AEROSPACE

SAFETY

UNITED STATES AIR FORCE

HOLIDAY GREETINGS

DEC 1962

Seasonal Suggestions

MAJOR GENERAL PERRY B. GRIFFITH
DEPUTY INSPECTOR GENERAL FOR SAFETY
USAF

NORMALLY, at this time of year, it is customary to commend all concerned for jobs well done during 1962 and extend wishes for a safe and happy holiday season. Along with such comments, it is also customary to remind everyone who plans holiday travel that airlanes and highways are more congested, seasonal weather hazards make travel more treacherous, and there is a natural tendency to relax our vigilance.

All the above are true, and certainly worth repeating. I endorse both the commendations for real successes that have been made in accident prevention this past year and the caution concerning travel during the holiday season.

However, I feel obligated to devote most of the space in this editorial to comments on the status of our accident prevention programs.

First, sincere congratulations are in order for those whose efforts effected a decrease in the accident rates. There were achievements in all areas — flight, missile, ground and nuclear during the first three quarters of the year.

These are successes of the most rewarding nature — the saving of lives and equipment. These are indicators of the success that can be achieved by dedicated professionals whittling away at the difficult task of lowering an already low accident rate. When it is remembered that much equipment was one year older, and the new equipment, in many cases, was infinitely more complex, the magnitude of such achievements is emphasized.

But, while analyses give cause to be proud, they also, in some areas, point up weaknesses in the accident prevention program. These, too, must be noted .

There is cause to suspect that many of the so-called materiel factor mishaps are personnel induced, and this applies both in aircraft and missiles. I wonder, if the truth could be ascertained, how marked an improvement could be realized if there had not been some unprofessional performance in the cases of "materiel factor" and "undetermined" accidents.

I think professional is the key word. Many of our accidents are caused by people who occasionally do not perform in a professional manner, or by the few whose standards negate the efforts of full time Air Force professionals.

In some areas we regressed during 1962. As my Deputy for Ground Safety points out in this issue, the motor vehicle fatality rate shows a definite increase. This is totally unacceptable, especially when we note that in *half* of all such accidents the drivers were *violating a law*. We could make the interpretation that half our Air Force fatalities could have been eliminated by obeying traffic laws. Every commander in the Air Force must crack down on violators and crack down hard, if we are to cut down on this needless loss of lives.

In other areas, both in missiles and aircraft, I suspect that many have the attitude that if we are to operate weapons systems we have to expect accidents. This attitude is wrong! We must have a positive attitude about accident prevention! Factually, accident records disclose that accidents are preventable. This is something we can see in retrospect, but it is also something we wouldn't have had to look at *if a common sense attitude had replaced chance-taking, if discipline had replaced carelessness, if command interest had been genuinely and widely spread.*

Proof of what can be accomplished in this vital area was illustrated on 16 October when the Air Force completed a full year's operation without loss of a single B-52. This proves what dedicated professionals can do, even with complex equipment that must be operated around the clock. If I were to offer a wish for the New Year, there is none I can think of that would be more rewarding than to have this same professional attitude exemplified throughout the Air Force. ★★

IN THIS ISSUE

FOR TOPS IN TRANSIENT MAINTENANCE

REX RILEY RECOMMENDS

Lt Col Rex Riley, *Aerospace Safety Magazine's* ace accident investigator, is getting an additional duty. Starting 1 January, he initiates the "Rex Recommends" program that is replacing "Adventures in Good Transient Maintenance." He will carry on the transient maintenance program that was formerly handled by the mythical team of transient maintenance experts, Lt Malcolm Heinz and Sgt Lancelot Duncan. This team, created five years ago by the staff of *Aerospace Accident and Maintenance Review,* is being transferred to other duties. (The Duncan and Heinz program is being discontinued at the request of a private business concern with a similar title.) In its five year tenure, this pair acknowledged outstanding transient maintenance and service for traveling Air Force flight crews through award of Duncan and Heinz certificates to over 50 bases throughout the world.

Lt Heinz and Sgt Duncan first appeared in the February 1958 issue of *Maintenance Review* when they announced their crusade to improve transient facilities for visiting aircrews and awarded the first of their certificates. Since that time, more than 50 AF bases have been selected for the coveted "Recommended by Duncan & Heinz" designation, based primarily on the visits and reports of globe-circling AF flight crews. On occasion, bases have been removed from the list when their services failed to measure up to the high standards required to retain the award.

Lt Col Riley's recommended listing will be carried as a regular feature of *Aerospace Accident and Maintenance Review* and new "Rex Recommends" certificates will replace the "Duncan and Heinz" certificates now seen in many base operations and transient alert facilities. ★

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VOLUME EIGHTEEN NUMBER TWELVE — USAF RECURRING PUBLICATION 62-1

If you'll pull up your reading chair we think we have a real treat for you this month. You are invited to sit in on a safety meeting with one of the most renowned Air Force pilots of all time, Colonel Charles E. "Chuck" Yeager. Colonel Yeager, who is presently the Commandant of the Air Force's Aerospace Research Pilot School at Edwards AFB, Calif., won worldwide recognition as the first man to fly faster than the speed of sound. But to introduce this soft-speaking, sincere man so briefly would be a great injustice. He also has a wealth of experience in more routine Air Force assignments that add to his qualifications as an authority on safety in aircraft operations.

Colonel Yeager graduated from Luke Field, Ariz., in 1943, flew P-39s with the 363d Fighter Squadron in Nevada, California, and Wyoming, then flew P-51s in combat out of England. He scored two aerial victories against the Germans before being shot down on his eighth mission. He evaded capture through occupied France and was interned in Spain. He was released to the British at Gibralter and flown back to England four months after he had been shot down. Thanks to considerable effort on his part, he managed to get reassigned to his squadron and flew 56 more combat missions. On these he shot down 11 more German aircraft, nine in two missions (five ME-109s in one mission and four FW-190s on another).

After the war Colonel Yeager served as a basic flying instructor in Texas, then began duty as maintenance officer, Fighter Test Branch, Flight Test Division, Wright Field. He participated in test projects on the P-80 and P-84 and evaluated all of the German and Japanese fighter aircraft brought back to the United States after the war. In 1947 he was assigned as project pilot on the XS-1. During the next two years he flew more than 40 X-1 flights, exceeding 1000 miles per hour and 70,000 feet. He was the first American to take a rocket powered aircraft off from the ground. In December 1953 he flew the X-1A 1650 MPH. The same year he flew the MIG-15 in tests on Okinawa to evaluate its performance capabilities.

After nearly 10 years of flight test work, Colonel Yeager was assigned to Germany as a fighter squadron commander. During this three year European tour he won first place honors in the 1956 USAFE Fighter Weapons Gunnery Meet. In 1957 he became commander of an F-100 squadron at George AFB, Calif. During this tour he took his squadron throughout the world, participating in TAC strike force exercises. His squadron spent five months in Spain and four months in Italy. Twice he led his squadron on non-stop flights across the Atlantic, using inflight refueling, and he made one flight to Japan. And he is still active in flying—the scheduled interview time had to be slipped until he returned from giving a student a T-38 orientation flight.

Aerospace Safety Magazine is privileged to present the following comments by Colonel Yeager:

A LOOK

Colonel Charles E. "Chuck" Yeager
Commandant, AF Aerospace Research Pilot School
Edwards Air Force Base, California

SINCE I AM FREQUENTLY asked to describe the Aerospace Research Pilot School, I will start with that. Presently we run two courses, an eight-month experimental test pilot course and the seven-month Aerospace Research pilot course. Almost without exception, students have B.S. degrees in engineering, together with considerable experience in supersonic aircraft. Graduates of the test pilots course go on to such bases as Wright-Patterson, Eglin, Kirtland, Tyndall, Nellis and here at Edwards. Graduates of the Aerospace Research Pilot course become instructors or go into space programs—two graduates of the first class were selected for Gemini. Aircraft used in the courses include T-33s, B-57s, T-38s and F-104s. Three '104s are to be modified with rocket boosters to enable flight in the 140,000-foot regime. These aircraft will provide an inexpensive means of giving the pilot a taste of space type flying. Pilots will be able to experience weightlessness in excess of two minutes and control the aircraft with X-15 type reaction controls.

AT FLYING SAFETY

As to some of our future philosophy, we have two proposed changes we would like to see incorporated. We would like to combine the two courses in order to put students through the complete training in less time, and we would like to get younger students into the course. Our thinking is that if we can get younger pilots, who have a degree in engineering and 600 to 800 hours in Century Series fighters, we will end up with men only 27 or 28 years old who can serve the Air Force in space programs for about 15 more years.

We could spend all our time on the school, but I've been asked for some of my views on safety, so maybe we had better get into that.

First, one of my pet subjects, the red line. I have always been one to preach that the red line has been put on for a purpose and it is not there just for the benefit of some of the less qualified pilots. At and beyond the red line point things begin to happen that the pilot has no control over. Pilots should discipline themselves to never operate their equipment in excess of red line limitations. One of the insidious dangers of failure to abide by these restrictions is that often nothing apparently happens. You might think you are getting away with exceeding the maximum indicated airspeed or tail pipe temperature or G load on an aircraft, but by continually doing this you are asking for trouble, either for yourself or for some buddy who may fly the same plane tomorrow or next week. We have had a lot of pilots killed because of this.

Somewhat along the same line, the Dash One. The Dash One is a guide that will tell you in general what to do. If you discipline yourself, know your equipment and can recognize certain characteristics, then you can analyze problems and take corrective action. But the Dash One won't solve all problems. One of the biggest advantages a pilot can have over his equipment is to know it better than anything else in the world. Sometimes, particularly in test work or when equipment is fairly new, this takes study every available minute. We had an example of this type of thing when we first got the '104. How to immediately recognize a compressor stall, and knowing what had to be done and just how to do it was extremely critical.

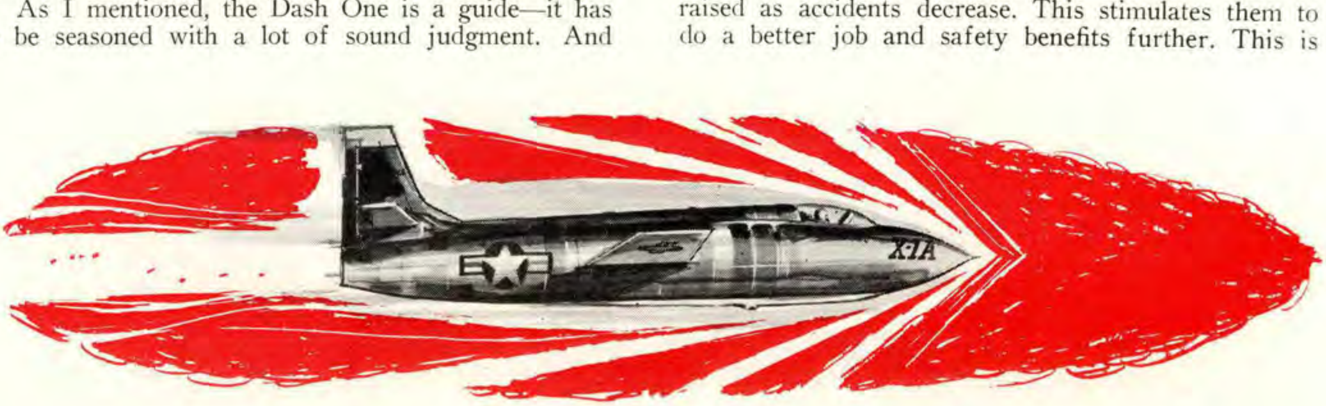
As I mentioned, the Dash One is a guide—it has to be seasoned with a lot of sound judgment. And here we come up with another example—the question of whether or not you would deadstick a jet. I have seen quite a few pilots get killed trying to land a flamed out jet and then making a decision, too late, to eject. This continues to be such a problem that I would like to give my philosophy. For every aircraft you fly, you should make up your mind as to the minimum requirements you would need to make a deadstick landing. There are a lot of things you need to look at. What is your general feeling? Your attitude? Are you feeling good that particular day, or are you feeling bad? Do you have a 15,000-foot runway? Is the weather clear? No wind?

When I have a flameout the decision is already made. I have already thought it over and I either eject or land the aircraft, depending upon whether the conditions meet my minimums.

Every airplane you fly should have a different set of rules. For example, when flying F-100s, if I had a normal fuel load, was feeling good, had a clear day with no wind and a 15,000-foot runway, then I would try to put it on. If I didn't have all of these things. I would eject. A T-33 isn't as critical. I say to myself that if I had a 10,000-foot runway, then I shouldn't have any trouble getting it on. I have deadsticked F-80 type aircraft on shorter runways, but that was when I was lucky and didn't know better.

One more point on this. Commanders can hardly teach this, all they can do is to drill into their guys' minds the importance of these rules, and sticking with them when the flameout occurs. Too many pilots who get killed trying to deadstick jet aircraft wait too long to eject. They think they have it made, but are not quite sure and they don't know for sure until on final. Then, when too low and too slow, out they go. It's too late.

