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NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

AIR TRAFFIC BULLETINS

BULLETIN NUMBER 94-1 FEBRUARY 1994
BULLETIN NUMBER 93-2 MAY 1993

Briefing Title: Air Traffic Bulletin Bulletin Number 94-1 February 1994 **Date:** 03-30-94

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(1/2004)

U.S. Department
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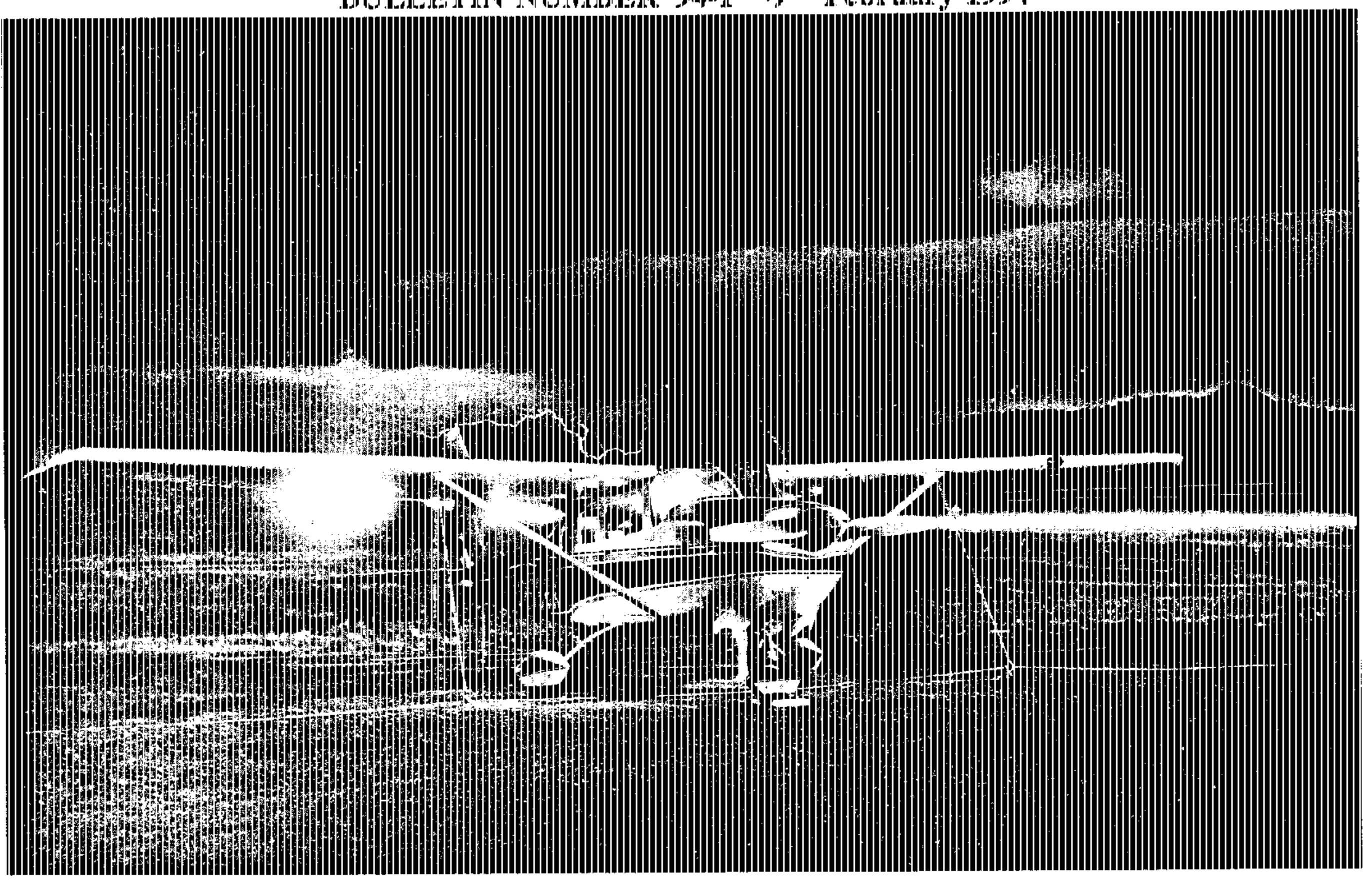
AIR TRAFFIC BULLETIN

CENTER ✈ TERMINAL ✈ STATION

Associate Administrator for Air Traffic

BULLETIN NUMBER 94-1 ✈ February 1994



THUNDERSTORMS

Although thunderstorms can be found over many parts of the country the year around, they increase, both in number and severity, starting in the spring and running through the summer and fall months. Annually, prior to the start of the SEASON, we dedicate one complete issue of the Bulletin to thunderstroms and related hazardous weather.

The more we understand the severe atmospheric hazards associated with convective activity and the impact they have on aircraft operation, the better position we are in to aid a pilot in coping with these hazards.

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Distribution: ZAT-423 *Published by: ATP-210*

A THUNDERSTORM UNITES JUST ABOUT EVERY HAZARD KNOWN TO AVIATION!

Annually, and prior to the start of the season, we publish an issue of the Air Traffic Bulletin to focus your attention on the upcoming thunderstorm season and to remind all controllers and specialists of the hazardous weather associated with it. The more we understand the severe atmospheric hazards associated with thunderstorms, the better position we are in to aid the pilot in avoiding these hazards. The article also presents factors that a pilot must consider when flying in the vicinity of, entering or penetrating a thunderstorm. Being familiar with these factors will help you better understand what is going on inside the cockpit.

JUST HOW POWERFUL ARE THEY?

The latent heat released by a moderate thundercloud is equivalent to the energy of a nuclear explosion of 400 kilotons! Flight through such clouds should be avoided whenever possible and, although most commercial aircraft are equipped with airborne weather radar, a pilot should always request up--to--date information concerning the location and extent of any active thunderstorm area which may affect their fight. Thunderstorms often reach far greater heights than the usual cruising levels of commercial aviation. The hazards involved in penetrating a thunderstorm are severe turbulence, hail, icing, extreme water ingestion and, to a lesser degree, lightning.

Downbursts, the strong descending air current found underneath storm clouds, cause rapid variations in wind speed and wind direction near the ground which have proven to be extremely dangerous to low--flying aircraft. Sometimes violent thunderstorms cause the formation of concentrated powerful vortices, extending from the ground well into the cloud, scattered tornadoes or, when over water, waterspouts. Tornadoes produce the highest wind speeds experienced near the ground (maximum values are estimated at 460 km/h). An aircraft entering a tornado vortex is almost certain to suffer structural damage. Thunderstorm hazards occur simultaneously in numerous combinations. The following discussions examine these and other thunderstorm phenomena.

TORNADOES --

The most violent thunderstorms draw air into their cloud bases with great vigor. If the incoming air has any initial rotating motion, it often forms an extremely concentrated vortex from the surface well into the cloud. Meteorologists have estimated that wind in such a vortex can exceed 200 knots, and the pressure inside the vortex is quite low. The strong winds gather dust and debris, and the low pressure generates a funnel--shaped cloud extending downward from the cumulonimbus base. If the cloud does not reach the surface, it is a funnel cloud; if it touches the land surface, it is a tornado; if it touches water, it is a water spout.

