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THE ANALYSIS OF NATIONAL TRANSPORTATION SAFETY BROAD SMALL SING--ETC(U)
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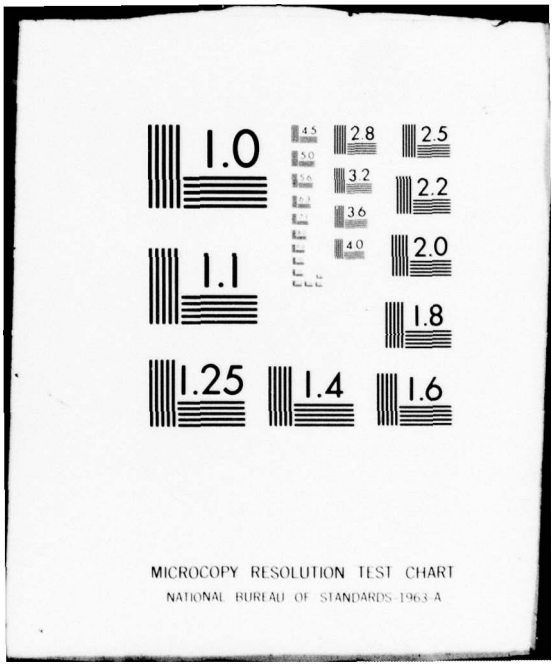
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REPORT NO. FAA-RD-79-3

(12) LEVEL II

THE ANALYSIS OF NATIONAL TRANSPORTATION SAFETY BOARD SMALL SINGLE-ENGINE FIXED-WING AIRCRAFT ACCIDENT/INCIDENT REPORTS FOR THE POTENTIAL PRESENCE OF LOW-LEVEL WIND SHEAR.

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Jack J. Shrager

MAY 1979

FINAL REPORT

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Systems Research & Development Service
Washington, D.C. 20590

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16. Abstract

The National Transportation Safety Board aircraft accident/incident data base covering the years 1964 through 1975 was screened to select those accidents involving single-engine aircraft of less than 12,500 pounds gross weight in which the potential of low-level wind shear as a factor could not be discounted. The software filtering resulted in indentifying 2,469 small single-engine aircraft accident briefs which met the criteria for the possible presence of wind shear. A review of these briefs for the years 1964 through 1973 (excluding 1970, 1971, 1974, and 1975) further reduced this number to 304, which comprised the final data base used in this analysis. The presence of a low-level wind shear was a distinct possibility in 71 of these takeoff, approach, or landing accidents. Of this number, 48 involved mechanically (orographic or topographic) induced shears. In 23 of the cases, thunderstorms were reported or observed close to the aircraft flightpath.

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METRIC CONVERSION FACTORS

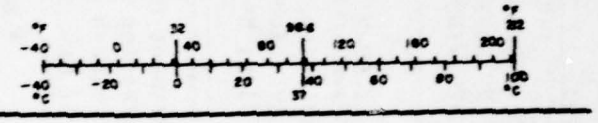
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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ABBREVIATIONS AND SYMBOLS
(Meteorological)

⊙ = Scattered Clouds

◐ = Broken Clouds

⊕ = Overcast

\+ = Increase/heavy

\- = Decrease/light

BS = Blowing snow

E = Sleet

F = Fog

G = Estimated

H = Haze

K = Smoke

L = Drizzle

LCS = Local controller specialist

M = Measured

PRESSRR = Rapid pressure rise

PRESFR = Rapid pressure fall

R = Rain

RW = Rainshowers

S = Snow

SW = Snowshowers

T = Thunderstorm

X = Obscuration (meteorological definition)

-X = Partial obscuration

ZL = Freezing drizzle

ABBREVIATIONS AND SYMBOLS (Cont'd)
(Aerotechnical)

C_L = Lift Coefficient

F_L = Lift

S = Wing Area

u = Wind velocity along X-axis

v = Wind velocity along Y-axis

V = Velocity (aircraft related data)

w = Wind velocity along Z-axis

X = Longitudinal axis parallel to earth surface

Y = Lateral axis parallel to earth surface

Z = Vertical axis perpendicular to earth surface

ρ = Air density

α = Angle-of-attack

INTRODUCTION

BACKGROUND.