But to get back to the big safety picture, there are two ways of looking at safety. One is the saving of human life, equipment and money. The other, and one I don't think we exploit enough, is the fallout of having a good safety record. As the record improves, a vicious circle effect occurs—actually, it is a beneficial circle. Morale of the pilots and maintenance crews is raised as accidents decrease. This stimulates them to do a better job and safety benefits further. This is



The author with the X-1, the aircraft he rode to fame in the world's first supersonic flight. At right, B-29 adapted for purpose takes off with rocket powered X-1 slung under bomb bay.

often inadequately stressed in our safety programs. High morale and stimulation are, I believe, extremely important in maintaining a low accident rate.

I have been asked to comment on some of the concepts that are recognized as keys to safety. I'll just briefly hit a few of these.

• SUPERVISION: I think the commander should be more interested in safety than any other single individual particularly in a fighter squadron. He can play a most effective role because of his experience. Usually his experience is much greater than that of his younger pilots. He can watch and see that his pilots don't go beyond a certain area where he got caught himself at one time. Experience is a most wonderful asset when dealing with younger pilots.

• DISCIPLINE: Discipline is trying to iron into the man to disregard the urge that all people have to fly an airplane a little farther than the other guy, a little faster, a little lower on a low altitude navigation flight. I think it is hard, maybe impossible, to insure effective discipline after a man grows up and becomes a pilot; this is something he should have learned when he was young.

• MAINTENANCE: There is no way to overemphasize the importance of good maintenance. The safety record hinges, in large measure, on the condition of the equipment flown. And this becomes more important every day. Take the case of a fighter pilot; he is asked to know the delivery technique and all the figures involved for nuclear weapons, conventional weapons, navigation, inflight refueling, gunnery—so many things his brain is saturated. Believe me, today if you get a sloppy ground crew or poor design of systems you can kill a pilot and tear up an aircraft with no chance for the pilot to prevent it. The younger people coming into the maintenance field should really be impressed with the importance of good equipment and thorough knowledge of the equipment they work on. The mechanic must know the equipment much better than the pilot if we are to have an outstanding flying safety record.

• DEVOTION: I think this is a vital ingredient in an effective Air Force, and one that is largely an individual development. Our best people are extremely devoted to the Air Force and the mission of the unit they are assigned to. It isn't easy to explain how a guy can stand alert 24 hours a day, seven days a week, and be ready to give his very best, his life if necessary, any minute of that time. This is what separates the men from the boys.

• TRAINING: This surely is a key factor. A man can learn so much on his own, but we think he can learn much more if there is a good training program in his unit. When I had an F-100 squadron I knew that there was much that had to be taught to a new pilot to get him combat ready. Most of this had to do with the weapons, the weapons system in the aircraft and their use. There just isn't time, at this stage, to teach the basic fundamentals of flying. I think that our training command and also our tactical commands have gone a long way in giving the operational units pilots who are well trained in flying. When this is the case the commander doesn't have to worry about whether or not the pilot can take off, fly formation, in weather, and land. Another thing, flying time that maintenance can generate is becoming so limited that time can't be devoted to boring holes and learning to fly in an operational outfit. New aircraft, such as the T-38, help here. A man comes into a tactical outfit with experience in operating at tactical speeds.

Another point on this training bit: no point in wasting training time getting a pilot proficient in a maneuver he will normally never have to perform. Spins are, I think, an example of this. I use myself as an example because I know more about myself than I do about any other pilot; I have never gotten an airplane into a spin inadvertently. I think a pilot should be taught to recognize the approach to a spin and action that should be taken to prevent a spin. If a pilot gets an aircraft into an inadvertent spin he is a pretty dull tool for not recognizing the approach to a spin. *This is my own personal opinion.* The more you teach a pilot about spinning different types of airplanes and let him experience spinning a little bit, then it not only builds confidence but it builds recklessness in that he does not respect a spin because, he says, "well, I can get out of a spin so I might as well fly this airplane straight up." There are many different modes of a spin in modern aircraft because of the compactness, small wings, high tails, and such that it is almost impossible —and I think the T-37 is a very good example—to come up with one recovery technique for all modes of a spin. When this is the case, every once in a while a pilot gets into a spin mode that he doesn't know how to get out of, or can't get out of, so you lose an airplane

and the pilot. I understand that a single recovery technique has been developed for the T-37, but this doesn't erase the accidents.

There is another point I'd like to get into; there is some idea on the part of those not in the business that testing and experimental work takes a devil-may-care attitude. This is 100 per cent wrong. It's a carefully planned business that is one of the most exacting and professionally demanding I know of. Certainly, a top concern is safety. It has to be. Take the X-15; the cost of the equipment, and not sacrificing that equipment or the pilot is paramount. When I was flying the X-1 my attitude was that once I had flown this airplane and was advancing the Mach number on up in increments of .2 or .3 at each flight, then coming down and looking at the data and knowing how I felt about the aircraft . . . I felt I knew more about the airplane and what would happen to it than the so-called experts whose predictions varied considerably. This is something that is real hard to explain to an individual who has never done real research flying in a rocket airplane. It is a feeling you get for your equipment. Of course you don't become a part of the airplane, but you do know your equipment and you learn a feeling for it and you respect it. You go along, progressing and programming, and soon you get confidence in this piece of equipment, such as I had in the X-1. You know it won't do some of the predicted things, such as swapping ends or wings coming off. So you build up a confidence and you go ahead. There is never a doubt in your mind. If there is, you quit. You don't fly any faster. But basically it is having confidence in your equipment and having a respect and feeling for it.

An example of this was Bob White's recent X-15 flight at high altitude. The flight was programmed for 280,000 feet; he ended up by going 314,000 or 315,000. He left his power on approximately a second or two longer than was called for; he had a much higher velocity, with the correct climb angle. At this point he knew he was going higher than programmed, yet was not the least bit concerned about the outcome. It just shows that he has confidence in his equipment. Here again you find a little difference of opinion between the pilot flying the airplane and the engineer working on it. The engineer simply doesn't have the feeling or confidence that the pilot develops. When it comes to the question of going a little higher, or a little faster, I feel the final decision should rest with the pilot. I think the pilot should be given more authority and much more of the responsibility in making decisions that affect the safety of his aircraft or capsule and his own neck.

This leads me into another area—the role of man in space. There are pros and cons on this: the black boxes vs. the man. With the boxes alone the stress and strain requirement is not nearly as critical and support systems are much less than those required to keep a man going. However, there is still the same old story that you can only pre-program into black boxes what you want. You can't change a decision after getting there and finding intangibles that should be controlled. I think as the support systems become more sophisticated and refined in supporting the man you will see a trend toward switching to man to do more and more of the work. For example, as we move into newer space vehicles I'm sure we will find the man having more to do in controlling the vehicle, especially during the boost-off phase.

This would probably be as good a point as any to wrap this up. In my opinion, you don't have to be a research pilot to realize a payoff through knowledge of equipment and the judgment to operate within its limitations and your limitations. The dividends are just as big—and I am talking of the pilot's life now— in any airplane in the Air Force inventory. This, to me, is the real meaning of safety, and the best way I know of to prevent accidents. ★

Then and now. Col Yeager holds photo of X-1 beside model of 4000-mph X-15, latest in series of research aircraft tested at Edwards Air Force Base.

cold weather

SINCE THE END of World War II, environmental testing of Air Force Weapon Systems has received greater emphasis than at any time prior to then. This is partially due to the bitter lessons that were learned during the war when lend lease aircraft were being ferried to the Soviet Union by way of the Arctic route. A more basic reason, however, is the realization that in any global conflict, a weapon system will be ineffective unless it has the capability to operate effectively under any climatic conditions that might be encountered on earth.

Many problems associated with cold weather operation of modern, high performance aircraft are similar to the problems encountered with aircraft of World War II vintage. Various changes in basic design concept have occurred during the past decade, however, and these changes have brought on a host of additional cold weather problems which must be solved as each aircraft is developed.

The Aeronautical Systems Division (ASD), which is responsible for insuring the All-Weather capability of new weapon systems, subjects each new weapon system to exhaustive tests in simulated low temperature environments and under actual arctic conditions. Although each weapon system has specific cold weather problems, a review of the results of ASD cold weather tests during the past 10 years shows that many problems that have been encountered are common to a number of different aircraft.

• *JET ENGINES*

Low temperature starting of jet engines has been a problem on almost every jet powered aircraft that has been developed. The problem is usually caused by: (a) insufficient starter power to motor the engine to starting rpm; (b) improper metering of the starting fuel to the fuel nozzles; or (c) icing of the starting fuel system.

The torque required to motor a very cold jet engine is considerably more than at normal temperatures due to decreased clearances resulting from thermal contraction and to increased viscosity of lubricating oil. Starting power available at low temperatures is often decreased if battery starting or cartridge starting is utilized. Decreased starter efficiency combined with increased engine torque requirements often is the cause of low temperature starting problems.

Accurate metering of fuel to the spray nozzles is critical during the starting cycle. The engine fuel control which accomplishes this function is a complicated and relatively delicate mechanism and is particularly susceptible to low temperature problems. Minute ice accumulations can restrict the valves in the fuel control and disrupt fuel flow. Thermal contraction of the fuel control case can alter clearances enough to cause the control to malfunction. Erratic fuel metering can result in *hung* starts or hot starts and cause serious damage to the engine.

Ice accumulation within the fuel system is a critical condition primarily due to the susceptibility of the fuel control unit to clogging. Later aircraft now incorporate fuel heaters which keep the temperature of fuel entering the fuel control unit above the freezing level. These heaters generally utilize engine oil or bleed air as a source of heat, however, so they are only beneficial after the engine is operating. Chemical additives are now available which, when added to the fuel will help to prevent the freezing out of moisture.

Although aircraft manufacturers have benefited by past experience, and progress is being made in the development of reliable jet engines, low temperature engine starting difficulties are still one of the prevalent problems associated with cold weather operation of jet powered aircraft.

• *HYDRAULIC SYSTEMS*

Hydraulic system leakage has always been a problem associated with cold weather operation of aircraft. In general, aircraft manufacturers are keeping ahead of this problem with the development of improved sealing materials and improved design methods. The trend to higher hydraulic system pressures in modern aircraft, however, has increased the severity of the hydraulic leakage problem. Almost every Air Force aircraft which has been subjected to arctic testing during the past 10 years has exhibited hydraulic system leakage problems of varying degrees.

Another design feature in some modern aircraft which has led to low temperature problems is the use of hydraulic power systems, i.e., utilizing hydraulic motors as power sources. In such systems the hydraulic flow rates are much higher than in a conventional system and the systems are susceptible to sluggish operation at low temperature due to high fluid viscosity.

• *FLIGHT CONTROLS*

Since many modern aircraft employ hydraulic flight control systems leakage problems are often encountered during cold weather operation. Excessive control force requirements and difficulty in maintaining proper control system rigging are the two most significant low temperature problems effecting aircraft employing mechanical flight control systems. The rigging problems are due

Herbert O. Abercrombie, Chief, Climatic Test Branch, Directorate of Flight Test, ASD

operation

to differential contraction between the airframe and the mechanical and/or cable linkage in the control system. The most practical solution to the rigging problem in mechanical systems is the employment of temperature compensators in the cable or mechanical controls to automatically compensate for temperature effects. The problem of excessive control forces can only be solved by meticulous care during initial design to insure that proper clearances are provided in mechanical linkages and to insure that low temperature lubricants are used in these systems.

• LANDING GEAR

The importance of satisfactory landing gear actuation at low temperatures has been emphasized with the advent of high performance aircraft. Often, acceleration rates are high following takeoff and gear retraction must be rapid in order to avoid exceeding the safe gear down speed of the aircraft. The F-104 and the F-101B aircraft exhibited this problem during early cold weather testing and retrofit action was required. Nosewheel steering systems are often sensitive to low temperature environments, since they are normally hydraulically powered, and low temperature operation is sluggish. The KC-135 was plagued with this deficiency which caused serious directional control problems during takeoff and landing under low temperature conditions.

• AIR CONDITIONING SYSTEMS

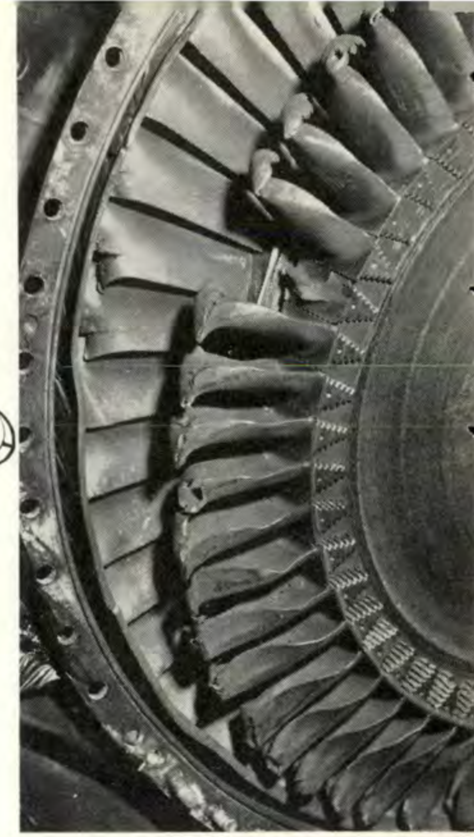
Two of the most prevalent aircraft air conditioning system problems encountered during cold weather are: (a) unsatisfactory air conditioning system controls; and (b) poor heat distribution within the heated areas of the aircraft. These problems are generally caused by basic design deficiencies in the system. Often, air conditioning system controls are overly sophisticated which penalizes reliability. The location of air distribution ducts and air outlets is often unsatisfactory which results in poor heat distribution. In general, the air conditioning system problems which have been encountered during cold weather tests of Air Force aircraft have been caused by basic design deficiencies rather than the effects of a low temperature environment.