Tornadoes have, at times, occurred with isolated thunderstorms, but more frequently they form with steady state thunderstorms associated with cold fronts or squall lines. Reports or forecasts of tornadoes indicate that atmospheric conditions are favorable for violent turbulence. Since the vortex extends well into the cloud, any pilot inadvertently caught on instruments in a severe thunderstorm could encounter a hidden vortex .

Families of tornadoes have been observed as appendages of the main cloud extending several miles outward from the area of lightning and precipitation. Thus, any cloud(s) connected to a severe thunderstorm carries a threat of violence. Frequently cumulonimbus mammatus clouds occur in connection with violent thunderstorms and tornadoes. These clouds display rounded, irregular pockets or festoons from its base and are a signpost of violent turbulence. Surface aviation observations specifically mention this and other hazardous clouds.

Tornadoes occur most frequently in the Great Plains states east of the Rocky Mountains; however, they have occurred in every state.

SQUALL LINES --

A "squall line" is a nonfrontal, narrow band of active, or very active, thunderstorms. They often develop ahead of a cold front in moist, unstable air, but they may develop in unstable air far from any front. The line may be too long to easily detour and too wide and severe to penetrate. They often contain severe steady state thunderstorms and presents the single most intense weather hazard to aircraft. They usually form rapidly, generally reaching maximum intensity during late afternoon and the first few hours of darkness.

TURBULENCE --

Hazardous turbulence is present in all thunderstorms; in a severe thunderstorm, it can damage an airframe. The strongest turbulence within the cloud occurs with shear between up-- and downdrafts. Outside the cloud, shear turbulence has been encountered several thousand feet above and 20 miles laterally from a severe storm. A low level turbulent area is the shear zone between the "plow" wind and the surrounding air. Often, a "roll cloud" on the leading edge of storm marks the eddies in this shear. The roll cloud is most prevalent with cold front or squall line thunderstorms and signifies an extremely turbulent zone. The first gust causes a rapid and sometimes drastic change in surface wind ahead of an approaching storm.

It is almost impossible to hold a constant altitude in a thunderstorm! Maneuvering, or attempting to do so, greatly increases the stresses on the aircraft. Stresses will be lessened if the aircraft is held in a constant attitude and allowed to ''ride the waves.'' To date, we have no sure way to pick ''soft spots'' in a thunderstorm.

MICROBURSTS --

Microbursts are small--scale intense downdrafts which, on reaching the surface, spread outward from the downflow center. This causes the presence of both vertical and horizontal wind shear effects that can be extremely hazardous to all types and categories of aircraft, especially at low, critical flight attitudes. Due to their small size, short life--span and the fact that they can occur over areas without surface precipitation, microbursts are not easily detectable using conventional weather radar or wind shear alert systems. Parent clouds producing microburst activity can be any of the low or middle layer convective cloud types.

Characteristics of microbursts include:

Size -- Approximately 6,000 feet in diameter above the ground with a horizontal extent on the surface spreading to approximately 2 1/2 miles outward from the center.

Intensity -- Vertical winds as high as 6,000 feet per minute above the ground becoming strong horizontal winds with as much as an 80 knot variation on the surface. The downward airstream may extend as low as tree top level.

Types -- Wet and dry. In wet areas of the U.S., microbursts are normally accompanied by heavy rain. However, dry areas provide falling raindrops with sufficient time and distance to dissipate before reaching the ground (VIRGA).

Life -- The life--cycle of a microburst from the initial downburst to dissipation will seldom be longer than 10 minutes with maximum intensity winds lasting approximately 2 minutes. Multiple microburst activity in the same area is not uncommon and should be expected.

Signs -- Dry microbursts often generate a ring of dust on the surface. Opposite direction winds over a short distance, accompanied by cell activity is also a clear indication of a microburst.

During landing and takeoff, microburst wind shear effects can cause a sufficient reduction in aircraft performance to create a severe hazard due to the possibility of ground contact. Flight in the vicinity of suspected microburst activity should always be avoided.

ICING --

Updrafts in a thunderstorm support abundant liquid water. The water becomes supercooled when carried above the freezing level. When temperature in the upward current cools to about --15 degrees Centigrade, much of the remaining water vapor sublimates as ice crystals. Above this level the amount of supercooled water decreases.

Supercooled water freezes on impact with an aircraft. Clear icing can occur at any altitude above the freezing level; but at high levels, icing may be either rime or mixed rime and clear. The abundance of supercooled water makes clear icing occur very rapidly between 0° and --15° C., and encounters can be frequent in a cluster of cells. Thunderstorm icing can be extremely hazardous.

HAIL--

Hail competes with turbulence as the greatest thunderstorm hazard to aircraft. Supercooled drops above the freezing level begin to freeze Once a drop has frozen, other drops latch on and freeze to it, so the hailstone grows -- sometimes into a huge iceball. Large hail occurs with severe thunderstorms usually towering to great heights. Eventually the hailstones fall, possibly some distance from the storm core. In fact, hail has been observed in clear air several miles from the parent thunderstorm.

As hailstones fall through the melting level, they begin to melt and precipitation may reach the ground as either hail or rain. Rain at the surface does not mean the absence of hail aloft. You should anticipate possible hail with any thunderstorm, especially beneath the anvil of a large cumulonimbus. Hailstones larger than ½ inch in diameter can sufficiently damage an aircraft in a few seconds.

LOW CEILING AND VISIBILITY --

Visibility generally is near zero within a thunderstorm cloud. Ceilings and visibility can become restricted in precipitation and dust between the cloud base and the ground. The restrictions create the same problem as all ceiling and visibility restrictions; but the hazards are increased many fold when associated with the other thunderstorm hazards of turbulence, hail, and lighting which make precision instrument fly virtually impossible.

EFFECT ON ALTIMETERS --

Pressure usually falls rapidly with the approach of a thunderstorm, then rises sharply with the onset of the first just and arrival of the cold

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downdraft and heavy rain showers, falling back to normal as the storm moves on. This cycle of pressure change may occur in 15 minutes. If the altimeter setting is not corrected, the indicated altitude may be in error by over 100 feet.

THUNDERSTORM ELECTRICITY --

Electricity generated by thunderstorms is rarely a great hazard to aircraft, but it may cause damage and is annoying to flight crews. Lighting is the most spectacular of the electrical discharges.

LIGHTNING --

A lightning strike can puncture the skin of an aircraft and can damage communication and electronic navigational equipment. Lightning has been suspected of igniting fuel vapors causing explosions; however, serious accidents due to lightning strikes are believed to be extremely rare. Nearby lightning can blind the pilot, rendering him momentarily unable to navigate either by instrument or by visual reference. Lightning can also induce permanent errors in the compass. Lightning discharges, even distant ones, disrupt radio communications on low and medium frequencies.

A few pointers on lightning:

The more frequent the lightning, the more severe the thunderstorm.

Increasing frequency of lightning indicates a growing thunderstorm.

Decreasing lightning indicates a storm nearing the dis--sipating stage.

At night, frequent distant flashes playing along a large sector of the horizon suggest a probable squall line.

