

# HOW DANGEROUS IS LIGHTNING?

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PHOTO BY DON DOWNIE

Recently there has been renewed interest in the significance of lightning as a hazard to flight. To best answer the question, "How Dangerous Is Lightning?" let's look at the Air Force record. In this way conclusions can be based on facts.

During the five year period from January 1959 through December 1963 there was one major Air Force accident in which electro-static discharge was the primary cause. In this case a pilot ejected from an F-102 after a discharge blew the radome and pitot tube off causing loss of instruments and control difficulty. In only one accident was lightning strike or electro-static discharge credited as a contributing cause.

Reporting procedures do not require reports on all incidents and it is fair to assume that many lightning strikes have been experienced where little or no damage resulted. However, during the two year period ending in December 1963 there were 66 reports of lightning strikes or electro-static discharges. In most of these damage was confined to pitting or discoloration of the extremities of the aircraft, such as wingtips, radome and vertical stabilizer.

Information available does not, in all cases, differentiate between a natural lightning strike and an electro-static discharge. Therefore, no distinction is made in the following statistical discussion.

## DAMAGE

Damage reported in the 66 inflight lightning strikes varies from skin discoloration to superficial skin damage and disruption of electrical systems. Pitting and discoloration of nose, wingtip and tail surfaces occurred in 41 incidents. The incidents of pitting occurred in large transport and bomber-type aircraft.

Radomes are particularly susceptible, and were involved in 22 incidents. Damage varied from pitting to complete loss. However, radar became inoperative in only two of these cases. One or more radios became inoperative in six cases, of which four were due to antenna damage.

In 11 cases more extensive damage resulted. The most significant was a C-130 pylon fuel tank aft section rupture when residual fuel was ignited and fuel burned for several minutes. Fabric control surfaces received rips that required repair or replacement in four cases.

Systems malfunction resulting from a lightning strike occurred in 12 incidents. The most serious was disruption of power in three engines of a C-124 due to temporary malfunction of magneto switches. Target darts were inadvertently jettisoned by firing squibs in two F-100 incidents. Airspeed systems were affected in three cases. Magnetic compass and directional gyro malfunctions occurred in a flight of two F-101 aircraft.

Figure One shows a damage breakdown. It includes more than one damage type in a single incident. In four incidents reported there was no damage.

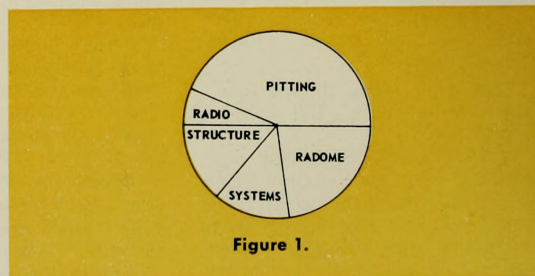
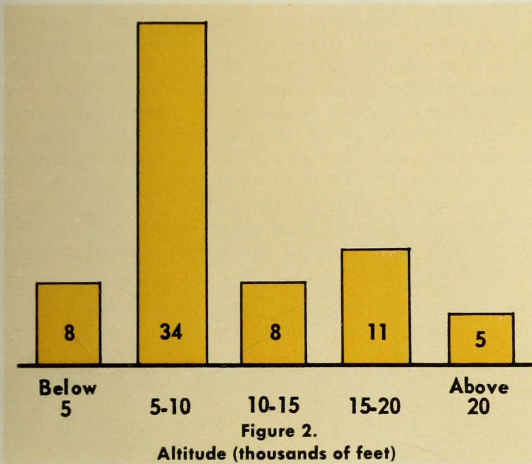


Figure 1.



### OCCURRENCE

A comparison of altitudes above mean sea level at which aircraft were operating when lightning strikes were reported shows maximum reports in the 5-10,000 foot area with a sharp drop in reports above 20,000 (Figure 2). It may be of interest to note that nine of the 11 lightning strikes reported on B-52s were below 20,000 feet.



### AIRCRAFT TYPE

Lightning strikes occurred to most aircraft types with the B-52 receiving the most (11), closely followed by the C-124 (9) and the C-54 (8). (Figure 3.)