• SUMMARY

Cold weather problems associated with arctic operation of modern aircraft can be minimized by proper consideration of environmental factors during initial design, extensive component and subsystem tests under extreme environmental conditions, and exhaustive testing of the complete weapon system under extreme climatic conditions. Simultaneously with this work, is the formulation of the proper procedures and techniques that a pilot should use in cold weather. These are presented in the Section IX of each Flight Handbook and should make interesting reading with the onset of winter. ★

B-r-r-r-r, it's cold! F-100 and C-123 undergo cold weather testing in Air Force's climatic hangar at Eglin AFB. Temperature in hangar may range from 165°F. down to −65°F.

NEW BUCKETS FOR OLD BIRDS



FIVE MAJOR ACCIDENTS and one minor accident, five flameout and three partial power landings was the record during the first eight months of 1962 due to turbine bucket failure in the T-Bird's J33 engine.

After five major T-33 accidents in 1961, the warning was plainly stated in the DIG/Safety T-33 Aircraft Accident Summary for 1961: *"By simple analysis, if like operations of the J33-A-35 engine continues, T-33 aircraft are going to crash because of turbine bucket failure."*

Obviously the problem has become serious enough to require positive action and such action is forthcoming in the form of an improved bucket for the J33 turbine. The prime AMA is shooting for first delivery of these buckets by March 1963, and a vast retrofit program is planned that will replace all of the J33 buckets with the new Waspaloy bucket.

Until retrofit, however, T-Bird drivers will have to live with the present equipment. Those who have experienced turbine failure are familiar with the symptoms. For those who haven't, here's what to look for: Symptoms might vary from barely noticeable to extreme vibration. This might result in failure of some other component such as throttle linkage from intense vibration. There will be a loss of power, but it may be possible to maintain enough RPM to provide power right down to the landing. In other cases, if vibration is severe enough, or if there is damage to other components, the engine will flame out or it will be necessary to shut it down. It is not uncommon, however, for ground crews to discover broken buckets after pilots have signed off an *OK* flight.

Pilots have handled the problem in a number of ways, depending on the circumstances, their skill and judgment. A brief discussion of some mishaps associated with turbine bucket failure may be helpful for aircrews who may run into this trouble in the future.

- Col Clayton M. Isaacson experienced sudden and severe vibration about 30 minutes after takeoff while cruising at 24,500 feet. Suspecting turbine bucket failure, he turned 180 degrees toward Alamosa, Colorado, and reduced power to minimum vibration, which turned out to be about 87 per cent. Meanwhile he requested the rear seat pilot to get information on possible landing fields in the area.

A few minutes later the engine flamed out and could not be restarted, even though four attempts were made, including hitting the gang start switch as the RPM dropped through 70 per cent.

The Alamosa runway appeared to be in good condition, so a landing was made there. High key was hit at 5500 feet above the ground for a perfect flameout landing. On final, feeling they were a little short, Colonel Isaacson retracted the flaps to 30 degrees. As soon as the last obstacle was cleared, he lowered

them all the way and the aircraft touched down 500 feet down the runway at 120 knots.

The engine had lost a turbine blade which damaged other blades. The resultant vibration broke the metering shaft from the throttle linkage to the main fuel control.

• Col Daniel A. Sims and Capt John Struchen were en route to Kirtland AFB from Norton AFB when they noted a slight vibration in the throttle while they were over Prescott, Arizona. RPM was 93-94 per cent. As a precaution they immediately reported their position and the vibration to Phoenix Center and asked the Center to standby. Attempts were made to decrease the vibration by throttle adjustments and deicing. The vibration became intermittent then increased. Course was changed immediately toward Phoenix. Phoenix Center was called advising that the aircraft was diverting to Luke AFB and requesting a known position and radar vector to Luke.

Approximately four minutes after the initial vibration the engine flamed out. The pilot immediately switched to battery power and selected emergency IFF, called Phoenix Center and informed them of the emergency. Four unsuccessful airstart attempts were made while the crew reviewed ejection procedures.

An airspeed of 180 knots was set up and headings provided by Phoenix Center were flown. From about 20 miles out at 15,000 feet they spotted Luke. High key was at about 8000 feet and a smooth, no-sweat landing was made.

Cause of this mishap was turbine bucket failure.

Other crews have not been so fortunate.

• A few minutes after takeoff, at 9000 feet and approximately 18 miles from the base, the pilot felt heavy vibration in the control stick. The aircraft was between cloud layers. The pilot's first reaction was to reduce power to 85 per cent, then to 50 per cent because of the extreme vibration. RAPCON was alerted and the pilot turned toward a clear area with intention of ejecting. Before he reached the clear area, however, he saw an air base through the clouds and, since the vibrations had eased and the engine was still running, he decided to land.

At about 6000 feet the pilot was able to see his home base and decided to land there rather than at the original base of intended landing. At the time he was approximately eight miles from home base. Seeing no problem, he planned to set up a base leg and a 90-degree turn onto final. Soon, however, he decided a straight-in was necessary. Airspeed was 250 knots, engine RPM 50 per cent. Between two and three miles out, the engine froze after indicating 1000°C. The pilot stop cocked at 2000 feet, then extended the dive boards and flaps. When he was certain he could make the runway, he extended the gear. Realizing he was high he slipped and S'd, crossing the end of the runway at 100 feet and 200 knots with the gear partially down.

Because of the excessive speed it was necessary for the pilot to force the aircraft onto the ground and it touched down 8000 feet down the runway at about 150 knots. The aircraft skidded off the runway, collapsing the gear and catching fire. The crew escaped with minor injuries.

Again, turbine bucket failure caused by fatigue. The resulting vibration caused failure of the Nr 3 and 4 bearings.

OCAMA, the prime engine AMA, says analysis indicates that failure is due to either foreign object damage or vibration and that these failures cannot be completely eliminated. ". . . The condition under which they operate, such as high heat, vibration, foreign object damage and the various stresses resulting from exhaust gas impingement and rotation are conducive to breaking any type material yet developed."

The S-816 turbine bucket will continue to fail. Through 7 September, there were 37 mishaps involving bucket failure. In 22 of these the engine was operating at 100 per cent. It appears that maximum turbine bucket stresses are encountered during engine acceleration in the high RPM range. The next stress level seems to be during operation at 100 per cent RPM. So, courteous consideration for these two conditions would lessen the incidence of S-816 bucket failure. In fact, DIG/Safety has recommended the following restrictions:

• Time limitation of 20 minutes for engine operation at 100 per cent.

• Climb to cruise altitude at 98 per cent when possible.

• That optimum engine operation while cruising be established in RPM range up to and including 96 per cent.

• Retrofit with Waspaloy buckets be accomplished as soon as possible.

OCAMA agrees and has provided some information that should be comforting to T-Bird pilots. During tests on Waspaloy buckets, one trailing edge failed with 191 rejects for all causes. Simultaneous operation of the same quantity of S-816 buckets under identical conditions resulted in 26 broken buckets and 608 rejects. Thirty per cent of S-816 buckets rejected was due to stretch; not one Waspaloy stretched.

While we're still living with the present turbine buckets, it would be wise to heed the advice of a crew who successfully landed after an engine failure. "Precautionary actions will prevent accidents. The key point is careful assessment of the emergency followed by decisive action."

In other words, plan ahead, then follow your plan. ★

ACKNOWLEDGMENT

Inadvertently omitted from the article "Ceilings That Fizzle With Drizzle," in the November issue, was the byline of the author: Lloyd V. Mitchell, Chief of Special Studies Branch, Physical Scientist's Office, Scientific Services, Hq Air Weather Service, Scott AFB, Ill.

CHUMLEY'S CHRISTMAS CHOPPER

Bob Harrison

"YESSIR, I'll get on it right away."

The operations officer replaced the telephone receiver, grasped his head with both hands and groaned, "Why? Why? What have I done to deserve this?"

His assistant swiveled his chair around and looked at his boss in alarm. "Your cat have kittens again?" he asked.

"Worse than that. Chumley's going to play Santa Claus."

"Santa Claus!"

"The old man just called. He's just had a meeting with the special services officer, the chaplain, the town mayor and some child welfare people. We're going to have a Christmas party for all the kids of base personnel and, I guess, every kid in town. Chumley is going to be the Santa Claus and I've got to furnish a pilot to fly him in by helicopter. The party will be in the big hangar and Santa is to arrive with a bag of toys and goodies for all the kiddies."

The assistant ops officer, a young, rather impressionable captain, pondered a moment; then, "Sounds like a good idea. What's wrong?"

"Look, son," said his superior, "I don't mind the idea of a Christmas party at all. It's good community relations and, for that matter, my kids will love it. But when you put Captain C. Z. Chumley into a Santa suit you're asking for trouble."

"What kind of trouble?"

"Any kind of trouble. Chumley will find some way of fouling things up. He'll catch his whiskers on fire, or knock down the Christmas tree, or scare some kid to death and get him crying. These things I suppose we can handle. But I shudder when I think of Chumley in a chopper. Something is bound to happen. Mark my words, boy."

The morning of the party Chumley reported bright and early to the flight line. Resplendent in red suit, a pillow under the coat to add to his already slightly protruding midsection, shiny black boots a trifle too large that caused them to squish in the snow and threaten to leave his feet, a bushy beard blowing back into his eyes from the brisk wind that stirred a thin cloud of ice and snow crystals, he was quite a sight.

The visibility being less than good, he had a difficult time finding the H-21 that was to bear him triumphantly to the door of the hangar where the children would be gathered impatiently awaiting the arrival of the Christmas elf. Finally he stumbled into the rear of a dark mass barely discernible in the gloom. The mass turned out to be the pilot who now lay sprawled in the snow and greasy slush.

"Pardon, ol' boy," said Chumley as the figure arose wiping a mess of black icy slush from his face and clothing. Chumley thought he heard a series of oaths issuing from a rapidly moving hole in the top of the dripping mass, but the wind was so strong the words were borne away.

"You Lieutenant Beaver?" he asked.

"Ugl . . . blrrrr . . . pooey . . . pfchhh," replied the apparition. Then, "Yeah, who in the blazes, oh you must be that Santa Claus I'm supposed to bring in from the North Pole. Why don't you be a little careful about where you walk, Santa?"

Chumley drew himself up to his full height, at which point the pillow slipped from under the coat and fell into the slush. Retrieving the pillow, which now was a cold gooey mass, Chumley addressed the junior officer. "Lieutenant, I'm sorry I bumped into you, the wind and flying snow, you know. It was unintentional and you should show more respect for your betters. Now, let's mount this trusty steed and off to yon far end of the field before the kiddies start arriving and see me here."

"Really, Captain, you don't expect to be going any place in this weather, do you?" He looked around, held out a hand for a moment and gathered a few snowflakes. "I can't see one end of this bird from the other. It looks like Santa is going to have to arrive in some other way."

"Nonsense. The kids have been told that Santa is going to arrive in a helicopter and he's going to. We can't disappoint the little dears. Besides, Santa can travel in any kind of weather and they know it. After all, we're not going to get off the airpatch, just go from one side of the base to the other. Now let's get this hunk of iron warmed up and go. It's getting chilly out here."

By now the icy pillow was becoming downright uncomfortable. Some drops of black water had fallen into the huge boot tops, others had frozen into filthy icicles that hung from the bottom of the red coat.

Beaver's attempt at a reply was stopped in midsentence as Chumley tut-tutted and started fumbling with the door on the side of the aircraft. A sudden gust of wind howled around the nose of the helicopter and Santa's beard disappeared in the direction of the tail. Chumley threw the bag of toys into the cabin and took off in the direction of the beard, yelling for the lieutenant to get in and get ready to go. A couple of minutes later he crawled into the left seat, the beard a wet, limp mass grasped in his hand. "Let's go," he shouted, showing a rare bit of Chumley temper.

Seeing that his passenger was determined, slightly angry and of higher rank, the lieutenant let the odds pile up against his judgment and fired up the bird.

"Take it up about 10 feet and scoot over to the alert area. We'll get some hot coffee and thaw out a bit before starting for the party."