PRECIPITATION STATIC --

Precipitation static, a steady, high level of noise in radio receivers, is caused by intense corona discharges from sharp metallic points and edges of flying aircraft. It is encountered often in the vicinity of thunderstorms. When an aircraft flies through clouds, precipitation, or a concentration of solid particles (ice, sand, dust, etc.), it accumulates a charge of static electricity. The electricity discharges onto a nearby surface or into the air causing a noisy disturbance at lower frequencies. The corona discharge is weakly luminous and may be seen at night. Although it has a rather eerie appearance, it is harmless. It was named 'St. Elmo's Fire" by Mediterranean sailors, who saw the brushy discharge at the top of the ship masts.

ENGINE WATER INGESTION --

Turbine engines have a limit on the amount of water they can ingest. Updrafts are present in many thunderstorms, particularly those in the developing stages. If the updraft velocity in the thunderstorm approaches, or exceeds, the terminal velocity of the falling raindrops, very high concentrations of water may occur. It is possible that these concentrations can be in excess of the quantity of water turbine engines are designed to ingest, resulting in flameout or structural failure of one or more engines.

At the present time, there is no known operational procedure that can completely eliminate the possibility of engine damage or flameout during massive water ingestion. Although the exact mechanism of the water--induced engine stalls has not been determined, it is believed that thrust changes may have an adverse effect on engine stall margins in the presence of massive water ingestion.

Avoidance of severe storm systems is the only measure assured to be effective in preventing exposure to this type of multiple engine damage or flameout. During an unavoidable encounter with severe storms, with extreme precipitation, the best known recommendation is to follow the severe turbulence penetration procedure contained in the approved airplane flight manual with special emphasis on avoiding thrust changes unless excessive airspeed variations occur.

WEATHER DISSEMINATION --

Let's be sure weather dissemination gets proper attention by timely updates of recorded messages on all equipment used to disseminate such information; such as, ATIS, TWEB and HIWAS. An efficient ATC system requires timely communications between all appropriate activities. This includes other facilities, sectors, etc. It may also include other organizations outside the FAA itself, such as the military, the airlines, airport management and other users of our services. Let's not exclude anyone from the communications loop who has a need to know.

WEATHER RADAR --

Weather radar detects droplets of precipitation size. Strength of the radar return (echo) depends on drop size and number. The greater the number of drops, the stronger the echo; and the larger the drops, the stronger the echo. Drop size determines echo intensity to a much greater extent than does drop number.

Meteorologists have shown that drop size is almost directly proportional to rainfall rate; and the greatest rainfall rate is in thunderstorms. Therefore, the strongest echoes are thunderstorms. Hailstones usually are covered with a film of water and, therefore, act as huge water droplets giving the strongest of all echoes. Showers show less intense echoes, and gentle rain and snow return the weakest of all echoes.

Since the strongest echoes identify thunderstorms, they also mark the areas of greatest hazards. Radar information can be valuable both from ground--based radar for prefight planning and from airborne radar for severe weather avoidance.

Thunderstorms build and dissipate rapidly, and they also may move rapidly. The best use of ground radar information is to isolate general areas and coverage of echoes. Remember that weather radar detects only precipitation drops; it does not detect minute cloud droplets. Therefore, the radar scope provides no assurance of avoiding instrument weather in clouds and fog.

The most intense echoes are severe thunderstorms. Remember that hail may fall several miles from the cloud and hazardous turbulence may extend as much as 20 miles from the cloud. Pilots should request separation from the most intense echoes by 20 miles or more.

PIREPS --

Since PIREP information may be such a significant factor in both the pilots' and controllers' operational decisions, the proper application of PIREP procedures should receive special attention. The imminent arrival of thunderstorm season is a good time for all operational personnel to review and refresh their knowledge of PIREP procedures.

DO'S AND DON'TS OF THUNDERSTORM FLYING --

Although the following suggestions are written for pilots, we believe they will be useful information for everyone. Above all, remember this: Never regard any thunderstorm as "light" even when radar returns show the echoes are of light intensity. Avoiding thunderstorms is still the best policy. The Following are some Do's and Don'ts of thunderstorm avoidance:

Don't land or take off in the face of an approaching thunderstorm. A sudden wind shift or low level turbulence could cause loss of control.

Don't attempt to fly under a thunderstorm even if you can see through to the other side. Turbulence under the storm could be disastrous.

Don't try to circumnavigate thunderstorms covering 6/10 of an area or more either visually, or by airborne radar.

Don't fly without airborne radar into a cloud mass containing scattered embedded thunderstorms. Scattered thunderstorms, not embedded, usually can be visually circumnavigated.

Do avoid, by at least 20 miles, any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.

Do clear the top of a known, or suspected, severe thunderstorm by at least 1,000 feet altitude for each 10 knots of wind at the cloud top. This would exceed the altitude capability of most aircraft.

Do remember that vivid and frequent lightning indicates a severe thunderstorm.

Do regard as severe any thunderstorm with tops 35,000 feet, or higher whether the top is visually sighted or determined by radar.

If you cannot avoid penetrating a thunderstorm, the following are some Do's before entering the storm:

Do tighten your safety belt, put on your shoulder harness if you have one, and secure all loose objects.

Do plan your course to take you through the storm in a minimum time and hold it.

Do establish a penetration altitude below the freezing level or above the level of −15 ° C., to avoid the most critical icing.

Do turn on pitot heat and carburetor or jet inlet heat. Icing can be rapid at any altitude and cause almost instantaneous power failure or loss of airspeed indication.

Do establish power settings for reduced turbulence penetration airspeed recommended in your aircraft manual.

Reduced airspeed lessens the structural stresses on the aircraft.

Do turn up cockpit lights to highest intensity to lessen the danger of temporary blindness from lightning.

Do disengage the altitude and speed hold modes if using the automatic pilot. The automatic altitude and speed controls will increase maneuvers of the aircraft thus increasing structural stresses.

Do, if using airborne radar, tilt your antenna up and down occasionally. Tilting it up may detect a hail shaft that will reach a point on your course by the time you do. Tilting it down may detect a growing thunderstorm cell that may reach your altitude.

The following are some Do's and Don'ts during thunderstorm penetration:

Do keep your eyes on your instruments. Looking outside the cockpit can increase danger of temporary blindness from lightning.

Don't change power settings; maintain settings for reduced airspeed.

Do maintain a constant attitude; let the aircraft "ride the waves". Maneuvers in trying to maintain constant altitude increase stresses on the aircraft.

Don't turn back once you are in the thunderstorm. A straight course through the storm will most likely get you out of the hazardous area most quickly. In addition, turning maneuvers increase stresses on the aircraft.

FSS/AFSS FACILITY MANAGERS

/*F/ Ensure the pertinent portions of the following publications are reviewed by weather observers and pilot weather briefers:

Advisory Circular AC 00--24, Thunderstorms

Advisory Circular AC 00--45, Aviation Weather Services. Pertinent charts pertaining to convective activity and analysis.

Regional and facility directives *concerning coordination with National Weather Service offices and the distribution of weather advisories to other air traffic facilities.

