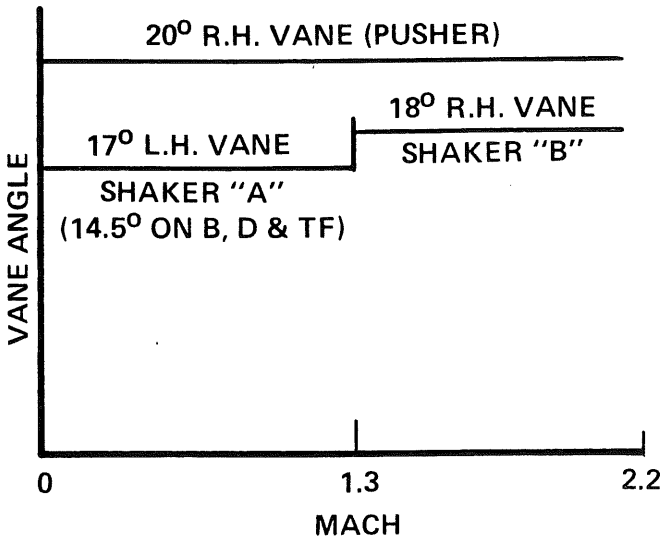
(PITCH RATE = 0)

F-104A THRU D

ALL CONFIG. BUT NO PUSHER WHEN
LDG. GEAR OR LDG. FLAPS ARE DOWN

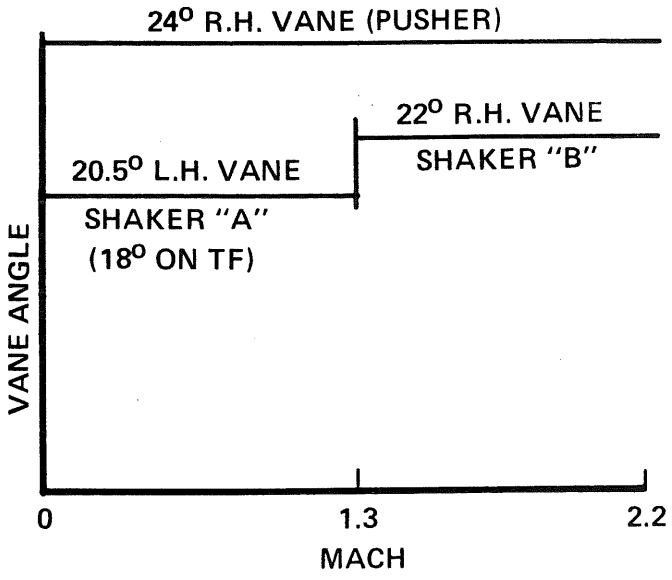
F-104G & TF-104G

CLEAN
CLEAN + GEAR DOWN (NO PUSHER)
CLEAN + LDG. FLAPS (NO PUSHER)



F-104G & TF-104G

CLEAN + MAN. FLAPS
CLEAN + MAN. FLAPS + GEAR DWN. (NO PUSHER)
CLEAN + LDG. FLAPS + GEAR DWN. (NO PUSHER)