"Yessir." The lieutenant struggled with the bird. As it rose slowly from the pavement a vast cloud of snow, ice and freezing slush obscured every landmark. Somehow he managed to level off, turn the bird and start moving slowly across the base without flipping over. There were times when he was sure they wouldn't make it. But his passenger seemed unconcerned as he grasped the beard in both hands and attempted futilely to wring all of the water out of it. It was rapidly freezing and becoming stiff.

Finally they arrived at the alert hangar after very nearly taking out a sizeable chunk of Uncle Sam's deterrent force. Shutting down, Lt. Beaver motioned for his passenger to debark. "Let's get inside before we freeze."

Incredulous looks greeted them as they stumbled through the door that let in a huge blast of frigid air that immediately broke up the card game as cards went flying in all directions. A few minutes of recriminations, ugly threats and sheer wonderment as to where the two weird dripping, half frozen characters had come from, and they were supplied with hot coffee and placed near the heat vents.

Shortly the Chumley spirit had revived and he was beginning to tell of the times he had had to fly when the weather was REALLY bad. About the time the shaking lieutenant had thawed out and was beginning to feel himself again Chumley suddenly stopped in midsentence and announced that they had to be off. "Can't keep the kiddies waiting; besides the old man told me that if we foul things up he'll ship me to Thule. Can't stand cold weather."

He presented quite a sight. The red suit was hanging damp and limp, in places the dye had run causing splotches and streaks. The boots, made of a felt material, were sodden and beginning to slump. The oncewhite fur-like trim on the coat and hat were now a dark gray. The wet pillow had sprung a leak and a few feathers had drifted out and stuck to the wet pant legs and boots.

Unaware of his appearance, Chumley grabbed Lt Beaver by the arm and propelled the protesting pilot out the door. The weather had not improved and Beaver, finally asserting himself, stated flatly that their transit of the base had been pure luck and that if Chumley thought he would try it again he was out of his cotton-picking mind.

Chumley, somewhat larger than his companion, grasped him tightly and pushed him into the aircraft. "Do you want to go to Thule?"

"What's the difference?" replied the struggling lieutenant, "I can't see how that can be any worse than this."

"Crank up this beast and let's go," Chumley said. "We've only got a couple of miles to go and we're not going to disappoint the kids. What kind of pilots are they turning out these days? This isn't the old fighting Air Force. Let's go, boy."

With that he slammed the small lieutenant into the seat, whipped belt and harness around him and got into his own seat.

Resigned to what might come, the reluctant pilot decided that it was either take his chances and possibly get the job over with and thereby get to a warmer place, or stay out in the freezing cold and fight with Chumley.

That stalwart attempted to put on the hard hat laying on the floor but couldn't quite make it, what with the Santa hat and beard. He flipped it to the rear and settled himself into his seat.

Once again they got into the air, the lieutenant groping along trying desperately to find some landmark by which to guide the violently rocking helicopter.

Chumley, meanwhile, had dug into the bag of toys and come up with a double barreled popgun. "Gee," he said, "I didn't know they made these things anymore," as he fired both barrels.

Lt Beaver picked that moment to look around at what Chumley was talking about and was struck in both eyes by the flying corks issuing from the popgun. Although it was later determined that no permanent eye damage was done, the corks temporarily blinded the pilot who, under the extreme pressure of the past hour, panicked. Chumley was left to fly the helicopter.

Virtue has its own rewards and somehow Chumley managed to get hold of the two controls and manipulate them accidentally but sufficiently to maintain control. Recovering slightly, the pilot shouted that Chumley would have to fly the bird since he was blind.

Despite his usual confidence, Chumley had judgment and presence of mind enough to know that he couldn't fly this wildly bucking monster. He also saw the lieutenant's condition and was able to reason it out that they were in serious trouble. The only solution he could see was for him to try to fly the bird on instructions from the pilot. "Tell me what to do," he shouted, "and I'll fly it."

In this fashion they finally arrived at the hangar which he recognized as a giant mound of blackness in an only slightly lighter atmosphere. Their flight had taken them up, down and sideways. Disaster had threatened several times, but unable to see anything, Chumley had not been aware of their peril. In fact, by the time the hangar suddenly loomed up he was beginning to think he had the hang of things and that chopper flying was really quite simple. Now, however, he faced the problem of getting on the ground.

Inside the hangar the base commander was beginning to tell the assembled children and proud parents the sad news that Santa Claus would be unable to make it. He was interrupted by loud thumping noises on the hangar roof and the roar of a laboring engine. His next remark was not fit for children's ears and he made it under his breath.

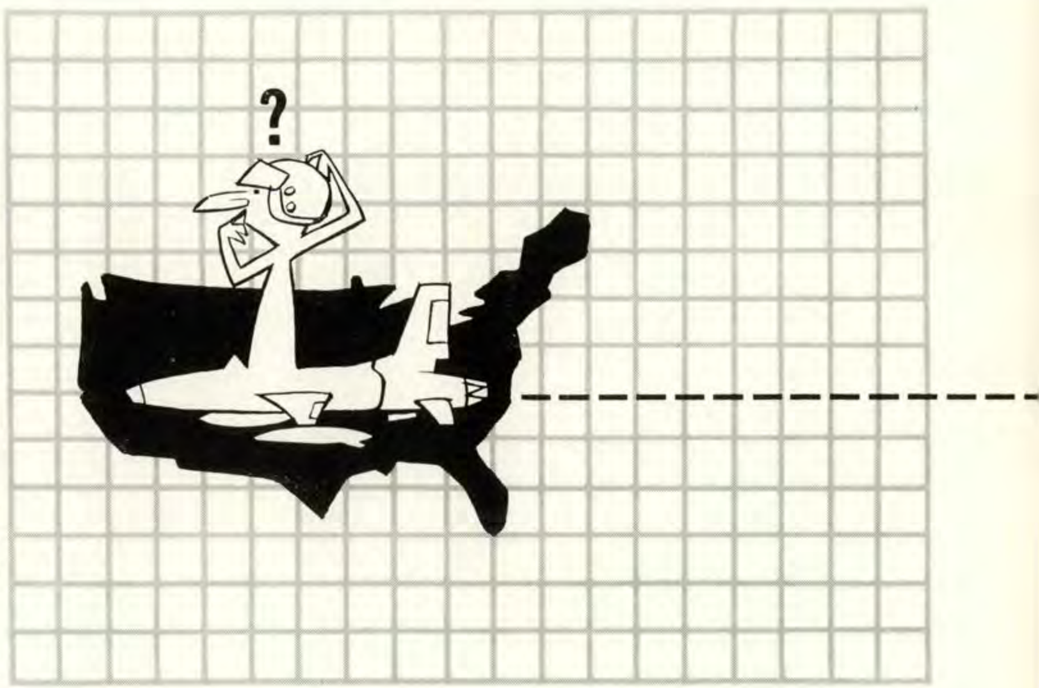
By this time the lieutenant was beginning to regain some sight in his burning eyes. Sensing that disaster was near, he struggled manfully to keep his eyes open long enough to take over control and land the craft. Chumley's beard, meanwhile, had curled upward and frozen stiff. As a result he had to turn his head sideways to see anything and, being so occupied with trying to keep the copter under control, failed to hear the pilot telling him he was taking over. For a few minutes they fought over the controls until a sudden gust of polar wind slammed the machine sideways. Chumley's head hit the side with a sickening crunch and the lights went out for him.

Relieved of Chumley's fighting the controls, Lt Beaver managed to get the helicopter on the ground in front of the hangar door just as the commander and other assorted officials arrived at the entrance.

Chumley groggily straightened in his seat, focused his eyes finally on the irate colonel, whom he could barely see through the gloom. "Hah, we're here. Open the door, Beaver boy, Santa mustn't keep the kiddies waiting." With that he leaped from his seat, grabbed the bag of toys and exited from the aircraft shouting "A Merry Christmas to All and to All . . ."

"Goodnight," finished the colonel as he saw the apparition climb from the aircraft and slosh through the snow. "This is Santa Claus?" ★

VAST NETWORK AIDS LOST PILOTS



Courtesy: FAA Aviation News, September 1962

WITH THE FLIP of the radio switch, a lost pilot is always within sound of the voices of some 18,000 FAA controllers and flight service specialists who are trained to lend an aerial assist.

Supporting their efforts is an extensive network of electronic systems. There are about 700 VORs and VORTACs throughout the air navigation system to help a pilot fix his position in the airspace. In addition, there are 961 air/ground communications channels for the 36 Air Route Traffic Control Centers.

The system also embraces 49 long range radars, 68 airport surveillance radars, 28 precision approach radars, some 300 airport lighting systems, about 200 instrument landing systems, more than 200 approach control facilities, almost 260 towers and combined station/towers, and 340 Flight Service Stations.

Helping a lost pilot find his bearings is generally a matter of routine for FAA's Flight Service Station specialists. When the plane's navigation equipment, for example, has quit, the station may ask the pilot to describe distinctive landmarks beneath him — bridges, rivers, lakes, open-air theaters, race tracks, smoke stacks, factories, etc. A station specialist knows his area thoroughly. Often, all the station man needs is a description of a prominent terrain feature to put the pilot back on course.

Should the plane's navigation equipment be in order but the pilot have difficulty orienting himself because of severe turbulence, lost maps or other causes, the station man can still help by serving as the pilot's co-pilot or navigator from the ground. He will plot the readings the pilot radios to him.

Orientation service for lost pilots goes beyond the station. In an area covered by FAA or military radar or DF (direction finder), the station will alert such facilities after being contacted by a lost pilot. When DF is used, an Air Route Traffic Control Center, which serves as the DF net control unit, plots the cross bearings obtained by other DF stations receiving the pilot's transmissions, generally in the form of a voice count. The fix will then be relayed to the pilot by the station initially contacted.

If the lost pilot is within radar range of a center or an approach control facility, the facility will instruct the station to ask the pilot to make an identifying maneuver. The radar facility will then spot the location of the lost aircraft, relay the information to the station and the station will give the pilot a course to take him back on his route. Radar will continue to monitor the plane as long as necessary.

Sometimes the Flight Service Station will enlist the help of another pilot in the area to help the lost pilot. In such a situation, when the pilots have sighted one another they can both switch to UNICOM frequency (122.8 or 123.0 mc. if in the area of a tower-equipped airport) and talk directly to one another. The station acts as intermediary in facilitating the communications change.

The stations are there to serve. Pilots should have no reluctance to let them know when they're in trouble. ★

Top Gun, Capt Charles E. Tofferi with the F-104 in which he shattered Air Force gunnery records during 1962 William Tell. At left, loading crew follows checklist for safe loading of GAM-83.

LAST SEPTEMBER, Capt Charles E. Tofferi, 436th Tac Fighter Squadron, George AFB, Calif., aligned the nose of Air Force Jet 70914 with the Nellis runway, pushed forward on the throttle and was off on another of the ten events that were to decide the top sharpshooter among Air Force fighter pilots. Airborne, he carefully followed a pre-briefed pattern that took his Lockheed Starfighter to the range without flight over congested areas.

This was but one of many safety precautions, carefully laid out in advance for competitors from 14 tactical fighter wings, and insisted upon during the five-day meet. Each event was designed to provide both realism and safety. Safety had to receive top consideration. The cannon shells, rockets, bombs, missiles and napalm were real.

On this air-to-air gunnery mission, Capt Tofferi joined up with the tow target F-100 to proceed to the range at 30,000 feet. Over the range the two aircraft banked away from each other, then turned back on a head-on pass. The F-100 pilot let the 5 x 16-foot, dart-shaped target reel out from under his wing. As the F-104 passed his wingtip he began 500 mph evasive maneuvers. Tofferi wrapped his plane around in a tight turn. He had five minutes to destroy the target but only 100 seconds for maximum possible score. In just 63 seconds he had lined up the aluminum dart and downed his target with a burst from his six-barreled 20 mm cannon.

In this, the fourth such competition since 1958, one major accident did mar the meet. An F-100 pilot, on a rocket pass, was unable to pull out of his dive. In two other cases, possible accidents were avoided by appropriate action on the part of the pilots concerned.

In one, an F-100 tow target pilot noticed blue-gray smoke in the cockpit and felt minor vibrations. He called for a join-up by a mission pilot who reported vapor coming from the split line. The F-100 pilot noticed a 3-4 psi oil pressure drop, jettisoned the dart, reduced power and returned to base where he made an uneventful landing out of an SFO.

Four days later Capt J. L. Pennington, a contestant from the 417th Tac Fighter Squadron, Germany, brought his plane back after FOD damage. He had completed two low level deliveries, made his two 750-pound bomb releases and on pullup from his first strafing pass, felt FOD damage occurring to his engine. He immediately retarded the throttle to 90 per cent and proceeded to the closest field, Indian Springs, where he was able to land sucessfully out of a low key SFO.

Key safety measures taken at William Tell included:

- Weather reconnaissance flights flown several times daily.
- Frequent sweeps of the weapons range to assure no stray aircraft in the area.
- Runways checked repeatedly for foreign objects.
- Taxi and scramble routes, as well as takeoff, rendezvous and landing times, thoroughly briefed.
- Mandatory checks of the aircraft while in flight and calls to the control tower at pre-assigned points.