The Federal Aviation Administration (FAA) has programs specifically dedicated to identifying and, where possible, reducing hazards encountered in normal aircraft operations. One of these hazards is low-level (surface to 1,500 feet) wind shear. Wind shear is defined (reference 1) as any change in windspeed and/or wind direction through any thin layer of the atmosphere. Thus, updrafts and downdrafts, wind gusts, turbulence, and mountain waves are examples of different forms of wind shear, as well as the wind shears associated with thunderstorms, rapidly moving frontal activity, and temperature inversions. In such an encounter, the airspeed of the aircraft changes, and the flightpath of the aircraft is altered.

The definition of wind shear can vary depending upon the point of view of the observer and the reference frame used. Appendix A discusses wind shear definition at some length. Examples of horizontal wind shear as defined in this report: (1) encountering a downdraft associated with a rainshower, thunderstorm, or the lee side of a mountain, (2) encountering wind shift caused by a variation in surrounding terrain, or (3) encountering a thunderstorm-induced sudden wind shift during the takeoff or landing roll.

Examples of vertical wind shear are: (1) shear associated with a descent through the gust front associated with a thunderstorm, (2) a descent below the treeline surrounding a small airport, or (3) the change in wind direction associated with a nocturnal temperature inversion.

Some of the above examples can produce both horizontal and vertical wind shears (ie.,thunderstorms and rotors associated with mountain waves). Examples of both horizontal and vertical wind shears are shown pictorially in figure A-3.

What constitutes a "significant" vertical or horizontal wind shear encounter is a function of aircraft performance and design. During a thunderstorm or a rainshower of 2.0 inches per hour, the rain area may have associated with it a downdraft in excess of 20 feet per second (reference 2). This would seriously compromise flightpath control of many aircraft if it occured at a critical point on approach. A low-level vertical shear in excess of 9 feet per second per 100 feet (approximately 5 knots per 100 feet) has been defined as "significant" (reference 3) by FAA personnel currently engaged in some of the wind shear programs.

During the approach, landing, takeoff, and initial climb phases of flight, the indicated airspeed (V) is only marginally greater than (V= 1.2 to 1.4 times V stall) stall speed. There is a minimum margin of altitude which can be exchanged for airspeed. Engine thrust is dictated by approach airspeed requirements (for flightpath control), noise abatement procedures, or may be the maximum available at the time. Thus, if a low-level wind shear is encountered, larger deviations from the intended flightpath can occur due to the change in both airspeed and lift when the pilot has only a minimum of corrective actions available.

As was previously noted, a low-level wind shear encounter may result in an accident or incident such as landing short (undershoot), ballooning with a resultant overrun (overshoot), drifting off to the side of the runway, stall, hard landing, etc. However, these types of accidents and incidents can also be due to factors totally unrelated to wind shear.

In the past, investigators were not as aware of the low-level wind shear hazard as they are today. This is particularly true since the analysis of certain well documented accidents by the National Transportation Safety Board (NTSB), and FAA's wind shear research and development program, documented in FAA report ED-15-2A (reference 3). It is certain that this hazard was present as an unrecognized factor in early aircraft accidents and, therefore, was omitted as a contributing weather factor. Thus, the magnitude of the low-level wind shear hazard to both large and small aircraft may not have been fully known, recognized, or understood by all segments of the aviation community. The greater awareness has come about as a result of the greater susceptibility of swept-wing jet aircraft to wind shear, and the greater use of multiple channel flight data recorders which have greatly increased our ability to analyze the dynamics of an accident.

PURPOSE.

One of the objectives identified in the FAA's research and development (R&D) program (reference 3) was a study to summarize the available information concerning both wind shear hazard and its detection. The results of this effort are contained in the FAA report FAA-RD-76-114 (reference 1.) With the aid of this information, a further study was undertaken to determine the magnitude of the wind-shear hazard using available historical accident data. The data base employed was the NTSB aircraft accident information file covering the years from 1964 through 1975.

The specific objectives of this project were to:

1. Develop a technique to evaluate the historical accident information for cause and effect as it relates to low-level wind shear. (This should not be construed to mean the probable cause of an accident or incident. That is determined by the NTSB.)

2. Identify significant meteorological, aircraft, pilot, and operational factors that suggest a common denominator with respect to the wind shear problem in the terminal area.

It was originally planned to separate the project into two segments, one dealing with aircraft of 12,500 pounds (lbs) gross weight or greater, and the other covering aircraft under 12,500 lbs gross weight. However, due to the significantly larger number of aircraft accidents in the lower gross weight category, this group was subdivided into multiengine and single-engine categories. Much of the methodology and analysis is applicable to all three groups. The larger weight class aircraft accidents are covered in the FAA report FAA-RD-77-169, reference 4, while the multiengine, lower gross weight category aircraft are covered in FAA report FAA-RD-78-55, reference 5.