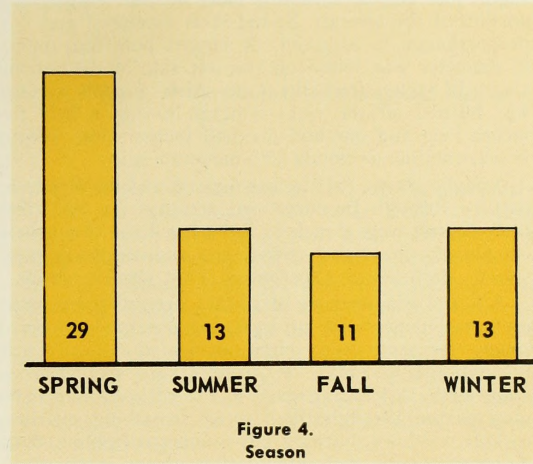
Most of the lightning strikes reported by single and twin-engine jet aircraft occurred during climb and in no case was metal skin pitting reported. These aircraft were subject to loss of tow targets, tip tanks and damage to pitot tubes.

Aircraft	Incidents
B-52	11
C-124	9
C-54	8
C-118	6
F-100	4
C-119	3
C-133	3
F-101	3
B-47	2
B-57	2
C-135	2
T-33	2
F-102	2
F-105	2
C-130	2
C-97	1
C-47	1
B-50	1
F-89	1
F-104	1
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Figure 3.

### SEASON

Incidents were reported in all seasons with a maximum in the spring and a minimum in the fall. (Figure 4.) Many reported incidents occurred in atmospheric conditions where natural lightning was not observed and does not normally occur. These were most likely electro-static discharges and generally occurred to large aircraft flying in clouds or precipitation.



### BRIEFS

*Major Accident.* F-102 pilot was at 4500 feet during instrument approach, when a ball of fire was observed in front of the canopy, accompanied by an explosive noise. The airspeed indicated zero and the attitude indicator was tumbling. The pilot experienced control difficulty and ejected. The radome and pitot tube were found to have been separated from the aircraft by an electro-static discharge.

*Incidents.* A B-52 had electro-static discharge while cruising on a low level navigation route at 4000 feet. Flight conditions were in-and-out of clouds with light sleet and snow. A streak of light was observed in front of the aircraft followed by a blue and red fireball about four feet in diameter. All systems were normal after discharge. Damage was a seven-inch hole in the radome and burning of the antenna in the right wingtip.

A B-52 was cruising at 9000 feet on a low level navigation route when a cloud-to-ground lightning strike was observed directly in front of the aircraft. Weather conditions were: overcast clouds with light rain. All systems appeared normal and the mission was continued. After the aircraft landed fuel was observed leaking from the aft section of the left external fuel tank. Inspection revealed a one-fourth inch hole in the tank and three other arc blobs of metal located horizontally along the outer portion of the tank.

C-130 cruising at 7000 feet, circumnavigating thunderstorms, was struck by lightning followed by one loud and one muffled explosion. Flames were observed outboard of the Nr 4 engine and trailing to the aft section of the fuselage. Flames disappeared after two minutes total burning. Inspection revealed that the aft cone section of the right pylon fuel tank was blown off by an explosion within the tank. Pitting was found in both wing tips and outboard extremities of both



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continued

aileron. Only normal residual fuel remained in the pylon tanks at the time of the incident.

A C-135 was climbing at 285 knots indicated through 4000 feet. An explosion was heard accompanied by a slight jolt and a lightning flash at the left forward portion of the aircraft. Sound level increased and held proportionate to airspeed. A jagged hole four inches in diameter was found on the left side of the radome about 12 inches from the nose. Also, a static arrestor was burned off the right wingtip leaving a hole five inches long and one and one-half inches wide. Weather was continuous clouds with moderate rain.

A flight of two F-101s was making an instrument departure through thunderstorm activity. At 5000 feet, both aircraft were struck by lightning. Loss of magnetic compasses, directional gyros, and radome damage resulted. Both pilots experienced mild electric shock.