Are there safety as well as operational benefits to be realized from William Tell meets? Definitely! Deficiencies that had to be corrected, as obtained from Nellis AFB safety officers, were:

- Some of the loading crews were non-qualified

Left, delicate weapon, handle with gloves, load with care. Lower left, F-105 and some of the more than 4000 combinations of weapons it can carry. Photos at right show care used in loading GAM-83: up and locked check, safety strap in place, meticulous men — and checklist.

TROPHY WINNERS

Capt Charles E. Tofferi, 479th TFW, George AFB, highest total points. Capt Roger D. Tucker, 48th TFW, Lakenheath, nuclear delivery. 1st Lt Charles M. Summers, 50th TFW, Hahn AB, air-to-ground missile Capt Anthony Gardecki, 4th TFW, Seymour-Johnson AFB, radar-nuclear. Major Ray W. Schrecengost and team, 66th Tac Recon Wg, Laon AB, reconnaissance.

and not certified. One team arrived three weeks early to become qualified; and they performed very well during the meet.

- In one case no checklist was available for the loading operation.
- Some team members became so proficient with the checklist that they didn't think they needed it. Safety officers quickly pointed out that they did.
- Action had to be taken to prevent removal of the missile non-propulsion system prematurely (during pilot walk-around). Though the possibility of inadvertent launch from stray voltage is slight, it should still be considered possible.
- Some pilots had to be reminded to keep both hands in sight when in the cockpit while armament men were arming bombs and missiles.
- All concerned must override the tendency to hurry when handling explosives. Safety observers recommend that grading on safe handling and loading be included in the overall score.
- Weapons officers and safety officers should be on the flight line to observe all operations.
- Range observation, scoring and photographic stations must be located so as to assure the greatest safety probability in case of an erratic missile.
- If you drop it, don't load it! Propellants can crack and the burning pattern can be disrupted. Blowup could then occur immediately after launch.

Quantity-Distance criteria in AFM 32-6 must be followed religiously. This was probably more of a problem at Nellis during the gunnery meet coupled with the fire power demonstration, because of the tremendous amount of explosives used. Nevertheless, Q-D requirements are mandatory for the safety of any flight line any time if a catastrophic explosive accident is to be avoided. ★

FIRE!

. . . *the home-wrecker*

A MAN HEARD A DULL THUMP and his wife's scream, "The water heater exploded!" She pushed the kids out the door and called the Fire Department while he grabbed a small dry chemical extinguisher he had mounted near the utility room only a few days before. The heater was enclosed in a wooden cabinet which he found ablaze from floor to ceiling—yet he was able to put out the fire and shut off the gas supply valve behind the heater in seconds. The Fire Department didn't lay a foot of hose when it arrived—instead, firemen inspected the room to make sure the fire was out for good.

If they had not had the extinguisher; if they had been forced to wait until the fire department arrived, this family probably would have been homeless. As it was, fire damage amounted to $500.

Contrast the relatively light damage in that fire to another homeowner who had no fire extinguishers. He and his wife, alone in the house, were wakened in the middle of the night by a fire which had started on the second floor. His wife, still half asleep, almost lost her life when she tried to put the fire out by throwing a glass of water on it. By the time the fire department arrived, the whole second floor of the house was involved and was almost a total loss. Furnishings, walls and floor coverings on the first floor were extensively damaged by smoke and water.

Now, if we agree that it's a smart move to acquire one or more home fire extinguishers, which extinguishers and extinguishing agents are best for home use?

First, a brief review of the three common types of fire. They are divided into *Class A*—wood, cloth, paper and other ordinary combustibles which burn with an ember; *Class B*—gasoline, alcohol, cooking oils and all other flammable liquids; and *Class C*—fires of electrical origin. There are extinguishing agents especially suited to each type of fire.

Water, of course, is the most obvious, plentiful and inexpensive agent. However, this isn't the complete answer to home fire protection. For one thing, it takes valuable time to get a hose out and connected. There are, of course, self-contained water extinguishers, but they are bulky and heavy to handle for the woman of the house. It's also dangerous to use water on flammable liquid or electrical fires. Flammable liquids will float on water and spread the fire; where live wires are involved, they can transmit a fatal shock through the hose stream.

Carbon dioxide is effective on Class B fires and is a non-conductor. Where there is a draft or a breeze, CO_2 may not be effective because it is a gas and is easily blown away. It gives the extinguisher operator little, if any, protection from the heat of the fire. On the other hand, it does not leave any sort of residue after a fire and, if the disadvantages mentioned are not a problem in your case, CO_2 is useful in fires involving food or delicate electrical equipment.

CO_2 extinguishers are comparatively heavy when the ratio of weight to extinguishing power is considered. This is because of the strong steel shell necessary to contain the gas under pressure.

Foam extinguishers are effective on Class A and B fires; although, foam does conduct electricity and does not knock down fire instantly, it is completely effective once a blanket of it has been laid down. Foam units compare in weight with carbon dioxide extinguishers. They do leave a residue, of course, which must be mopped up or washed away with a hose.

Dry chemical, a fine powder with a sodium-bicarbonate base and additives to keep it moisture resistant and free-flowing, is the most effective agent for flammable liquid fires. It will not conduct electricity and, while not to be relied on for final extinguishment in Class A fires, it will knock down and control the flames until you can get your indoor hose line connected and operating.

Pound for pound, dry chemical is also the most effective fire extinguishant in actual agent weight or in total weight of the extinguisher. A dry chemical unit with a total weight of five pounds has a 4-B:C Underwriters' Laboratories rating—comparable to a foam extinguisher with total weight of 25 pounds and a carbon dioxide extinguisher with a total weight of 16 to 22 pounds. Remember the old one-quart pump-type carbon tetrachloride extinguishers? This same dry chemical unit is equal to eight of them. Water, of course, weighs about eight pounds per gallon.

Then there is the question of recharging the extin-

Art Spleiss, Ansul Chemical Company — San Francisco, California

guisher. It's just as well to consider this possibility when you are buying the extinguisher because it can present a problem later on. In general, carbon dioxide extinguishers should not be recharged by anyone except the manufacturer or his authorized and supervised agent. Dry chemical extinguishers generally can be recharged at home without special tools. In fact, some of the smaller ones designed for home use have fresh, factory sealed spare charges that can be screwed into the discharge heads like a light bulb.

Once you get the fire extinguisher, put it in a strategic place. It should be near possible sources of fire such as the furnace and the kitchen appliances but not so near that a fire might cut off access to it. One good place is the entrance to the basement where it's easily reached for a fire on either floor. If you have a basement or garage workshop, you might consider placing a separate extinguisher there, because such areas are always full of likely spots for fire to start. Paints and varnishes, scrap wood and sawdust, electrical tools are examples.

While you're at it, look around your home to make sure you're practicing good fire prevention measures. At this time of year, your heating plant should have had a thorough going over by a qualified service man. You should see that someone does every year. Check to see if flue pipes are far enough away from combustible joists and beams so that they aren't in danger of becoming overheated and bursting into flame. In oil and coal burning furnaces, check your grade of fuel to make sure it's the right type for the equipment. Heating equipment is one of the leading causes of dwelling fires, according to the National Fire Protection Association and, of course, this hazard is at its height during the winter months.

Unlined chimneys and those with loose mortar are serious fire hazards and, of course, the hazard of wooden roof shingles or other non-fire-resistant roof coverings is obvious.

Tragically, the Christmas season is one of the likeliest times of the year for fires to start. Trees, candles, Christmas lights, decorations and gift wrappings are all serious offenders in the records of home fires. It's very dangerous to use open flame candles on the Christmas tree as almost everyone knows, but a string of substandard electric lights which doesn't carry the Underwriters' Laboratories label may be just as great a hazard. In Massachusetts on a recent Christmas, a tree light exploded and fire burst out so quickly from the tree to other furnishings in the room that it spread beyond control before the mother could go upstairs to rescue a child on the second floor. The child died.

It's very important to keep a tree in the house as few days as possible and to keep the butt end immersed in water all the time. Christmas trees may have been cut months before the holiday and, by the time they are put up, are usually very dry. Even fresh green trees quickly dry in the warm climate of most homes and become a serious fire hazard. Another child was trapped and killed by fire when a tree his mother was carrying out of the house brushed against a coal stove and ignited. By the time the mother had carried two other children to safety, the fire and heat stopped her from reentering her home.

Christmas balls and other trimmings which are noncombustible are also a must — more than one fire has started in cotton batting decorating the base of the tree.

Children and their unquenchable enthusiasm for Christmas also precipitate many fires. Gift wrappings tossed aside as boxes and packages are eagerly opened have become the fuel for Christmas fires.

Christmas cookery is also responsible for fires when the lady of the house starts preparing complicated and unfamiliar dishes. Grease fires in the kitchen are particularly treacherous. Melted butter is a frequent offender — once ignited it's as deadly as burning gasoline. One housewife vows her home dry chemical extinguisher saved her life last year when she turned the stove element on "high" instead of "simmer" to melt two pounds of butter.

Of course, many precautions which must be taken at this season are just as necessary and effective throughout the year. The largest percentage of dwelling fires occurs between three and nine a.m. That means you're most likely to have a fire when you're asleep and not prepared to act quickly. It's always a good idea to close your bedroom door and open your windows at least a little. The closed door will delay fire and smothering gases from entering the room if a fire starts at night.

Have several plans of evacuation from your house in case of fire and hold fire drills with the family as you might at a base installation. Thus, even if you are caught unaware and half asleep, you will have a plan of action to fall back on.

Keep your home neat and tidy and in good repair. Be careful about cigarettes and matches — they're the greatest single cause of home fires. Store flammable liquids in safe places; keep matches and such out of children's reach; don't tempt fate by being careless about a hazard when you know better. Have an extinguisher handy and be sure it's ready to operate. ★

TURBULENCE DEFINITIONS

FOR YEARS forecasters and pilots have been trying to bridge the gap of misunderstanding concerning reports and forecasts of flight turbulence intensity. Even among pilots in the same aircraft, disagreement may arise concerning interpretation of turbulence intensity. Differences of opinion exist because of degree of pilot's experience, type of aircraft, varying airspeeds, control techniques and the like. Forecasters have had to rely mostly on pilot reports or their own weather experience to come up with a turbulence forecast. Sometimes a forecaster even went operational and tried to forecast turbulence based upon the type of aircraft the pilot was flying.

The National Coordinating Committee for Aviation Meteorology (NACCAM) established a Working Group to eliminate this problem by establishing meteorological definitions of atmospheric turbulences as related to flight operation.

Although the working group was unable to develop definitions suitable for a standard, descriptions of idealized conditions considered highly probable were recommended. NACCAM approved the recommendations and the following guide is being initiated.

• EXTREME TURBULENCE—This rarely-encountered condition is usually confined to the strongest forms of convection and wind shear, such as:

In mountain waves in or near the rotor cloud (or rotor action) usually found at low level leeward of the mountain ridge when the wind component normal to the ridge exceeds 50 knots near the ridge level.

In severe thunderstorms where available energy indicates the production of large hail (¾ inch or more), strong radar echo gradients or almost continuous lightning. It is more frequently encountered in organized squall lines than in isolated thunderstorms.

Symptoms: The aircraft is violently tossed about and is practically impossible to control. There may be structural damage. Airspeed fluctuation: rapid, in excess of 25 knots.

• SEVERE TURBULENCE—In addition to the situations where extreme turbulence is found, severe turbulence also may be found:

In mountain waves:

• When the wind component normal to the ridge exceeds 50 knots near the ridge level: at tropopause up to 150 miles leeward of the ridge.

• When the wind component normal to the ridge is 25-50 knots near the ridge level: up to 50 miles leeward of the ridge, from the ridge level up to several thousand feet above and at the base of relatively stable layers below the tropopause.

In and near mature thunderstorms and occasionally in towering cumuliform clouds.

Near jet streams within layers characterized by horizontal wind shears greater than 16 knots per degree latitude (40 knots per 150 nautical miles) and vertical wind shears in excess of six knots per 1000 feet. When such layers exist favored locations are below and or above the jet core and from roughly the vertical axis of the jet core to about 50 to 100 miles toward the cold side.

Symptoms: Aircraft may be momentarily out of control. Occupants are thrown violently against the belt and back into seat. Unsecured objects are tossed about. Airspeed fluctuation: More than 25 knots.

• MODERATE TURBULENCE—In addition to the situations where extreme and severe turbulence are found, moderate turbulence may also be found:

In mountain waves:

• When the wind component normal to the ridge exceeds 50 knots near the ridge level: between the surface and about 10,000 feet above the tropopause from the ridge line to as much as 300 miles leeward.

• When the wind component normal to the ridge is 25-50 knots near the ridge level: between the surface and the tropopause from the ridge line to as much as 150 miles leeward.

In, near, and above thunderstorms and in towering cumuliform clouds.