The present report covers only single-engine aircraft accidents in the lower weight class.

EXPERIMENTAL DESIGN

GENERAL.

It was recognized at the beginning of the project that many segments of the aviation community have an interest in this effort and could make a significant contribution. This contribution could include criteria and techniques which could be used to screen and/or evaluate aircraft accident data for the potential presence of a low-level hazardous wind shear. Accordingly, at the onset of this project, the letter shown in appendix B was sent to the potentially interested organizations listed below, soliciting suggestions and recommendations for the screening and evaluation of aircraft accident data.

1. Air Line Pilots Association (ALPA),

2. Aircraft Owners and Pilots Association (AOPA),

3. Air Transport Association (ATA),

4. Department of Defense Safety Centers (DOD) (Army, Navy, Air Force),

5. General Aviation Manufacturers Association (GAMA),

6. National Business Aircraft Association (NBAA),

7. National Aeronautic and Space Administration (NASA),

8. National Oceanographic and Atmospheric Administration (NOAA),

9. National Transportation Safety Board (NTSB), and

10. Transportation Systems Center (TSC).

Coordination was also accomplished with various segments within the FAA including the Air Traffic Service, Flight Standards Service, Office of Systems Engineering Management, and Systems Research and Development Service.

The NTSB provided a copy of its in-house safety analyst's coding guide which is used in encoding accident data for storage and retrieval. NTSB was also helpful in suggesting the encoded types of accidents, phase of operations, and weather factors which would be helpful in a machine search of the approximately 59,000 accident files.

ALPA provided a list of accidents which it had evaluated for a potential wind-shear hazard contribution. ALPA also provided some of the criteria upon which it based its evaluation and made available several ALPA studies on the subject. These studies were prepared by ALPA members which included such recognized experts as Dr. Kenneth Hardy and Captain William Melvin. These documents were among those which have been reviewed and are contained in reference 1.

NOAA provided suggested guidelines for selecting those reported meteorological factors which might be indicative of the presence of wind shear. Many of the recommended surface weather observation filtering criteria are contained in the Federal Meteorological Handbook No. 1, reference 6.

FILTERING PROCEDURES.

The flow chart for the total Wind Shear Accident/Incident Analysis Program is shown in figure 1. In each of the filtering procedures, the criteria for selecting the specific arguments were, in part, selected based on inputs requested and received from the sources noted in figure 1. Most of the software screening criteria were based on recommendations received from NTSB. ALPA provided significant guidance in the selection of the filtering techniques used in reviewing the briefs and the NOAA recommended meteorological criteria used in the docket examinations.

The flow diagram for the software to screen the NTSB data base is shown in figure 2, using the NTSB coding defined in reference 7. An expansion of the software-controlled filtering is shown in table 1. Incorporated into the program was a subroutine to generate an output summary for each filter control. A separate program was prepared to print the coded information in plain language for each accident that met the software filtration criteria.

The briefs were reviewed using the factors noted in table 2. This eliminated those accidents in which the presence of a low-level wind shear, as a significant factor, was not likely or the accident was not applicable to the terminal area phase of flight operations of interest in this study.

The final filtering of those accidents which met both the software and briefing criteria was an examination of the accident files (dockets) maintained by NTSB. All the records relating to an aircraft accident are retained and stored either within the NTSB public docket files (most current 2 years) or, under NTSB control, at the National Archives in Washington, D.C. The filtering factors used in this final phase are shown in table 3.

The following portions of the dockets were examined to obtain pertinent information relating to the filtering criteria.

Factor	Docket Section
Thunderstorm/Squall Line	Surface Weather Observations, Weather Radar Reports, Radar Controller, Pilot Reports, Witness Statements, Crew Statements
Barometric Pressure	Surface Weather Observations, Barograph, LCS, Reported Altimeter Setting
Precipitation at Surface	Surface Weather Observations, Pilot Reports, LCS, Witness Statements
Surface Winds	Surface Weather Observation, LCS, Witness Statements
Wind Shear, Updrafts/Downdrafts	Pilot Reports, Winds Aloft Observations, Meteorological Analysis, Flight Data Recorder, NTSB Analysis, Witness Statements
Temperature	Surface Weather Observations