Airman's Information Manual, Chapter 6, Section 1, Meteorology

7110.10, Chapters 2 and 3

FMH No. 1 -- All portions pertaining to specials, required remarks, and observing instructions concerning thunderstorm reporting.

FMH No. 7 Weather RADAR Observations

Remind all pilot briefers to include the availability of En Route Flight Advisory Service (EFAS) and of the Hazardous Inflight Weather Advisory Service (HIWAS) program in all pilot briefings.

Encourage all operating personnel to actively solicit and disseminate PIREPS on convective activity.

TERMINAL FACILITY MANAGERS

/*T/ Ensure the pertinent portions of the following publications are reviewed and complied with:

7210.3, para. 2--121, Receipt and Dissemination of Weather Observations

7210.3, para. 12--32, Low Level Wind Shear Alert System (LLWAS facilities only)

72103, para. 12--30, SIGMET and PIREP Handling

In addition to the actions above, terminal facility managers shall ensure that all controllers and supervisory personnel review the following reference material:

7110.65, para. 2--111, Hazardous Inflight Weather Advisory Service (HIWAS)

7110.65, para. 2--112, PIREP Information

7110.65, para. 2--113, Weather and Chaff Services

7110.65, para. 3--32, Timely Information

ARTCC FACILITY MANAGERS

/*E/ Review FAA Order 7210.3, para. 8--30, Handling of SIGMET'S, CWA's and PIREP's to ensure Weather coordination requirements are met.

Review FAA Order 7210.38 and conduct an evaluation of the Center Weather Service Unit (CWSU) to ensure timely and accurate dissemination of hazardous weather information.

In addition to the action above, en route facility managers shall ensure that all controllers and supervisory personnel review and comply with the following reference material:

7110.65, para. 2--111, Hazardous Inflight Weather Advisory Service (HIWAS)

7110.65, para. 2--112, PIREP Information

7110.65, para. 2--113, Weather and Chaff Services

7110.76 Narrowband Weather Sub--system.

AUTOMATED WEATHER SYSTEMS

/*TEF/ Automated Weather Observing Systems (AWOS) are being implemented through--out the National Airspace System (NAS). These systems are designed to reduce the amount of work necessary for the controller to perform in providing surface weather observations to pilots. AWOS was designed to provide weather observations at airports where no weather information was previously available. The implementation of AWOS allowed airports without weather reporting to establish reduced approach minimums and provide pilots with information never before available. The results were safer pilot operations and increased safety in the NAS.

AWOS implementation has identified issues which need resolution. Among those issues are the availability of the data to the controller; the accuracy of the data being provided to the pilot; accessibility of the data to pilots other than by the radio outlet; and the use of AWOS to establish or maintain control zones.

Controllers do not always have access to AWOS data. Air Traffic has established policy that pilots have a requirement for weather and controllers have the responsibility to ensure the data is made available to pilots. The requirement is satisfied if controllers ensure pilots can get weather information or provide the data directly. Numerous changes to Order 7110.65 were made to allow controllers to instruct pilots of the AWOS frequency to listen to the automated weather broadcast.

AWOS is accessible by radio, telephone, and in some instances, via the Leased Service A telecommunications network. The radio and telephone systems seldom present problems. The availability via computer may sometimes not be accessible because the station is not connected to the Leased Service A network. Air traffic procedures do not suffer because controllers may always instruct pilots to listen to the AWOS on the appropriate radio frequency.

AWOS may be used as the official weather report to establish or maintain a control zone. The question was asked and answered during lengthy negotiations and discussions between Air Traffic and Flight Standards. Flight standards has agreed that pilots should be trained to interpret weather data and to validate the information being reported by AWOS.

The accuracy of the data being offered is the pilots responsibility. Pilots are responsible to accept or reject the data and continue or to abandon the procedure if the system is reporting conditions that are missing or inaccurate. Controllers are responsible for informing succeeding pilots of known inaccurate or unreliable elements. Elements that are being reported as missing on the radio, Leased Service A network, and telephone, do not require any further action by Air Traffic.

PROCEDURES FOR UNLAWFUL INTERFERENCE

/*TE/ All air traffic personnel are reminded to review the procedures for handling unlawful interference. Order 7110.49D, Unlawful Interference -- Hijack/Bomb (Threat) Aboard Aircraft -- Procedures and Covert Signals, dated February 22, 1980 is still in effect. LOCAL REPRODUCTION OF THE DIRECTIVE IS NOT AUTHORIZED.

IS IT TRUE OR MAGNETIC???

/*TF/ A recent letter from a pilot has brought this question to bear. When is the wind reported as true or magnetic? The pilot indicated that controllers have informed him that they report the wind on the weather observations in degrees magnetic. THIS IS NOT CORRECT!

Operational wind data, however, such as those issued for landing or takeoff, is reported to pilots in degrees magnetic because runways are aligned to magnetic north, as are the navigational instruments aboard the aircraft and our own radar antennas. Surface weather observations ALWAYS use true north as the standard. Because area forecasts normally encompass large expanses of the country, crossing several lines of magnetic variation, the true north standard is necessary to ensure continuity and accuracy. The magnetic variation in the continental United States varies from as much as 19° west variation in Maine, to 16° east variation in Washington and up to as much as 36° West in Alaska!

Wind information, as *reported in aviation weather* observations, is used to formulate both area and terminal forecasts, thus inaccurate wind data (resulting from large variations) would contribute to inaccurate forecasts. Therefore, wind data reported on official weather observations MUST be reported in true. Incidently, even the forecasted winds aloft are oriented to true north.

Air Traffic Bulletin

The Air Traffic Bulletin is produced Quarterly for the Associated Administrator for Air Traffic by the Air Traffic Publications Branch, ATP–210.

ATP–100 is always looking for interesting articles for the Air Traffic Bulletin. Should you wish to submit an article having an operational or procedural impact, forward your article through the appropriate channels as specified in 7210.3, para. 2–36. Comments and/or suggestions for the bulletin may be forwarded directly to ATP–1. Pleasant reading.......

In this publication, the option(s) for which a briefing is required are indicated by an asterisk (*) followed by one or more letter designator, i.e, *T = Terminal, *E = enroute or *F = flight service. (Reference 7210–3, para. 2–36.)