Near jet streams and in upper trough, cold low, and front aloft situations where vertical wind shears exceed six knots per 1000 feet or horizontal wind shears exceed seven knots per one degree latitude.

At low altitude (usually below 5000 feet above the surface) when surface winds exceed 25 knots or the atmosphere is unstable because of strong isolation or cold advection.

Symptoms: Occupants require belts and are occasionally thrown against belt. Unsecured objects move about. Airspeed fluctuation: 15 to 25 knots.

• LIGHT TURBULENCE—In addition to the situations where more intense classes of turbulence occur, the relatively common class of light turbulence may be found:

In mountainous areas even with light winds.

In and near cumulus clouds.

Near the tropopause.

At low altitudes when winds are near 15 knots or where the air is colder than the underlying surface.

Symptoms: Occupants may need belts. Objects in aircraft remain at rest. Airspeed fluctuation: 5 to 15 knots. ★

USAF Safety Report

The following nine pages contain discussions of some of the major safety problems during the first nine months of 1962, as prepared by the following safety directors:

FLIGHT . . . BRIGADIER GENERAL JAY T. ROBBINS

MISSILE . . . COLONEL GEORGE T. BUCK

GROUND . . . COLONEL EARL S. HOWARTH

FLIGHT

AS THE END OF CALENDAR 1962 APPROACHES it appears that there is to be a slight decrease in the overall aircraft accident rate. Reporting provisions of AFR 127-4 are making themselves felt in the increased number of incidents recorded—a desired goal, since greater emphasis on incident reporting is a planned approach to more effective accident prevention. Under this regulation reporting requirements for the accident category are, in some cases, less stringent than in past years and commanders and safety officers are reminded that merely holding the accident rate line may reflect decreased effectiveness in accident prevention.

One of the major aims of the revised reporting system is to encourage prompt and complete reporting of all accidents and incidents. Reduction of the aircraft accident rate from over 43 to under six in the past 15 years makes it apparent that vigorous and conscientious effort can produce further improvement. A review of 1962 accident and incident experience to date leaves no doubt of this. Major problem areas, particularly those which give promise of carry-over into 1963, deserve everyone's attention. As presented here, they represent information collected from all sources, Air Force-wide, and analyzed by weapons system project officers.

Before examination by aircraft type, however, there are several problems that are deserving of special attention.

Power plant failures, both in jet and reciprocating aircraft, account for a substantial part of the materiel failure accidents/incidents. There is reason to suspect that many failures are maintenance and operator induced. Because of this, teams are being sent out in an effort to re-educate personnel on causes and preventive measures. Some engine failures, e.g., 110 C-119 engines shut down in the first seven months, are attributed primarily to overhaul problems, and higher headquarters action has been taken to rectify such situations. This is true also of flight control malfunctions that have caused increased concern during 1962. Every effort is being exerted to solving this problem. In some cases aircraft are impounded. This is an example of prompt incident reports paying off in a big way. In fact, with materiel the leading accident cause factor (40 per cent), the value of field reports such as URs, OHRs and incident reports has reached a new high.

Inadvertent BAK-6 and BAK-9 barrier engagements have been experienced on the touchdown end of the runway because pilots had no indication when the hook was down. As a result of OHRs on this problem, a hook down light modification has been approved for certain aircraft. The few moments it takes to make out a report may save an aircraft and crew.

Perfectly good aircraft flying into the ground with fatalities to all on board is another area of major concern. Such accidents have involved some of our first line aircraft and most highly trained crews. This matter is receiving top attention and special articles are forthcoming on this problem. Supervision, discipline, standardization and proficiency warrant careful inspection.

Starters have been disintegrating in both bombers and fighters. Several incidents have been reported with one inflight fatality when a crewman was struck by flying debris.

Inflight loss of life rafts continues to be a problem —on the increase in one cargo type aircraft.

This year's experience spotlights two major helicopter problem areas: engines and supervision. Efforts are continuing to improve engine reliability. Publication and distribution of a report on helicopter limitations is urged as one means of solving the supervision problem.

Pilot factor, though second to materiel failure as an accident cause factor, accounted for 32 per cent of all accidents through September. Most of these were preventable. Lack of sound judgment and failure to adhere to known safety of flight precepts were the glaring shortcomings here. The scope of the problem is indicated by the 10 C-47 accidents that occurred in the first five months of 1962—as many as during all of 1961.

Now for specifics in the safety problem area, by aircraft type:

TRAINERS

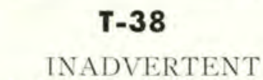
T-33

SEAT-MAN SEPARATOR. Chances for a successful low altitude ejection should increase with the installation of the seat-man separator. Latest word is that the seat rocket and the seat-man separator will be issued as a TO modification package. Kits are scheduled for delivery beginning in January 1963.

TURBINE BUCKET FAILURE. Recent information is to the effect that the service test of the Waspaloy blades on the J33 engine has been completed, with excellent results. Air Force has procured some Waspaloy blades and they are to be distributed to selected bases. Distribution of these first procured blades is to be made prior to January 1963. It is not known when the entire T-33 fleet is to be equipped with the new turbine blades. Air Training Command is to be commended for their efforts in making this test successful.

T-37

THE MAJORITY OF INCIDENTS REPORTED were engine flameouts. A program to modify the fuel distributors and the issuance of TO 2J-J69-525 has been accomplished. TO 2J-J69-530, replacement of fuel control filter screens, is now being accomplished in the field.



T-38

INADVERTENT LOSS OF CANOPIES. From 1 January 1961 through 31 August 1962 there have been 12 canopy loss incidents. In a majority of these the cause was incomplete rigging procedures or misconception of rigging. To make the canopy locking mechanism more reliable, a redesigned hook was developed by the contractor and is being installed in the field by a Norair team.

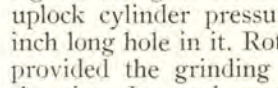
ENGINE MALFUNCTIONS. Through 30 July there were 37 flameouts or engine shutdowns. Thirty-two flameouts resulted in single engine landings; 13 single engine landings were attributed to fuel pump shaft failure and nine engine failures were attributed to eighth stage rotor failure. Improved spline shafts are being issued to the field. The improved shaft has an increase in the Rockwell hardness and more spline shaft grooves. TO 2J-J85-579 limits maximum time of shafts to 100 hours prior to inspection. The eighth stage rotor has been under study by the engine contractor and tests are being conducted on the beefed up blade.

FIGHTERS

F-84

J65 ENGINE RELIABILITY. The J65 engine as installed in the F-84 continues to be the outstanding problem associated with this aircraft. From 1 January through 31 August, there were eight major accidents involving materiel failure. Fifty per cent of these accidents were caused by engines as follows: two bearing failures; one engine fuel control malfunction; and one engine turbine failure. A J65 engine modernization program has been approved by AFLC and is to be performed by Curtiss-Wright Corporation, New Jersey. Initial engine input date was 15 October with first output to take place in December. The modernization program should see a marked improvement in the overall reliability of the already overworked J65.

MAIN GEAR TIRES. An RF-84 received major damage as a result of the right main gear failing to extend after loss of the utility hydraulic system. The right main gear ice and snow tire had contacted the uplock cylinder pressure line and had cut a one-half inch long hole in it. Rotation of the tire after retraction provided the grinding action for the wire inserts of the tire. Ice and snow tires have a slightly larger circumference than the standard rubber tread tire. Insufficient clearance between the tire and uplock line routed between wing station 96.5 and 134.5 results in the described safety of flight condition. It is recommended that use of the ice and snow tire be discontinued. However, early reports from the tire AMA indicates that other type tires will not be available for some time. The aircraft prime is looking into the possibility of rerouting the tubing in the effected area to obtain additional clearance.



F-100

AFTERBURNER FUEL PLUMBING SYSTEM. Failures in this system still cause inflight fire and explosion. TO 1F-100-746 and 746A (Project High-Wire) installs an inner support for afterburner spray bars and also provides improved spray bars and pigtails.

TURBINE FRONT BEARING SUPPORT WELDMENT. Failure of unimproved weldments and heatshields cause loss of oil, bearing failure and engine seizure. TO 2J-J57-707 (Project Backbone) provides for improved front bearing support weldment and heatshield with a vented cavity.

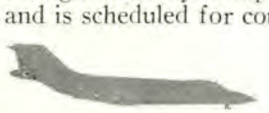
MAIN FUEL MANIFOLD. F-100 major aircraft accidents are being caused by failure of the main fuel manifold and ensuing inflight fire. Proposed retrofit of all F-100 J57 engines with Ni-Gold braze concentric manifolds was approved and delivery of first kits has been requested for April 1963, with efforts to improve delivery date. Kits will be apportioned for retrofit of the F-100 fleet as rapidly as field capabilities will permit.

FLIGHT CONTROLS. As presently configured, a line blockage in the return line of one flight control system can fail both flight control systems. The installation of a run-around check valve to correct this deficiency is included in Project High-Wire.

MAIN FUEL SHUTOFF VALVES. Confirmed and suspected failures of the main fuel shutoff valve are considered a major flight safety deficiency. A fail-safe feature to prevent inadvertent closure of the valve has been developed and is a relatively simple fix which can be accomplished at wing-base level. Kit deliveries should be completed by now.

HYDRO-MECHANICAL FUEL CONTROL. Separation in the throttle linkage can cause the main fuel control to go to the idle or below idle position. SAAMA advises that the study for a fail-safe feature is complete and the engineering change was presented to the Air Force about 1 October. This fix will allow sufficient power to be available to maintain flight in event of linkage separation. Additionally, TO 1F-100-784 has been issued to correct a discrepancy in the linkage system which has previously caused separations. Accidents are presently occurring where failure of the fuel control is suspect. The prime depot is furnishing assistance in the field to discover the cause of recent engine flameouts.

PROJECT HIGH-WIRE. Major corrective actions are included in Project High-wire and the J57 engine modernization program. Project High-Wire provides for rewiring of the F-100, accomplishing outstanding TOs, IRAN and heavy maintenance. This project is scheduled for completion at the end of FY 64. Engine modernization program brings J57 engines up to latest configuration by complying with all outstanding TOs and is scheduled for completion June 1964.



F/RF-101

MAIN LANDING GEAR STRUTS. Failures have caused one major and one minor accident this year. Approximately 18 defective struts have been found. TO 1F-101-975 has been issued as an interim fix. Interim TOs 1F-101A-6E and 1F-101B-6G have been issued requiring strut inspections during hourly post-flight inspections. Depot teams are being outfitted with portable equipment for TO 4S1-1-509 compliance in the field.

MAIN LANDING GEAR SIDE BRACE ACTUATOR. Four major accidents have been caused by failure of this unit. Three were caused by failure of the rod end and one by a rupture of the actuator cylinder barrel. Complete metallurgical analysis was conducted on all failed parts. A complete retrofit will be made of the cylinders converting them to an improved configuration. This retrofit will incorporate a strengthened rod end.

HYDRAULIC PUMP. A deluge of failures has occurred since the first of the year. Cause is believed to be system contamination and quality control of modified pumps. A meeting at OOAMA resulted in 24 action items. Get well date will depend upon completion of these items.

HOT AIR DUCT ASSEMBLY. Failures have produced safety of flight hazards. TO 1F-101-926 was issued to eliminate the potential flight safety hazard by this duct failure. Most of the kits for this fix have been issued.

F-102

MAIN LANDING GEAR. Shipment of retrofit kits began in May with get well date April 1963. However, recent cracks found on the lower portion of the strut outer cylinders have revealed the necessity for another fleet inspection before retrofit with new gear components is completed. This inspection, using conductivity (Eddy Current Principle) testing machines, has been completed in PACAF and is in progress in USAFE. Inspections in other using commands will follow.

UNSNUBBED LAUNCHER EXTENSIONS have resulted in inflight loss of weapon system evaluator missiles and damage to GAR missiles and launcher rails. Malfunction was determined to be in the launcher pneumatic selector valve. Modified valves are being distributed in accordance with priorities of programmed units. Recently two unsnubbed armament launcher *retractions* have occurred on aircraft with the modified valve installed. SAAMA is investigating.

TAIL HOOK POSITION LIGHT. Modification may be completed by now.

GAGE TYPE OIL PRESSURE INDICATING SYSTEM. Proto-proofing disclosed the feasibility of incorporating a new design restrictor orifice into the installation which will serve to dampen excessive oil pulsation to the new gage. Contractor is presently engaged with installation drawings and acquiring parts necessary for actual installation and final proto-proofing.

ARMAMENT BAY PNEUMATIC CYLINDERS. On many occasions these have exploded causing extensive damage in the armament bay. Contracts have been let to provide 1200 cylinders a month. Approximate get well date is January.

ASD, OOAMA and SAAMA have determined that the TALCO-15 (LAU-28/A) catapult will be used to provide improved low altitude escape capability. Amendment is being processed to cancel the purchase request which specified M-19 catapult. Get well date is unknown at this time. Target date for availability of parts and instructions is December 1962.