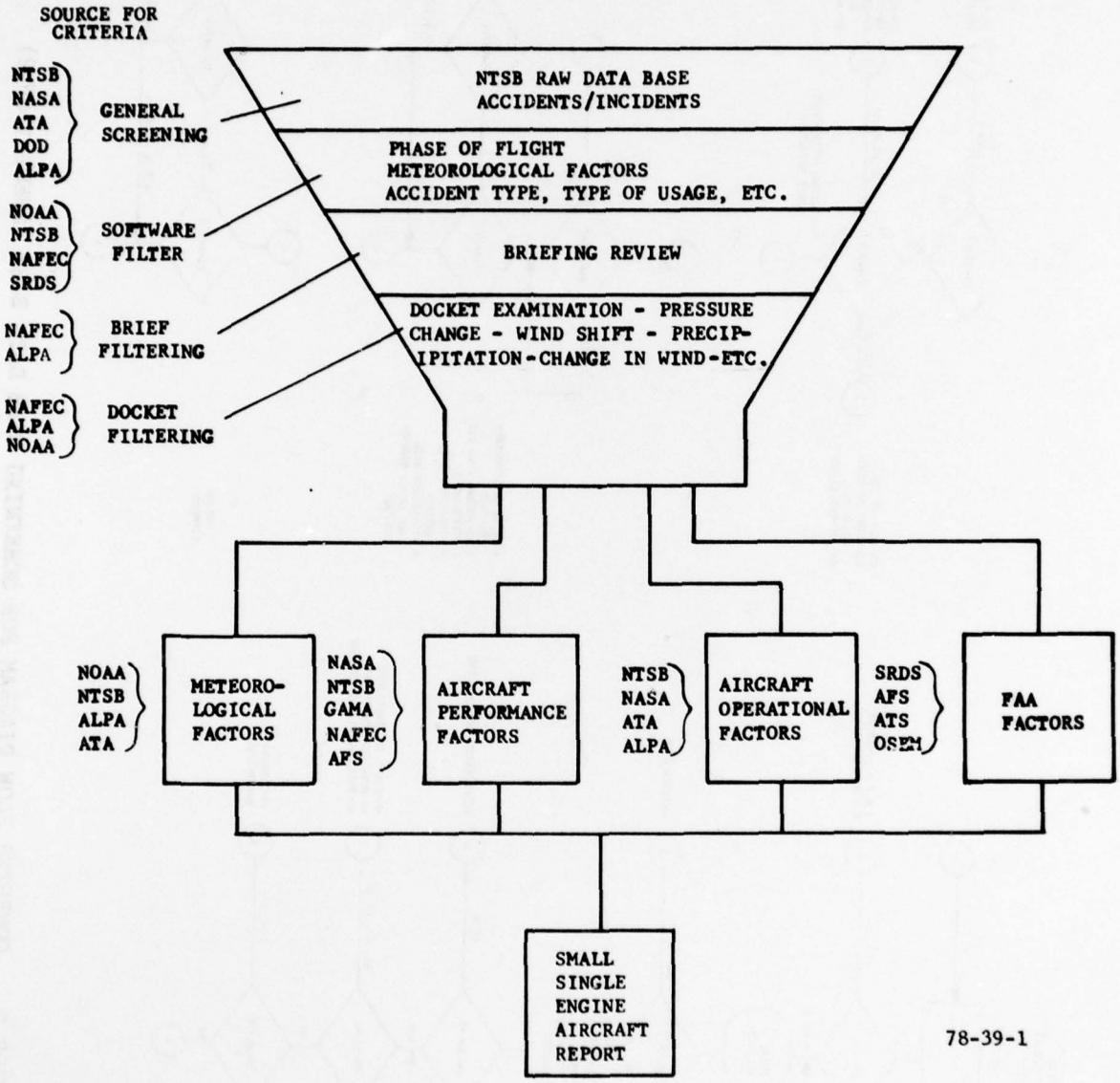

FIGURE 1. WIND SHEAR ACCIDENT/INCIDENT ANALYSIS FLOW CHART