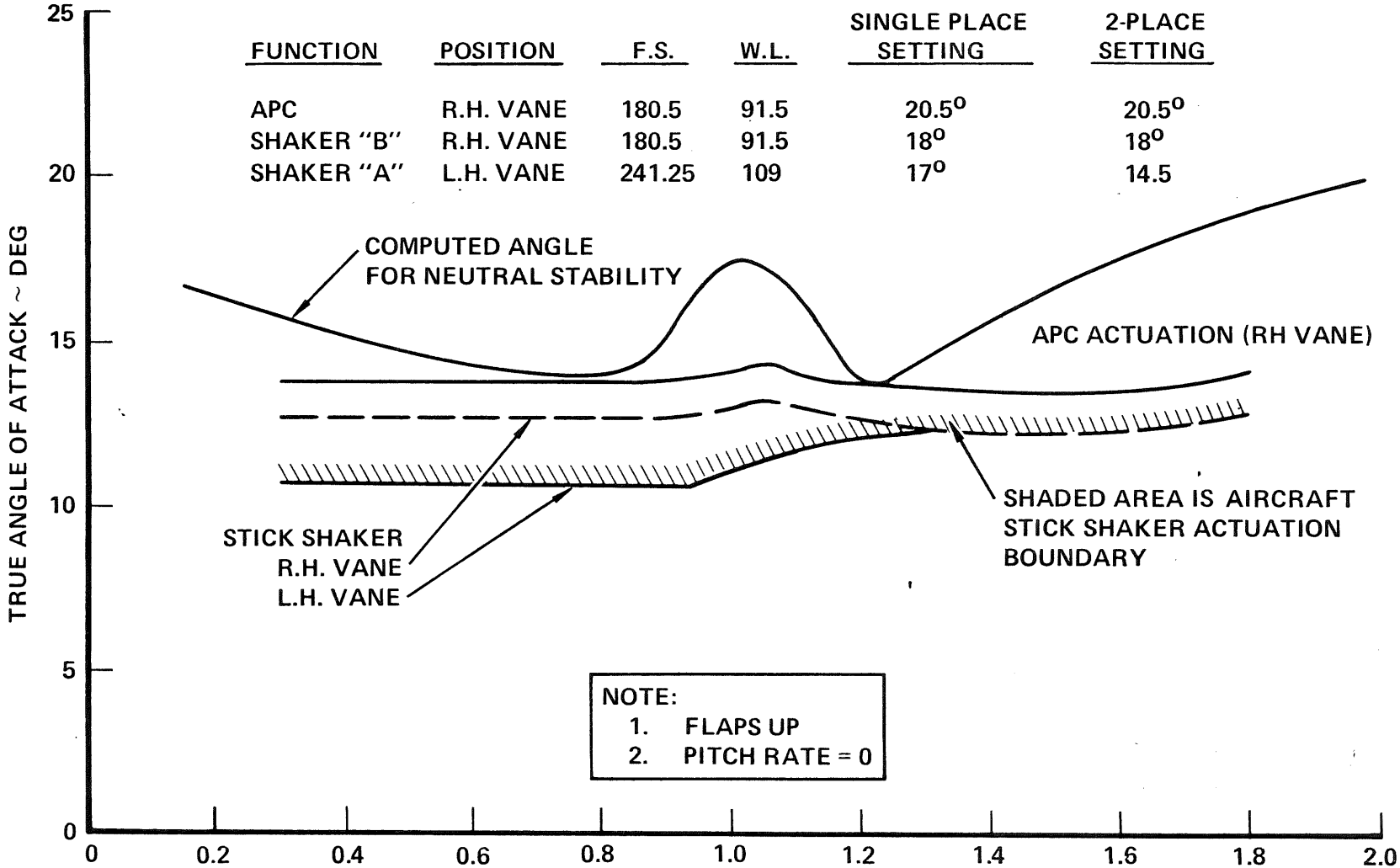


ATTACHMENT 5

ANGLE OF ATTACK STICK SHAKER, APC OPERATION

STEADY STATE FLIGHT

FUNCTION	POSITION	F.S.	W.L.	SINGLE PLACE SETTING	2-PLACE SETTING
APC	R.H. VANE	180.5	91.5	20.5^{o}	20.5^{o}
SHAKER "B"	R.H. VANE	180.5	91.5	18^{o}	18^{o}
SHAKER "A"	L.H. VANE	241.25	109	17^{o}	14.5