*U.S. G.P.O.:1994-301-717:80528

Briefing Title: ATB "Show Time" Date: 6-1-93

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U.S. Department of Transportation

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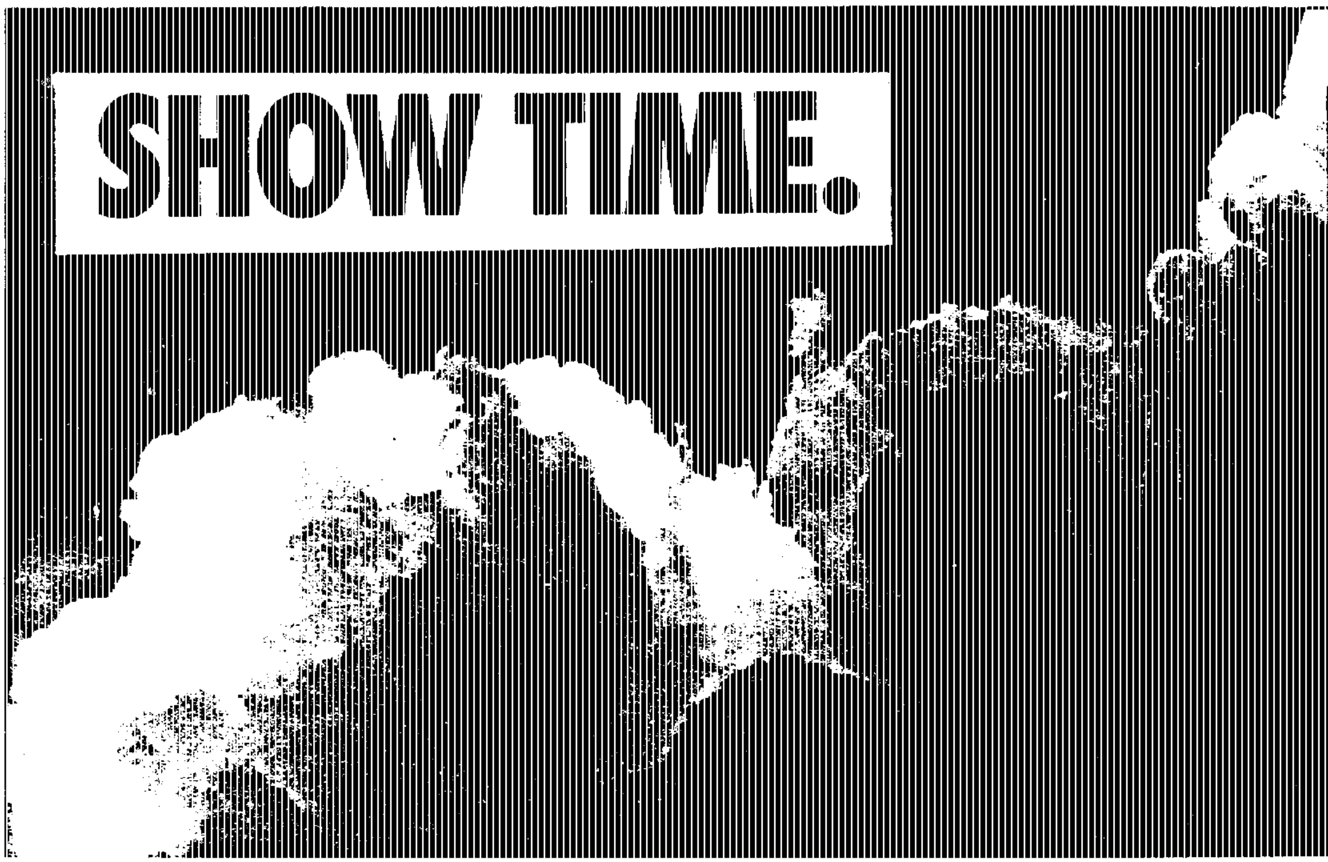
AIR TRAFFIC BULLETIN

CENTER ✦ TERMINAL ✦ STATION

Associate Administrator for Air Traffic

BULLETIN NUMBER 93-2 ✦ May 1993



Annually, and prior to the start of the season, we publish an issue of the Air Traffic Bulletin to focus your attention on the upcoming thunderstorm season and to remind all controllers and specialists of the hazardous weather associated with it. The more we understand the severe atmospheric hazards associated with thunderstorms, the better position we are in to aid the pilot in avoiding these hazards. Our lead article presents factors that a pilot must consider when flying in the vicinity of, entering, or penetrating a thunderstorm. Being familiar with these factors will help you better understand what is going on inside the cockpit.

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A THUNDERSTORM UNITES JUST ABOUT EVERY HAZARD KNOWN TO AVIATION!

JUST HOW POWERFUL ARE THEY?

/*FTE/ The latent heat released by a moderate thundercloud is equivalent to the energy of a nuclear explosion of 400 kilotons! Flight through such clouds should be avoided whenever possible and, although most commercial aircraft are equipped with airborne weather radar, a pilot should always request up--to--date information concerning the location and extent of any active thunderstorm area which may affect their fight. Thunderstorms often reach far greater heights than the usual cruising levels of commercial aviation. The hazards involved in penetrating a thunderstorm are severe turbulence, hail, icing, extreme water ingestion and, to a lesser degree, lightning.

Downbursts, the strong descending air current found underneath storm clouds, cause rapid variations in wind speed and wind direction near the ground which have proven to be extremely dangerous to low--flying aircraft. Sometimes violent thunderstorms cause the formation of concentrated powerful vortices, extending from the ground well into the cloud, scattered tornadoes or, when over water, waterspouts. Tornadoes produce the highest wind speeds experienced near the ground (maximum values are estimated at 460 km/h). An aircraft entering a tornado vortex is almost certain to suffer structural damage. Thunderstorm hazards occur simultaneously in numerous combinations. The following discussions examine these and other thunderstorm phenomena.

TORNADOES --

The most violent thunderstorms draw air into their cloud bases with great vigor. If the incoming air has any initial rotating motion, it often forms an extremely concentrated vortex from the surface well into the cloud. Meteorologists have estimated that wind in such a vortex can exceed 200 knots, and the pressure inside the vortex is quite low. The strong winds gather dust and debris, and the low pressure generates a funnel--shaped cloud extending downward from the cumulonimbus base. If the cloud does not reach the surface, it is a funnel cloud; if it touches the land surface, it is a tornado; if it touches water, it is a water spout.

Tornadoes have, at times, occurred with isolated thunderstorms, but more frequently they form with steady state thunderstorms associated with cold fronts or squall lines. Reports or forecasts of tornadoes indicate that atmospheric conditions are favorable for violent turbulence. Since the vortex extends well into the cloud, any pilot inadvertently caught on instruments in a severe thunderstorm could encounter a hidden vortex .

Families of tornadoes have been observed as appendages of the main cloud extending several miles outward from the area of lightning and precipitation. Thus, any cloud(s) connected to a severe thunderstorm carries a threat of violence. Frequently cumulonimbus mammatus clouds occur in connection with violent thunderstorms and tornadoes. These clouds display rounded, irregular pockets or festoons from their base and are a signpost of violent turbulence. Surface aviation observations specifically mention this and other hazardous clouds.

Tornadoes occur most frequently in the Great Plains states east of the Rocky Mountains; however, they have occurred in every state.

SQUALL LINES --

A ''squall line'' is a nonfrontal, narrow band of active, or very active, thunderstorms. They often develop ahead of a cold front in moist, unstable air, but they may develop in unstable air far from any front. The line may be too long to easily detour and too wide and severe to penetrate. They often contain severe steady state thunderstorms and presents the single most intense weather hazard to aircraft. They usually form rapidly, generally reaching maximum intensity during late afternoon and the first few hours of darkness.

TURBULENCE --

Hazardous turbulence is present in all thunderstorms; in a severe thunderstorm, it can damage an airframe. The strongest turbulence within the cloud occurs with shear between up-- and downdrafts. Outside the cloud, shear turbulence has been encountered several thousand feet above and 20 miles laterally from a severe storm. A low level turbulent area is the shear zone between the ''plow'' wind and the surrounding air. Often, a ''roll cloud'' on the leading edge of storm marks the eddies in this shear. The roll cloud is most prevalent with cold front or squall line thunderstorms and signifies an extremely turbulent zone. The first gust causes a rapid and sometimes drastic change in surface wind ahead of an approaching storm.