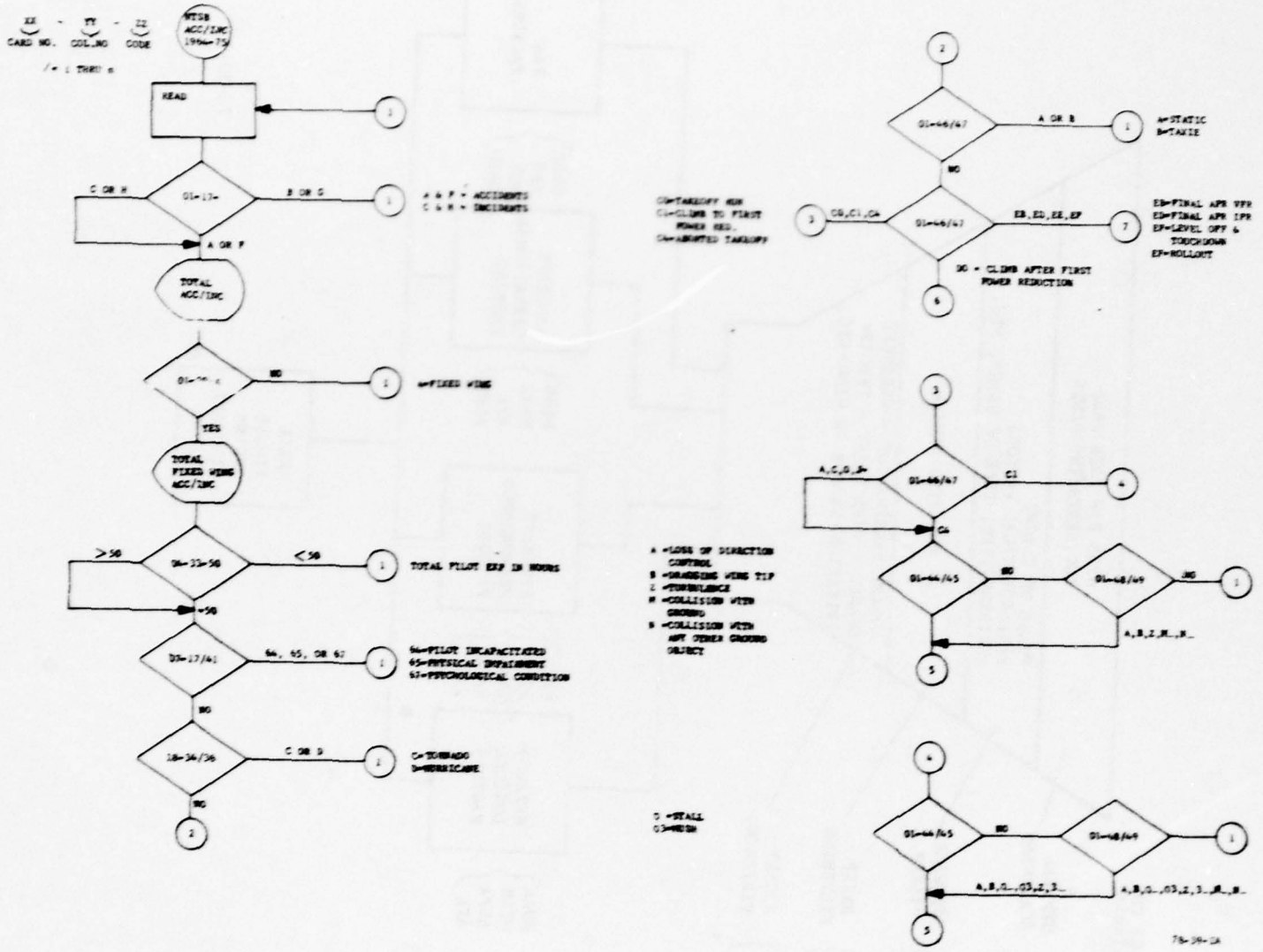

FIGURE 2. COMPUTER FLOW DIAGRAM FOR SCREENING NTSB DATA BASE (SHEET 1 of 2)