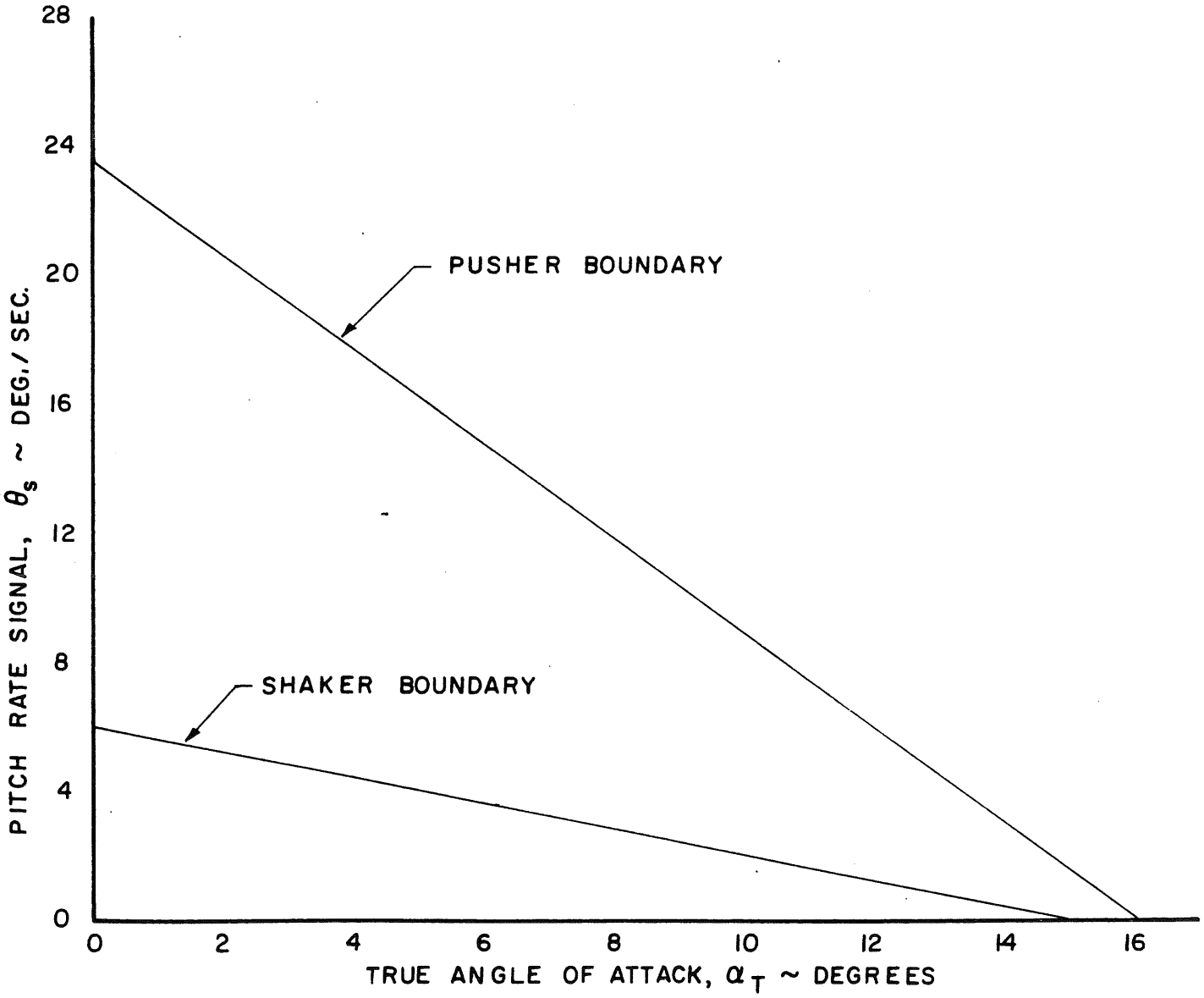


ATTACHMENT 6

ATCH 6

LOCKHEED F-104

APC AND STICK SHAKER OPERATING BOUNDARY vs. AIRPLANE ANGLE OF ATTACK MANEUVERING FLAPS DOWN



ATTACHMENT 7

FOD-FOOTED MUCKING-BIRD

"Show me a nesting area, and I'll show you a mucking bird" goes an old bird watchers' adage. And sure enough — across the muckiest region of the infield, FOD-foot comes vehiculating toward the runway. Once on firmer ground, there commences a stomping of feet — an instinctive ritual which is this bird's greatest delight. Divested of his deadly debris he glances momentarily backward to admire the mire; at this point — if you listen to the mucking bird — you'll hear his chortling call:

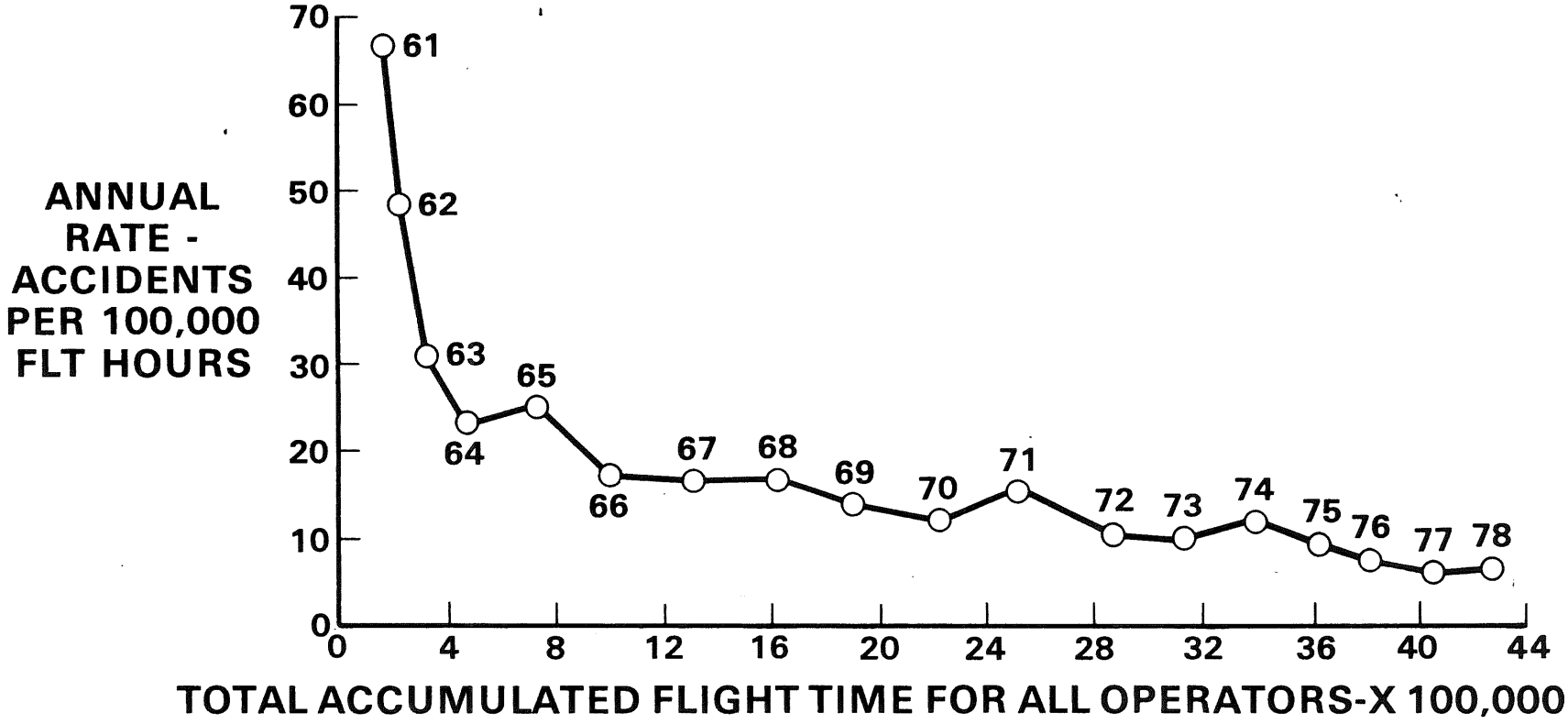
ICOULDGROUNDTHEWHOLEFLEET WITHMYFILTHYFEET

ATTACHMENT 8

F-104 INVENTORY

ANNUAL ACCIDENT RATES VS. TOTAL ACCUMULATED FLIGHT TIME

FOR ALL OPERATORS



ATCH 9