It is almost impossible to hold a constant altitude in a thunderstorm! Maneuvering, or attempting to do so, greatly increases the stresses on the aircraft. Stresses will be lessened if the aircraft is held in a constant attitude and allowed to ''ride the waves.'' To date, we have no sure way to pick ''soft spots'' in a thunderstorm.

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MICROBURSTS --

Microbursts are small--scale intense downdrafts which, upon reaching the surface, spread outward from the downflow center. This causes the presence of both vertical and horizontal wind shear effects that can be extremely hazardous to all types and categories of aircraft, especially at low, critical flight attitudes. Due to their small size, short life--span and the fact that they can occur over areas without surface precipitation, microbursts are not easily detectable using conventional weather radar or wind shear alert systems. Parent clouds producing microburst activity can be any of the low or middle layer convective cloud types.

Characteristics of microbursts include:

Size -- Approximately 6,000 feet in diameter above the ground with a horizontal extent on the surface spreading to approximately 2 1/2 miles outward from the center.

Intensity -- Vertical winds as high as 6,000 feet per minute above the ground becoming strong horizontal winds with as much as an 80 knot variation on the surface. The downward airstream may extend as low as tree top level.

Types -- Wet and dry. In wet areas of the U.S., microbursts are normally accompanied by heavy rain. However, dry areas provide falling raindrops with sufficient time and distance to dissipate before reaching the ground (VIRGA).

Life -- The life--cycle of a microburst from the initial downburst to dissipation will seldom be longer than 10 minutes with maximum intensity winds lasting approximately 2 minutes. Multiple microburst activity in the same area is not uncommon and should be expected.

Signs -- Dry microbursts often generate a ring of dust on the surface. Opposite direction winds over a short distance, accompanied by cell activity is also a clear indication of a microburst.

During landing and takeoff, microburst wind shear effects can cause a sufficient reduction in aircraft performance to create a severe hazard due to the possibility of ground contact. Flight in the vicinity of suspected microburst activity should always be avoided.

ICING --

Updrafts in a thunderstorm support abundant liquid water. The water becomes supercooled when carried above the freezing level. When temperature in the upward current cools to about --15 degrees Centigrade, much of the remaining water vapor sublimates as ice crystals. Above this level the amount of supercooled water decreases.

Supercooled water freezes on impact with an aircraft. Clear icing can occur at any altitude above the freezing level; but at high levels, icing may be either rime or mixed rime and clear. The abundance of supercooled water makes clear icing occur very rapidly between 0° and --15° C., and encounters can be frequent in a cluster of cells. Thunderstorm icing can be extremely hazardous.

HAIL--

Hail competes with turbulence as the greatest thunderstorm hazard to aircraft. Supercooled drops above the freezing level begin to freeze, creating a hail stone. Once a drop has frozen, other drops latch on and freeze to it, so the hailstone grows -- sometimes into a huge iceball. Large hail occurs with severe thunderstorms usually towering to great heights. Eventually the hailstones fall, possibly some distance from the storm core. In fact, hail has been observed in clear air several miles from the parent thunderstorm.

As hailstones fall through the melting level, they begin to melt and precipitation may reach the ground as either hail or rain. Rain at the surface does not mean the absence of hail aloft. You should anticipate possible hail with any thunderstorm, especially beneath the anvil of a large cumulonimbus. Hailstones larger than ½ inch in diameter can disable an aircraft in a few seconds.

LOW CEILING AND VISIBILITY --

Visibility generally is near zero within a thunderstorm cloud. Ceilings and visibility can become restricted in precipitation and dust between the cloud base and the ground. The restrictions create the same problem as all ceiling and visibility restrictions; but the hazards are increased many fold when associated with the other thunderstorm hazards of turbulence, hail, and lighting which make precision instrument flight virtually impossible.

EFFECT ON ALTIMETERS --

Pressure usually falls rapidly with the approach of a thunderstorm, then rises sharply with the onset of the first just and arrival of the cold downdraft and heavy rain showers, falling back to normal as the storm moves on. This cycle of pressure change may occur in 15 minutes. If the altimeter setting is not corrected, the indicated altitude may be in error by over 100 feet.

THUNDERSTORM ELECTRICITY --

Electricity generated by thunderstorms is rarely a great hazard to aircraft, but it may cause damage and is annoying to flight crews. Lighting is the most spectacular of the electrical discharges.

LIGHTNING --

A lightning strike can puncture the skin of an aircraft and can damage communication and electronic navigation equipment. Lightning has been suspected of igniting fuel vapors causing explosions; however, serious accidents due to lightning strikes are believed to be extremely rare. Nearby lightning can blind the pilot, rendering him/her momentarily unable to navigate either by instrument or by visual reference. Lightning can also induce permanent errors in the compass. Lightning discharges, even distant ones, disrupt radio communications on low and medium frequencies.

A few pointers on lightning:

The more frequent the lightning, the more severe the thunderstorm.

Increasing frequency of lightning indicates a growing thunderstorm.

Decreasing frequency of lightning indicates a storm nearing the dis--sipating stage.

At night, frequent distant flashes playing along a large sector of the horizon suggest a probable squall line.

PRECIPITATION STATIC --

Precipitation static, a steady, high level of noise in radio receivers, is caused by intense corona discharges emenating from sharp metallic points and edges of flying aircraft. It is often encountered in the vicinity of thunderstorms. When an aircraft flies through clouds, precipitation, or a concentration of solid particles (ice, sand, dust, etc.), it accumulates a charge of static electricity. The electricity discharges onto a nearby surface or into the air causing a noisy disturbance at lower frequencies. The corona discharge is weakly luminous and may be seen at night. Although it has a rather eerie appearance, it is harmless. It was named 'St. Elmo's Fire'' by Mediterranean sailors, who saw the brushy discharge at the top of the ship masts.

ENGINE WATER INGESTION --

Updrafts are present in many thunderstorms, particularly those in the developing stages. If the updraft velocity in the thunderstorm approaches, or exceeds, the terminal velocity of the falling raindrops, very high concentrations of water may occur. Turbine engines have a limit on the amount of water they can ingest. It is possible that these concentrations can be in excess of the quantity of water turbine engines are designed to ingest, resulting in flameout or structural failure of one or more engines.

At the present time, there is no known operational procedure that can completely eliminate the possibility of engine damage or flameout during massive water ingestion. Although the exact mechanism of the water--induced engine stalls has not been determined, it is believed that thrust changes may have an adverse effect on engine stall margins in the presence of massive water ingestion.

Avoidance of severe storm systems is the only effective method to prevent exposure to this type of multiple engine damage or flameout. During an unavoidable encounter with severe storms, with extreme precipitation, the best known recommendation is to follow the severe turbulence penetration procedure contained in the approved airplane flight manual with special emphasis on avoiding thrust changes unless excessive airspeed variations occur.