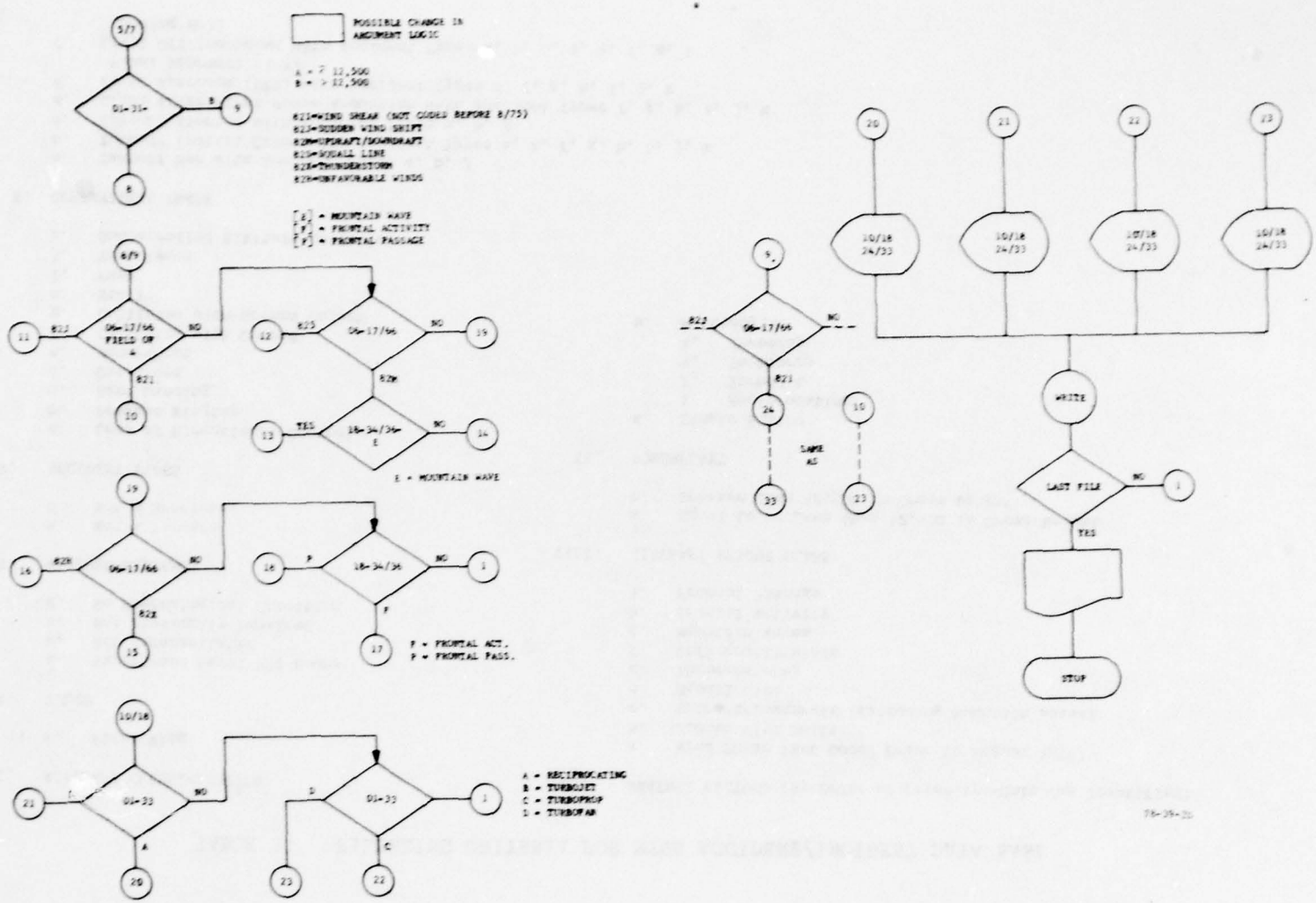

FIGURE 2. COMPUTER FLOW DIAGRAM FOR SCREENING NTSB DATA BASE (SHEET 2 of 2)

TABLE 1. FILTERING CRITERIA FOR NTSB ACCIDENT/INCIDENT DATA BASE

I. AIRCRAFT CLASSIFICATION

a. Fixed Wing

II. PILOT

a. Experience Level >50 Hours
b. Not Incapacitated
c. Not Physically Impaired
d. No Psychological Condition

III. WEATHER EXTREMES

a. Not a Tornado
b. Not a Hurricane

IV. ACCIDENT TYPES

a. Loss of Directional Control
b. Dragged Wingtip
c. Hard Landing
d. Overshoot
e. Undershoot
f. Collision with Ground
g. Collision with Ground Object
h. Stall
i. Mush
j. Turbulence
k. Uncontrolled Altitude Deviation

V. OPERATIONAL PHASE

a. Takeoff Run with Accident Types a, b, j
b. Takeoff Initial Climb with Accident Types a, b, f, g, h, i, j, k
c. Takeoff Aborted with Accident Types a, b, j
d. Climb After First Power Reduction with Accident Types f, g, h, i, j, k
e. Final Approach (VFR) with Accident Types a, f, g, h, i, j, k
Final Approach (IFR)
f. Level Off/Touchdown with Accident Types a, b, c, d, e, f, g, i
Landing Roll

VII. WEATHER FACTORS (By Order of Priority--Only One Identified)

a. Wind Shear (Not Coded Prior to August 1975)
b. Sudden Wind Shift
c. Updraft/Downdraft (Excluding Mountain Waves)
d. Squall Line
e. Thunderstorms
f. Unfavorable Winds
g. Mountain Waves
h. Frontal Activity
i. Frontal Passage