F-104

ENGINE RELIABILITY. Loss of thrust at critical phases of flight resulted in an extensive engineering study on the reliability of the -3A engine. As a result three programs for improvement have been accomplished, the latest, *Project Hardcore,* consisting of 19 modifications. Engines are being modified at depot level on turn around basis. All -3A engines should be modified to the -3B by end of 1962.

NOSEWHEEL SHIMMY. In 1961 nosewheel

shimmy during landing roll and takeoff caused numerous external stores release, blown nosewheel tires and nose gear failures. Several modifications were made which reduced the number of shimmy incidents but did not eliminate them. Lockheed has fabricated six kits that incorporate a 1000 psi return pressure to the steer damper thus giving a greater dampening effect. These kits are presently installed on 479th TFW aircraft and are being tested at George AFB. Preliminary reports have indicated only one incident of shimmy.

LOSS OF ENGINE OIL. The oil low level warning system is still a problem since the system does not alert the pilot of impending loss of oil until 80 per cent of the oil is lost. An improved system that will give the pilot an immediate indication of impending loss of engine oil is being studied by the responsible Air Force and contractor agencies.

F-105

INADVERTENT TAILHOOK EXTENSION. There have been numerous inadvertent tailhook extensions and approach-end engagements of the F-100, F-102 and F-106 aircraft. Although the F-105 has not experienced an approach-end engagement to date, the problem of inadvertent extension and possible engagement is a factor which must be considered, since an engagement at touchdown could result in a major accident and possible aircraft destruction. Recommendations have been made to ASD to approve modifications that will: (a) provide for a positive indication of tailhook extension; (b) prevent inadvertent engagement of the tailhook while in the stowed position.

AUTOPILOT MALFUNCTIONS. The Directorate of Flight Safety has received reports of more than 40 incidents involving F-105 autopilot malfunction since 1 July. There are numerous modifications in the mill for the autopilot in Phase I and II of *Project Look Alike.* These fixes are aimed primarily at precluding spontaneous hard core signals in the autopilot, inadvertent disengagement of the stability augmentation system and to provide a positive disengagement capability to the pilot. To date the incidents reported have not indicated a specific trend except in the area of maintenance. Therefore, the contractor has been directed to perform a reliability study following which further corrective action may be indicated. Until the time that such action can be taken, greater emphasis should be placed upon proper maintenance of the autopilot system, particularly in yaw and pitch trim pot adjustment and proper rigging of the flight control system.

REVERSE CURRENT RELAY. Under some conditions following a malfunction in the DC electrical system, it is possible that the reverse current relay function of the generator control panel will not be tripped. When this occurs the generator becomes motorized by the battery and has caused battery failure. There have been seven known instances in which failures of this type have occurred. The prime AMA has established a project to study methods for precluding such occurrences in the future. Until such time as this study can be completed and a fix can be installed, pilots of aircraft equipped with load meters should pay closer attention to load meter readings inasmuch as the DC generator OFF light may not be activated. For aircraft equipped only with the DC generator OFF light, there is no known method by which a check can be made to determine this type of malfunction before battery failure occurs.

F-106

CONSTANT SPEED DRIVE. System reliability is expected to improve following compliance with numerous TOCs. Beefed-up gear boxes are being tested at an ADC base and results are encouraging.

TAIL ARRESTOR HOOK. Pilots are unable to determine the position of the hook since an indicator was not included in the original design. Engineering and prototyping for a caution light have been completed, and TO 1F-106-762 installation of barrier hook caution light and rework of barrier hook latching mechanism have been assigned. The estimated completion date is December.

DRAG CHUTES. Inflight loss continues to be a problem. The present entire system is being evaluated to determine if a redesign is necessary.

EXTERNAL TANKS. At the present time pilots are unable to determine when the external tanks are empty. A "tank empty" caution light is being prototyped for installation.

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BOMBERS

STATISTICS computed through mid-September 1962 indicate bomber aircraft major accidents will approximate the 33 that occurred in 1961. Compared to 1961: B-52 and B-66 accidents for comparable dates are fewer; B-57 and B-58, a little more; B-47, even with 1961, approximately 40 per cent of all bomber aircraft accidents. Non-jet bomber accidents increased primarily because of B-26 accidents since the aircraft returned to the active inventory.

Some major bomber problems that have contributed to accidents are included in this report.

B-47

DURING THE FIRST EIGHT MONTHS of 1962 three B-47s were destroyed and 11 crewmembers lost their lives on low level missions. One aircraft hit the peak of a mountain 28 miles off course; another was directly on course but flew into a mountain 7000 feet below the altitude specified in the Airman's Guide for the low level entry; the third also was nearly on track but hit a peak about 2500 feet below the prescribed level off altitude for entry. A highly qualified standardization crew was aboard this aircraft. Some of the low level entries and bomb runs are pretty tricky and the slightest mistake in planning or en route procedures can be disastrous. The only effective way to avoid the rocks is to fly over them. Know your position and planned altitude and fly exactly what the route prescribes.

Sixteen cases of loss of artificial feel have been reported since issuance of TO 1B-47-1155, 10 Feb 62, which blocked off the hot air duct to the empennage anti-icing system. On each occasion the copilot was unable to detect any ice formation in the ram air scoop of the vertical fin. The Boeing Company, working with OCAMA, is making a study of the B-47 ram air duct and plumbing associated with the Q spring to determine specifically where the ice forms and how best to prevent or eliminate this hazard. Results of the tests should now be available. In the meantime, all B-47 crews have been directed to stay out of forecast icing conditions or if they are inadvertently encountered, to get out of icing area as soon as possible.

Engine failures continue to be reported. Reasons for failure are many; however, those resulting in turbine failure are by far the most serious. Overtemperature is the cause for this type failure. A team composed of SAC, GE and OCAMA personnel is touring SAC bases to re-educate maintenance and operations personnel on proper procedures to be followed both in flight and in engine conditioning.

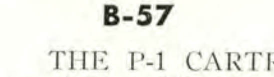
B-52

THREE FAILURES of the main landing gear struts of G and H aircraft in the past 12 months have resulted from stress corrosion. Two occurred in the base of the tripod lug slot area while the third failure originated from a minute pit in the forging. Since the circumstances indicate a hazard to other G and H aircraft an ultrasonic inspection is being developed which will be performed on all of that series of aircraft struts. Also action has been initiated to procure new strut cylinders to prevent grounding of aircraft as inspection progresses.

Pneumatic duct failures in B-52 B through F aircraft continue to be a major safety of flight problem. Two serious incidents of duct failure in the engine struts "kneecap" area occurred in 1962. Corrective action for this problem is currently in progress. TO 1B-52-1469 replaces critical ducts in the strut "kneecap" area and is scheduled for completion by December 1962. TO 1B-52-1501 which provides an inspection and repair procedure for the entire pneumatic duct system is scheduled for incorporation during the 1962-63 depot level maintenance program. These programs should provide for greatly increased reliability of the pneumatic ducts system in the B-52 aircraft, but do not eliminate the requirement for thorough leak check inspection by base level personnel during phase inspections.

B-57

THE P-1 CARTRIDGE STARTER will overspeed to turbine wheel disintegration under certain operating conditions. Nine incidents occurred within a 60-day period in which starters failed and threw flying debris through various parts of the aircraft including engine nacelles, fuselages and fuel tanks. Urgent starter and cartridge projects have been established to resolve this serious hazard.



B-58

TWO B-58 AIRCRAFT were destroyed and four flight crewmembers were killed because of flight control system failures on takeoff. Consequently a program has been established to investigate abnormal flight control system malfunctions considered to affect safety of flight. A special team of Air Force-Industry flight control system specialists was organized to investigate these malfunctions. Twelve malfunctions have been investigated. The investigations thus far have revealed faulty elevon control valves and control surface movement rate limitations. The elevon control valves are presently being redesigned. An engineering re-evaluation of the hydraulic system capacity together with surface rate commands and responses in excess of hydraulic system rate capability are underway.

Two minor accidents and one flight crewmember fatality were caused by pneumatic starter disintegration in flight. Several interim fixes have been made. A project has been established to incorporate a method of containing the metal fragments of the starter wheel in the event of an overspeed and burst condition.

B-66

AS A RESULT OF THE MANY gray areas uncovered in investigation of three undetermined accidents in 1961, a complete non-destructive evaluation was performed of the B-66 structure and systems. This evaluation determined:

- Inspection procedures and techniques
- Mandatory equipment changes
- Recommended reworks
- Recommended ECP actions

Seven aircraft were looked at during the engineering evaluation. Thirteen safety of flight items and 16 potential safety of flight items were immediately fixed by instructions to the field; remaining items are incorporated into the FY 63 heavy maintenance program now in progress on the B-66 fleet. In addition, there were 45 other recommendations for fixes or modifications that were either incorporated in the heavy maintenance program work specifications or submitted as ECP actions. All the recommendations as a result of the evaluation are not complete as yet, and it is expected that another 20 to 30 will be made. The thoroughness of the engineering evaluation and subsequent heavy maintenance program should insure that the B-66 is a safe aircraft capable of a relatively trouble free existence for its programmed life.

The J-71 engine became a problem in the B-66 during the latter part of 1961. The engine was plagued with forward frame seal leaks, broken eighth and second stage compressor blades and stator shifting problems. Engineering support was given these and other J-71 problems and fixes began to appear. The magnitude of the fixes to be made on the J-71 brought an accelerated turnaround overhaul program called "Quick Trip." Apparently the actions taken on this engine problem have been effective. There have been very few reported failures on the J-71s that went through "Quick Trip."

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TRANSPORT/UTILITY

TRANSPORT-UTILITY ACCIDENTS have increased in rate and numbers this year. Factors have included operating environment such as short strips and difficult and mountainous terrain under which some of these aircraft conduct their USAF mission. Helicopters have experienced a slightly improved record. Some major problems associated with transport aircraft for 1962 are included in this report.

C-119

THERE WERE 110 REPORTED engine shutdowns in the C-119 aircraft. Eighty of these were caused by R4360-20WA & R3350-89A engine failures. SAAMA believed the numerous engine malfunctions were due to use of an unknown number of sub-standard engines that were overhauled prior to 1 July 1961. The engines overhauled since then are believed to be satisfactory and when the sub-standard engines are removed from inventory, the C-119 engine problem should cease. CONAC acted to identify the sub-standard engines and will place these engines under special surveillance until they are removed.

C-123

ONE MAJOR C-123 ACCIDENT was the result of main landing gear wheel failure. Action has been taken to procure split type wheels for retrofit of the C-123 fleet. Delivery was scheduled to begin in October.

C-124

PROPELLER SHAFT FAILURE and deterioration of electrical wiring were reported in the September issue of Aerospace Safety. The 4360-63A engine conversion program for all C-124 aircraft is proceeding on schedule and two aircraft have been modified by Douglas Aircraft Co. Delivery of modification kits began in August.

An electrical wiring analysis is being made by Hayes Aircraft Corp. on 20 aircraft from various areas. Target date for completion of the analysis is January 1963.

T-29/C-131

THERE HAS BEEN AN INCREASE in T-29 R2800-99W and C-131 R2800-103W engine failures. The problem: broken exhaust rocker arms and intake push rods. The prime AMA (SAAMA) has advised that a refinement of the overhaul procedures and a closer quality control inspection should reduce this discrepancy.

C-130

THE INADVERTENT RELEASE of life rafts in flight has represented a serious safety of flight deficiency in the C-130. There have been 23 such incidents reported. In 20 cases the rafts left the aircraft. The loss of these rafts, which weigh approximately 165 pounds, frequently causes minor structural damage to the aircraft and could foul the control surfaces. In addition to the possible loss of an aircraft, death or serious injury to persons on the ground could result if struck by a falling raft.

Suspected causes of this deficiency are: expansion of residual air in the rafts at altitude; CO_2 leaking into the raft due to a faulty CO_2 valve; failure of the cylinder support allowing the CO_2 cylinder to shift; and tightening of the valve actuator cable sufficiently to open the valve and release the CO_2.

Actions taken to correct this problem include: TCTO 1C-130A-696 providing for a more rigid attachment of CO_2 cylinder retainers; TCTO 1C-130A-511 modifying set screw stops on CO_2 cylinders; TCTO 14SB-1-505 for replacement of cylinder valve poppet assemblies; TCTO 1C-130-630 providing for installation of restraining straps in each life raft compartment; and Safety of Flight Supplement and other recommendations to using activities. In addition to these improvements, a contract has been let to secure vent valves for installation in all rafts.

C-133

NOSE CASE FAILURES ON T-34 ENGINES. Since January 1960, there have been over 30 recorded instances of nose case failures on T-34 engines installed on C-133 aircraft. Two aircraft were lost at sea during routine operations. Separation of the propeller and/or nose case was the primary suspected cause in both instances. The problem was believed to have been associated with the T-34-P9W engine only. However, the last aircraft destroyed had T-34-P7W engines installed. The most common cause of failures has been cracked nose cases and failure of the high speed reduction gear pinions. The prime AMA has established an aggressive modification program to improve the reliability of T-34 engines and allow continued operation of the C-133 until such time as a permanent and dependable fix can be engineered and tested. The modifications will apply to both P-9W and P-7W engines. The engines on which all modifications have been completed are identified as "super white dot" engines. It is anticipated that the entire C-133 fleet will be retrofitted with "super white dot" engines by April 1963.