WEATHER DISSEMINATION --

Let's be sure weather dissemination gets proper attention by timely updates of recorded messages on all equipment used to disseminate such information; such as, ATIS, TWEB and HIWAS. An efficient ATC system requires timely communications between all appropriate activities. This includes other facilities, sectors, etc. It may also include other organizations outside the FAA itself, such as the military, the airlines, airport management and other users of our services. Let's not exclude anyone from the communications loop who has a need to know.

WEATHER RADAR --

Weather radar detects droplets of precipitation size. Strength of the radar return (echo) depends on drop size and number. The greater the number of drops, the stronger the echo; and the larger the drops, the stronger the echo. Drop size determines echo intensity to a much greater extent than does drop number.

Meteorologists have shown that drop size is almost directly proportional to rainfall rate; and the greatest rainfall rate is in thunderstorms. Therefore, the strongest echoes are thunderstorms. Hailstones usually are covered with a film of water and, therefore, act as huge water droplets giving the strongest of all echoes. Showers show less intense echoes, and gentle rain and snow return the weakest of all echoes.

Since the strongest echoes identify thunderstorms, they also mark the areas of greatest hazards. Radar information can be valuable both from ground--based radar for prefight planning and from airborne radar for severe weather avoidance.

Thunderstorms build and dissipate rapidly, and they also may move rapidly. The best use of ground radar information is to isolate general areas and coverage of echoes. Remember that weather radar detects only precipitation drops; it does not detect minute cloud droplets. Therefore, the radar scope provides no assurance of avoiding instrument weather in clouds and fog.

The most intense echoes are severe thunderstorms. Remember that hail may fall several miles from the cloud and hazardous turbulence may extend as much as 20 miles from the cloud. Pilots should request separation from the most intense echoes by 20 miles or more.

PIREPS --

Since PIREP information may be such a significant factor in both the pilots' and controllers' operational decisions, the proper application of PIREP procedures should receive special attention. The imminent arrival of thunderstorm season is a good time for all operational personnel to review and refresh their knowledge of PIREP procedures. *(ATP--120)*

AIRSPACE RECLASSIFICATION

/*FTE/ On or about June 1, 1993 facilities and personnel will be receiving the September edition's of the 7110.10, 7110.65, 7210.3 and the 7930.2 as well as the Pilot/Controller Glossary. The effective date of these publications will be September 16, 1993.

The Air Traffic Rules and Procedures Service is distributing these edition's well in advance of their normal scheduled dates to ensure sufficient training time(s) for the Airspace Reclassification change. These orders, associated briefing guides and video/ slides shall serve as the training material to meet this preparatory requirement.

Training departments should anticipate gearing up for this training. A lead time of approximately one hundred days are provided to ensure that all personnel be trained by the September 16 date. If the materials required for this training are not available, an immediate inquiry should be made to your individual region 530 Branch. To help you get started, here is a list of the current legal definitions for each category of Airspace.

CONTROLLED AIRSPACE---- An airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification.

Note 1---- Controlled airspace is a generic term that covers Class A, Class B, Class C, Class D, and Class E airspace.

Note 2---- Controlled airspace is also that airspace within which all aircraft operators are subject to certain pilot qualifications, operating rules, and equipment requirements in FAR Part 91 (for specific operating requirements, please refer to FAR Part 91). For IFR operations in any class of controlled airspace, a pilot must file an IFR flight plan and receive an appropriate ATC clearance. Each Class B, Class C, and Class D airspace area designated for an airport contains at least one primary airport around which the airspace is designated (for specific designations and descriptions of the airspace classes, please refer to FAR Part 71).

Controlled airspace in the United States is designated as follows:

1. **Class A.** Generally, that airspace from 18,000 feet MSL up to and including FL600, including the airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States and Alaska. Unless otherwise authorized, all persons must operate their aircraft under IFR.

2. **Class B.** Generally, that airspace from the surface to 10,000 feet MSL surrounding the nation's busiest airports in terms of airport operations or passenger enplanements. The configuration of each Class B airspace area is individually tailored and consists of a surface area and two or more layers (some Class B airspaces areas resemble upside--down wedding cakes), and is designed to contain all published instrument procedures once an aircraft enters the airspace. An ATC clearance is required for all aircraft to operate in the area, and all aircraft that are so cleared receive separation services within the airspace. The cloud clearance requirement for VFR operations is "clear of clouds."

3. **Class C.** Generally, that airspace from the surface to 4,000 feet AGL surrounding those airports that have an operational control tower serviced by a radar approach control and that have a certain number of IFR operations or passenger enplanements. Although the configuration of each Class C airspace area is individually tailored, the airspace usually consists of a surface area with a 5nm radius, and an outer area with a 10nm radius that extends from 1,200 feet to 4,000 feet AGL. Each person must establish two--way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while within the airspace. VFR aircraft are only separated from IFR aircraft within the airspace.

4. Class D. Generally, that airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures. Arrival extensions for instrument approach procedures may be Class D or Class E airspace. Unless otherwise authorized, each person must establish two--way radio communications with the ATC facility providing air traffic services prior entering the airspace and thereafter maintain those communications while in the airspace. No separation services are provided to VFR aircraft.

5. Class E. Generally, if the airspace is not Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E airspace. Class E airspace extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace. When designated as a surface area, the airspace will be configured to contain all instrument procedures. Also in this class are Federal airways, airspace beginning at either 700 or 1,200 feet AGL used to transition to/from the terminal or enroute environment, enroute domestic, and offshore airspace areas designated below 18,000 feet MSL. Unless designated at a lower altitude, Class E airspace begins at 14,500 MSL over the United States, including that airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States and Alaska. Class E airspace does not include the airspace 18,000 MSL or above.

SERVICE--- A generic term that designates functions or assistance available from or rendered by air traffic control. For example, Class C service would denote the ATC services provided within a Class C airspace area.

SURFACE AREA--- The airspace contained by the lateral boundary of the Class B, C, D, or E airspace designated for an airport that begins at the surface and extends upward. *(ATP--230)*

"You would like a VFR ....WHAT ?" or

TO "V" OR NOT TO "V", That is the Question!

/*TE/ Know the answers to the following questions?

1. I can approve VFR separation in any airspace that I have control responsibility for ?

TRUE/FALSE -- WHY/WHY NOT

2. I can assign VFR climb/descent at my option to expedite traffic ?

TRUE/FALSE -- WHY/WHY NOT

3. Once I give a clearance which includes VFR climb/descent, I am no longer responsible for the separation of that aircraft from others.

TRUE/FALSE -- WHY/WHY NOT

4. If a pilot requests VFR/OTP (VFR--on--top), and I approve the request, then normal radar service/ ATC service is terminated ?

TRUE/FALSE -- WHY/ WHY NOT

5. The same pilot above, that has requested VFR/ OTP, reports on top at an altitude of 14,500, and the aircraft is generally east bound. Since, as above, when I said VFR/OTP is approved, and radar service was terminated. I am not required to say anything about the pilots altitude for direction of flight ?

TRUE/FALSE -- WHY/WHY NOT

For an explanation of some of the things that you might consider concerning these questions, please read on.

We receive a lot of correspondence from both pilots and controllers on the subjects of VFR climbs/descents for IFR aircraft and the use of VFR OTP clearances. It is clear that more of a mutual understanding of these procedures would help the teamwork between pilots and controllers. It is our goal to discuss these procedures and their pros and cons in this article.