VIII. AIRCRAFT WEIGHT CLASS

a. Equal to or Less than 12,500 lb Gross Weight
b. Greater than 12,500 lb Gross Weight

IX. POWERPLANT

a. Single Engine
1. Reciprocating
2. Turbojet
3. Turboprop
4. Turbofan
b. Multiengine

TABLE 2. FILTERING CRITERIA FOR REVIEW OF ACCIDENT BRIEFS

Area Evaluated	Factors
Accident Statistics	Date, File Number, Aircraft Type, Registration Number, Location
Type of Approach	NAVAID Horizontal Guidance, NAVAID Vertical Guidance, Visual Horizontal Guidance, Visual Vertical Guidance
Weather at Time of Accident	Expected by Flight Crew, Unexpected by Flight Crew, Visibility
Type of Accident	Could be Triggered by a Shear Encounter, Unrelated
Weather Factors	Frontal Activity, Precipitation, Shifting Winds, Wind Direction with Respect to Runway, General Weather
Airplane Factors	Navigation Equipment Available, Usage, Autopilot Information
Location of Accident	Distance from Runway in Use, Airport Elevation, Altitude of Occurrence

It is most important to note that this study does not, nor is it intended to, redefine the "PROBABLE CAUSE" of any accident. The filtering criteria used at each level (software, review of accident briefs, and docket examination) did not consider the NTSB-defined probable cause of the accident.

TABLE 3. FILTERING CRITERIA FOR DOCKET EXAMINATION

Factor		Criteria
Thunderstorm/Squall Line	(1)	Along the aircraft's flightpath, within 5 nmi of approach and moving in the direction of the aircraft's flightpath
Barometric Pressure Jump (rate of change)	(2)	* 0.0005 inches of mercury (inHg)/minute (0.017 millibar/ minute) (pressure jump)
	(2)	** 0.06 inHg/hour (2 millibars/ hour) (pressure rise or fall)
Precipitation at Surface	(1)	0.03 inches/minute (approximately 2 inches/hour)
Surface Wind Direction (Shift of)	(1)	* 30° or greater
Surface Windspeed Change	(2)	15 knots or doubles its value (above 10 Knots) between successive surface weather observations
Peak Surface Windspeed	(1)	$\geq$ 25 knots
Horizontal Wind Shear Gradient	(1)	1 knot/100 feet or greater
Vertical Wind Shear Gradient	(1)	5 knots/100 feet or greater
Difference between the In-Flight and Airport Surface Windspeeds	(1)	10 knots
Pilot NWS/ATS Report	(1)	Wind shear/updrafts/downdrafts
NTSB Analysis	(1)	Wind shear, updrafts/downdrafts, mountain waves, or sudden wind shift noted as a factor
Others	(1)	Moderate or heavy shower along aircraft's flightpath
	(1)	Frontal system movements of 10 knots, temperature across front $\geq$ 10° F
	(1)	Terrain (orographic and local topography)

* Changes occurring within $\pm$15 minutes of accident
**Changes occurring within $\pm$60 minutes of accident

(1) Selected by and/or recommended to author. (2) Extract from reference 7.

RESULTS

The NTSB data base contained 59,465 accidents or incidents from the time period of 1964 through 1975 inclusive. Within the terminal area, there were 19,332 accidents/incidents which met the criteria I through IV shown in table 1. This could be further broken down to 5,277 that occurred during the takeoff phase of flight and 14,055 which happened during approach or landing.

Within the lower weight class (less than 12,500 lbs gross weight), there were 2,625 accidents which met criteria V through IX of table 1. This was further divided into 2,469 single-engine aircraft and 156 multiengine aircraft accidents/ incidents which met the software filtering criteria shown in table 1. It was earlier noted that reference 5 reported the results of the analysis for the 156 multiengine aircraft occurrances.

The 2,469 accident briefs were reviewed using the filtration factors noted in table 2. It became obvious during this review process that the number of accidents which would meet the criteria shown in table 2 could easily exceed 500, which could make the docket review phase monumental. Accordingly, the review of briefs was limited to those covering the years 1964 through 1969 and 1972 through 1973 inclusive. This limit still produced 304 accidents/incidents which met the criteria noted in tables 1 and 2.