HELICOPTERS

THREE MAJOR ACCIDENTS in H-19 and H-21 helicopters resulted from inflight engine failures. SAAMA programs established to improve dependability of these engines include:

- All H-19 engines overhauled after March 1962 have shot-peened cylinders.
- Replacement of number 5 and 6 cylinders with shot-peened cylinders on all three H-19 engines.
- Replace all R1820-103 engines installed in H-21s with R1820-103A engines. This was to have begun in November.

Supervision was a contributing factor or additional finding in 50 per cent of all 1961 major helicopter accidents in that:

- The mission was not properly briefed.
- The flight was cleared in violation of existing directives.
- Adequate facilities were not provided for safe operations.
- Supervision of helicopter aircraft maintenance was inadequate.
- Directives were inadequate for helicopter checkout, training and operations.

Review of 1962 helicopter accidents indicates the same deficiencies. In view of the above, Hq USAF has directed the Air Training Command to prepare and distribute helicopter familiarization kits Air Force-wide. ★

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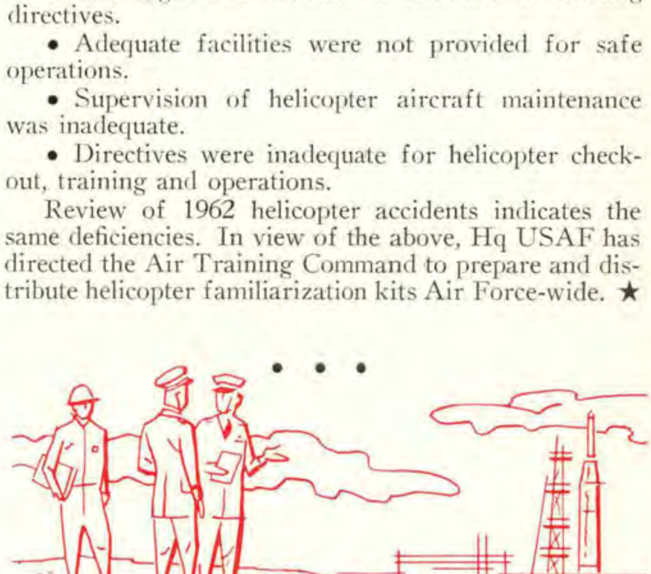

MISSILE

IN GENERAL missile safety problems can be categorized into two areas: Program problems and Technical problems. An example of the former is the assignment of many additional duties to missile safety officers. It has been observed that in at least one instance the MSO of an ICBM squadron was assigned duty as ground safety officer, nuclear safety officer and supply officer for all items of safety equipment on the UAL. Obviously these additional duties detract from the MSO's effectiveness in accident prevention.

Noncompliance with technical orders and failure to use checklists continue to dominate the personnel error type accident cause factors. Adherence to TOs and the use of checklists are keystones to accident prevention. Item: Ground handling of small air launched missiles, particularly uploading and downloading, continues to account for most GAR missile mishaps. To aggravate this situation many aircraft/missile loading configurations are not covered by a formal TO checklist. This deficiency has been brought to the attention of responsible agencies for early corrective action. The Deputy Inspector General for Safety will not be satisfied until there is a workable, printed TO checklist for every aircraft/missile loading configuration.

The technical safety area contains many problems. Projects designed to prevent missile accidents include:

SAFETY MIL SPEC. Safety surveys, failure data and hazard reports consistently point out safety deficiencies which should have been observed in early design or development of the weapon system. Drafting of a mil spec for safety has been the result. This document will become part of the contract requirements for future missile weapon systems just as reliability, quality control and life expectancy have been in the past. The mil spec will require a contractor's safety organization, identification of hazards, a System Safety Engineering Plan (SSEP), and designation of milestones for safety reviews and evaluations.

Tentatively planned for publication in the third quarter of FY 63, the new mil spec should buy more safety, eliminate duplication, reduce expensive follow-on modifications and reduce the number of interface problems.

RISK STANDARD. An effort is being made to define an acceptable level of risk that can be used for Air Force planning in missile weapon systems. This would give managers a more realistic and practical approach to problems of personnel protection, real estate requirements and range safety.

LIGHTNING PROTECTION. Lightning strikes have been responsible for damage to sensitive components and the frequency of these occurrences has increased with the activation of more ICBM sites. Convinced that there is much that man can do to reduce the probability of these strikes, the Directorate of Missile Safety (DMS) in April published a study on "Lightning Protection for Surface Launched Missiles."

An immediate solution to the lightning strike problem is not in the offing. Meanwhile, MSOs should insure that the requirements in AFM 32-6 on inspection and test procedures for lightning protection on surface structures are being met. Further guidance can be found in TO 11A-1-40, Ordnance Safety Manual; TO 11N-20-2, Standards for Electrical Grounding; TO 31-1-175, Lightning Protection for Antenna Systems.

DETECTING SAFETY HAZARDS. Safety hazards sometimes lie dormant for years then appear in the form of catastrophic failure. To preclude this, the DMS has a project to inspect each system minutely for safety deficiencies or accident potential. The product of this effort is a Weapon System Technical Safety Review. Such a review requires from four to six months to complete and includes a comprehensive engineering review and evaluation of system hardware. During a review, emphasis is placed on the safety of all subsystems and components, as well as the safety of the total system in its intended operational environment. Reviews were completed and published during 1962 on the GAM-72 Quail, GAM-87 Skybolt, GAM-77 Hound Dog, SM-68B Titan II, and SM-80 Minuteman. A total of 41 safety deficiencies were uncovered and recommendations made for correction or further safety evaluation.

Technical Safety Reviews for the Atlas F and Titan I are near completion and will soon be published.

MISSILE SAFETY MANUAL. The Air Force's first Missile Safety Manual, designed to save MSOs and technicians from thumbing through dozens of books, manuals and other publications, has been written. It is being edited and publication is expected soon.

The manual will deal with hazards and general accident prevention procedures with missile weapon systems. Though conceived as a quick reference for safety and supervisory personnel, it will contain enough material for complete understanding of the problems and will highlight hazards and accident prevention procedures now contained in many different documents. The manuals should be in the field by the beginning of FY 1964.

HIGH PRESSURE SYSTEMS. Until recently there was a relative vacuum of information, guidance and standards concerning high pressure systems. TO 00-25-223, Integrated Pressure Systems and Components (Portable and Installed), was published to plug this hole. It is directive to all engaged in the operation, installation, testing and maintenance of high pressure piping systems applicable to missile and airborne systems, AGE and facilities. Strict adherence to its requirements is essential.

AIR FORCE-INDUSTRY CONFERENCES. To promote a free interchange of technical safety data in selected missile hardware trouble spots, the DMS annually sponsors a conference of Air Force and industry representatives. In June of this year the subject was "Missile Electrical-Mechanical Safety Problems."

Although it is difficult to measure direct benefits from the conferences, there is one certainty: the people responsible for design, development and production of missile hardware are fully aware of the nature and extent of operational safety problems. ★

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GROUND

THIS ARTICLE deals with the moral responsibility of all Air Force members.

This year the increased loss of life and incapacity resulting from accidents involving Air Force personnel, highlight a serious problem. In spite of the many loss prevention measures which have been developed and applied, fatalities, injuries and property losses are on the increase. These extensive losses result in high operating costs, poor public relations and decrease in mission

capability. Accidents are the leading cause of man days lost in the Air Force.

To prevent serious accidents, attention must be directed to preventing all accidents—the small ones as well as the big—for after an accident has been caused by something or someone, the resulting damage, injury or death is purely a matter of chance.

There are no big or little accidents as far as accident prevention is concerned. Every preventable or near accident is proof that something is wrong in your organization and affords an opportunity to take corrective action before someone is injured or killed.

An analysis of contributing factors to serious accidents this year indicated that personnel failure was involved in a large proportion of the cases. Investigation of operating practices will contribute valuable information upon which remedial measures may be used.

Motor vehicle accidents continue to be the number one killer of Air Force personnel. The balance of this article will deal with this extremely serious problem.

MOTOR VEHICLE ACCIDENTS involving Air Force personnel resulted in an increase in the number of fatalities during the first nine months (preliminary figures indicate 13 per cent), and a large increase of seriously injured. Driving training, use of seat belts, and adequate disciplinary action would have reduced this accident loss considerably.

The methods and techniques of effective traffic-accident prevention are well known and have produced results in many areas. The real problem is how to develop the interest, leadership and support needed to keep people from killing themselves. Highway traffic deaths and injuries are of a magnitude to be classed as a public menace.

An effective system of on-base licensing is needed to weed out drivers not physically or mentally fit to operate a motor vehicle. An effective system of revoking or suspending permits of drivers who show gross disregard of traffic laws is necessary.

Along with an adequate system of driver examining and licensing, there must be a definite system for suspending permits of traffic law violators. A system, assessing penalty points for each violation, when properly administered, develops in most drivers a healthy respect for safety and regulations. (These tools are at our disposal in AFR 125-14. What is needed is better utilization of them.)

Another incentive to safe driving was presented during the 84th Congress. A special sub-committee on traffic safety reported that half of the civil lawsuits on court calendars have their origin on our streets and highways. Remember, the majority of all motor vehicle accidents result from violations.

Accident records provide data that can furnish the information needed to weigh results of accident-prevention programs. Unfortunately, in too many instances the type of data furnished by investigations of accidents is not meaningful for this purpose. Accident investigations should show WHY the accident happened and what was done *before* the accident to prevent it.

Another way of pointing out this deficiency is that too many accident reports are compiled to determine responsibility for the accident, *not* the cause of it. The failure to make full use of accident data for effective and factual accident-prevention activities is another glaring weakness. Accident records are a necessary and vital tool for safety. With proper analysis and use, they can serve as an important weapon in reducing deaths and injuries.

Efforts to encourage the installation and use of seatbelts are to be commended. Such belts do not, of course, prevent accidents, but available evidence indicates that their proper use reduces the likelihood of death or serious injury in the case of accidents.

Vehicle inspection is needed so no one can operate a vehicle which does not meet certain minimum safety requirements. It must be brought home to drivers everywhere that driving is a privilege and not a right. It is a privilege that should be curbed for violators who do not respect laws and rights of others.

PRIVATE MOTOR VEHICLE FATALITIES

	1962	1961
January	32	20
February	17	25
March	29	28
April	33	30
May	45	24
June	36	36
July	33	49
August	39	25
September	33	27
Total for first 9 months:	297	264
Labor Day:	10	4

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NUCLEAR

THE CLASSIFIED NATURE OF THIS SUBJECT precludes a meaningful discussion of nuclear safety problems. The director of Nuclear Safety has, therefore, directed that the article on this subject be placed in the December issue of USAF NUCLEAR SAFETY. ★

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Captain Richard E. Merkel

CAPT RICHARD E. MERKEL, 526th Fighter Interceptor Squadron, USAFE, has won a Well Done Award for his skillful performance in landing a crippled jet fighter on 26 March 1962.

Assigned to fly a functional flight test on an F-102A just out of periodic, Capt Merkel made a normal takeoff in weather forecast to be 5000 feet broken, 7000 overcast extending to 15,000 feet. After completing airborne tests of the flight controls and fuel system below the cloud deck, Capt Merkel climbed to 15,000 feet and resumed the tests, all systems functioning normally.

The last test was a maximum speed dive beginning at 43,000 feet with recovery at 24,000 feet. After zooming back to 30,000 feet and leveling off, Capt Merkel moved the throttle forward but the RPM hung up at 82 per cent with low fuel flow and tail pipe temperature. Attempts to accelerate the engine both on normal and emergency fuel were fruitless so the pilot declared an emergency with Sembach Control. By now the RPM had dropped to 79 per cent and Capt Merkel realized that power was inadequate for a normal landing. He asked Sembach for a random letdown and requested control to keep him within 10 nautical miles of the field. Moments later the engine flamed out while the aircraft was five miles southeast of the field at 20,000 feet and above the clouds. Repeated air start attempts were not successful.

Capt Merkel prepared for bailout. He was then advised to make a hard left turn to 270 degrees and that after completing the turn he would be lined up with the runway.

Flight instruments were now on emergency power as the aircraft entered the clouds at 15,000 feet and the radio went dead. At this point Capt Merkel realized that he was over the city of Kaiserslautern and that ejection would endanger the community below. He decided to bail out at 3000 feet if he had not broken out of the clouds or was not in a position to land. By then he would be west of the city above an unpopulated area. As he passed 4500 feet he broke out of the overcast and saw the field three miles ahead and one mile to the side. Lowering the gear and extending the ram air turbine for hydraulic power, Capt Merkel completed the landing successfully directly in front of Mobile Control. ★

WELL DONE

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