A C-124 was cruising at 10,000 feet in light to moderate turbulence with no lightning observed. Areas of severe weather were circumnavigated visually and through use of radar. St. Elmo's Fire was observed followed by a blinding flash in the cockpit. The lightning passed through the aircraft, smashing overhead cockpit windows, burning out numerous lights and radio components, and interrupting power in three engines. Power loss was due to popping of the magneto switch pins to the OFF position, possibly the result of heat generated by arcing in the switch case. Power was regained by returning the magneto switches to the ON position.

A B-47 crew observed St. Elmo's Fire on the nose section followed by an electro-static discharge. The incident occurred during departure at 26,000 feet in haze above broken cumulus clouds. There was no damage.

### CONCLUSIONS

Lightning strikes and electro-static discharges frequently occur to Air Force aircraft. Damage resulting from these incidents is usually negligible. Isolated cases indicate that structural damage does occur but rarely results in an aircraft accident.

Lightning strikes occurred most frequently below 10,000 feet and rarely occur above 20,000 feet.

Reporting requirements and lack of exposure statistics by aircraft prevent a close comparison of susceptibility by aircraft type. There is some indication that lightning strikes and electro-static discharges are more likely with large aircraft and result in damage greater than with smaller aircraft.

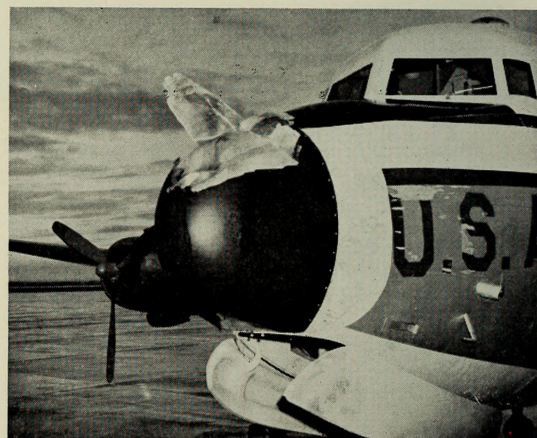
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Lightning strikes are among the most startling phenomena an aircrew can experience. They are usually accompanied by explosive sounds and blinding flashes of light. Historically, the evidence shows they are rarely dangerous, but aircrews should recognize the hazard potential.

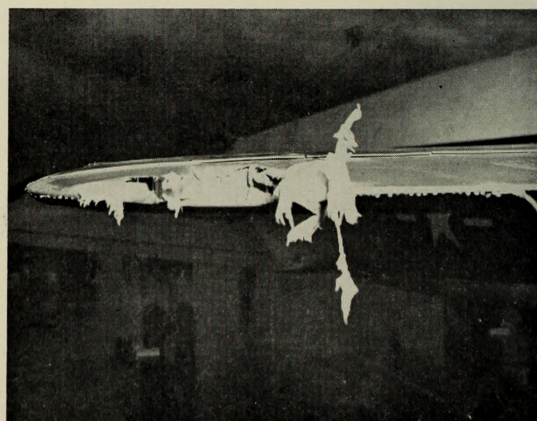
### RECOMMENDATIONS

Flight handbook recommendations, such as turning cockpit lights up bright, should be followed. Better yet, avoid all areas where lightning strikes are most probable. Other weather phenomena of greater hazard to flight safety—such as extreme turbulence and icing—are frequently associated with areas of greatest lightning prevalence.

Report lightning strikes and electro-static discharges in accordance with paragraph 29, AFR 60-16. Inflight reports should be given to a Military Metro or Flight Service Station. Reports may be given to the ATC controlling agency when conditions do not permit leaving ATC frequency. After landing, the pilot is required to complete an AF Form 1228, "Aircraft Hazardous Weather Report," available at the weather station. The forecaster will assist, and completion is quite painless. Information obtained from these reports will be used to develop techniques in predicting unusual weather phenomena. ☆



Lightning damage to radome of C-54



Same plane received serious damage to horizontal stabilizer