We're certainly not setting out to insult anyone's intelligence, but we are going to start with the basics to be sure that we don't miss any critical facts. First let's make it clear that we're not talking about the pilot that has "Come up on your frequency" and requested "Radar vectors or radar handling" while remaining VFR; we're talking about an aircraft on an IFR flight plan that has requested VFR climb/descent, or to fly VFR on top (VFR/OTP) in conjunction with the IFR clearance.

A review of FAA Handbook 7110.65, Air Traffic Control, Chapter 7, Sections 1 through 4, will enable us to find the answers to some of our questions. In a nutshell, these sections say; Not

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in positive control areas, pilot must request VFR climb/descent, you must insure that separation is maintained before and after visual separation, pilot requests VFR--ON--TOP on an IFR flight plan, altitude for direction of flight, visual apporach, vectors for visual approach, and clearance for visual approach. These are again only highlights, and a thorough review of Chapter 7 along with other portions of Handbook 7110.65 dealing with the VFR climb/descent, VFR/OTP, etc., will pay us dividends later.

An IFR aircraft which requests to operate VFR/OTP is required to follow its ATC assigned routing and to operate at or above minimum IFR altitude as specified in FAR 91.177. The pilot is required to fly at an appropriate VFR altitude for direction of flight, to comply with VFR cloud clearance criteria, and to see and avoid other aircraft. The pilot may elect to change from one VFR altitude to another without specific ATC clearance, but is expected to advise ATC when doing so. Standard IFR separation is not required once an aircraft is cleared to maintain VFR/OTP (Please see 7--20a Note 1 and Note 2). In some circumstances this may permit you to approve routing changes which would not otherwise be possible, due to traffic conditions. A request for VFR/OTP does not constitute a request to cancel IFR. The aircraft remains on its IFR flight plan, and is subject to all normal control instructions, including reassignment to a hard altitude if necessary. Pilots on an IFR flight plan are also permitted to request a VFR climb/descent between one IFR altitude and another. In so doing the pilot assumes responsibility for seeing and avoiding other aircraft for the duration of the altitude change, however, "if in your judgment that flight in VFR conditions may become impractical, issue an alternative clearance which will insure separation from all other aircraft for which you have separation responsibility." (Para. 7--2.b.)

Now for those of you who have not worked a lot of requests for IFR VFR/OTP, here are some situations to consider.

Scenario: As is common on the west coast, an aircraft wants to proceed northwest--bound through your sector on an airway that has an MEA of 14,000 MSL. The aircraft can meet minimum IFR altitude requirements by asking for VFR/OTP at 8,500 MSL. Ask yourself the following questions when considering whether or not to approve this operation:

1. Will I be able to maintain radar surveillance of this aircraft at 8,500 MSL?
2. If not, how will I coordinate progress along the route of flight?
3. Are radio communications guaranteed along the route of flight at 8,500 MSL?
4. If not, how will I coordinate changes in route of flight and/or altitude/OTP?

A lot of controllers have gotten themselves into difficult situations because they failed to consider these differences in OTP flights. Also, many have devised innovative ways to accommodate OTP and still meet coordination requirements.

We controllers must be able to communicate clearly and concisely. Our profession requires a complete understanding of the pilot's requests/intentions. Some pilots recently have reported that when they (on an IFR flight plan) have requested "A VFR climb/descent", they have received a response from the controller, "Roger, squawk 1200, radar service is terminated." Now, don't laugh! Just review the portions of 7110.65 listed above, so you won't have to say "You would like a VFR what?" *(ATH--200)*

I HEAR YOU...BUT WHERE ARE YOU?

/*F/ The statement *"I here you...but where are you?"* is becoming more and more prevalent in today's automated flight service stations (AFSS's). With each AFSS having a large geographical area and many remote communication outlets (RCO's), the person working inflight or flight watch does not know which frequency to select if the pilot does not state the name of the RCO being used. There may be several locations with the same frequency, giving a "Christmas Tree" effect to the inflight or flight watch radio panel, thereby increasing the frustration felt by assigned personnel. This is why location, not just frequency, is needed. Several efforts have been made through FAA Communications Awareness programs to help with this problem, but it still exists. The AFSS/FSS can help to eliminate this problem by reminding pilots of the proper frequencies and phraseology to use when communicating over the radio. *(ATP--110)*

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CORRECTIONS:

In our article on "Misinterpretation of NOTAM data" in the February 93 issue (93--1), we stated that "three character contractions are no longer used," . . . . . What we intended to say was that "three letter contractions are NO LONGER ASSIGNED" . . .to avoid confusion with three letter identifiers.

Also, in the article about the Air traffic Bulletin, we stated that distribution of the bulletin is accomplished using labels from ATZ--10. We stand corrected -- --

The labels are generated by the DOT's Automatic Distribution System, from an ADP run in accordance with the ZAT--423 list. DOT is responsible for the shipping of the Bulletin. Corrections, additions, deletions, and changes to copy requirements are to be routed though your Regional Distribution Officer.

AT BULLETIN FEDERAL AVIATION REGULATIONS REFRESHER QUIZ

1. Several ultralight vehicle operators have been authorized to operate at the airport where you work (Level 2, VFR Tower). Ultralight vehicle operators must meet the following training requirements: (103.7)

a. Hold a recreational pilot certificate

b. Complete ten hours of dual instruction in same type ultralight vehicle

c. Instruction, or training is not required prior to operating an ultralight vehicle

2. The pilot in command of an aircraft in your sector reports the number two VOR in the aircraft is out of service. Is this a required report? (91.187)

ANSWER KEY

1. c. No training is required since ultralights are considered "vehicles", not "airplanes". However, owners who chose to register their ultralights as experimental aircraft will be subject to the pilot training and certification requirements set forth in FAR 61.

2. Yes. Any malfunction of navigational, approach or communication equipment shall be reported to ATC, along with the degree to which the pilots capability to operate in the IFR system is impaired. The pilot may require no assistance, yet this report is still required and should be passed along to each sector the aircraft will transition. If it is unclear to you how this malfunction will impact the aircraft's operation, ask!!!!!

Air Traffic Bulletin

The Air Traffic Bulletin is produced Quarterly for the Associate Administrator for Air Traffic by the Air Traffic Publications Branch, ATP--210.

- ATP--100 is always looking for interesting articles for the Air Traffic Bulletin. Should you wish to submit an article having an operational or procedural impact, forward your article through the appropriate channels as specified in 7210.3, para. 2--36. Comments and/or suggestions for the bulletin may be forwarded directly to ATP--1. Pleasant reading.......

In this publication, the option(s) for which a briefing is required are indicated by an asterisk (*) followed by one or more letter designator, i.e, *T = Terminal, *E = enroute or *F = flight service. (Reference 7210--3, para. 2--36.)

A Listing of Bulletins published over the last two years are as follows:

1991	1992	1993
91--1 MAY	92--1 JAN	93--1 FEB
91--2 SEP	92--2 MAY	
91--3 AUG	92--3 AUG	
	92--4 NOV	
	SPECIAL DEC	