Requests for the 304 dockets were submitted to NTSB. It was the intent to review these 304 dockets at the Public Inquiry Division of NTSB as had been done for references 4 and 5. Due to the physical limitations for storage, the accident/incident files for the current year, one previous year, and all older files which are still active, are maintained by the NTSB at their Public Inquiry Division. Older files are transferred for storage to a General Services Administration (GSA) depository where they are stored for a prescribed time period. This time frame is normally 10 years for general aviation accidents and 15 years for air carrier and selected general aviation accidents, after which the files are eligible for destruction.

Thus, the request for 304 dockets placed a very large workload on several different agencies within the government, and it was further possible that some of these dockets may no longer be available for examination. In fact, 55 of the requested dockets were not located.

There is no basis for assuming that the analysis could be dependent on any given year within the initial time frame (ie., 1964 through 1975). Accordingly, it was determined that in the interest of economy of both time and manpower, the analysis would be based on those records which could be readily obtained and evaluated for the years selected. This resulted in the identification of 249 accidents/ incidents which met the criteria noted in table 3 and were available for examination.

Prior to discussing the specifics of the docket examinations, there are several general points which a review of the dockets produced.

1. There is very limited information in the dockets concerning documented weather conditions prior

to, at the time of, and following the accident. Yet, all of the accidents evaluated occurred in close proximity to an approved airport. Many of these airports were classified as municipal airports, yet, meteorological information relative to the accident was not included in the docket. It is, therefore, assumed that such information may not be available at a majority of municipal airports.

2. The extent to which the accident/incident was investigated was, in most cases, much less than that which was accomplished for the larger gross weight aircraft accidents (reference 4).

3. The official accident reports were usually filled out by the pilot and lacked many of the specifics which would have been helpful in the analysis of the accident. In many cases, the subsequent formal investigator's report was accomplished in the office based on the pilot's statement and limited additional correspondence and official phone conversations.

4. According to the information contained in the applicable dockets, a number of airports were known to have orographic or local topographically induced wind anomalies, but this information was not readily available to the nonlocal pilot.

5. Some of the airports which were identified in the docket no longer exist. Thus, specifics regarding local topography, facilities, etc. could not be determined.

The above factors influenced the number of accidents which were considered for exclusion or inclusion in table 4. These factors also influenced the results reported in references 4 and 5. The quantitative effect of such factors could not be established during these studies. Therefore, it is assumed that the effects were similar in all three studies. This assumption provides a basis for comparison of results.

Table 4 is a listing of the single-engine small-aircraft accidents or incidents in which there is a possibility that a low-level wind shear could have been present in the terminal area along the aircraft's flightpath at the time of the accident. The basis for the selections in the list was the docket examinations. The 71 accidents listed are those in which a low-level wind shear could have been a contributing factor.

The matrix table of low-level wind shear factors was structured to examine these accidents in greater detail. These factors were:

1. A change in reported surface wind direction in excess of 30 degrees (°) within 15 minutes of the accident.

2. A change in reported average surface windspeed in excess of 10 knots.

3. Reported surface wind gusts of 10 knots or more above average windspeed or double average windspeed.

4. Reported barometric pressure jump of 0.0005 inHg/minute or more.

5. A continuous change in barometric pressure in one direction of 0.06 inHg/hr.

TABLE 4. SINGLE ENGINE SMALL AIRCRAFT IN WHICH LOW-LEVEL WIND SHEAR COULD HAVE BEEN A FACTOR VERSUS CRITERIA OF CLASSIFICATION

Accident No.	Date	Examination Criteria 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1/6/64	U	U	N	U	U	U	N	N	U	U	U	Y	B	N	C/N
2	3/16/64	U	C	N	U	U	U	N	N	N	Y	N	N	C	N	T/N
3	4/2/64	U	U	U	U	U	U	U	U	Y	N	N	Y	A	N	C/N
4	4/5/64	U	U	U	U	U	U	N	N	N	N	Y	N	A	N	C/L
5	5/3/64	L	U	Y	U	U	U	Y	U	Y	N	N	Y	B	N	T/L
6	5/8/64	U	U	U	U	U	U	N	N	N	Y	N	N	B	N	C/N
7	6/24/64	N	N	N	U	N	N	N	N	N	N	U	N	C	N	C/N
8	9/14/64	U	U	U	U	U	U	Y	Y	Y	N	N	N	C	N	C/N
9	9/22/64	U	U	U	U	U	U	Y	Y	Y	N	N	Y	A	N	T/N
10	6/27/65	U	U	U	U	U	U	N	N	N	Y	N	Y	A	N	T/N
11	7/23/65	U	U	U	U	U	U	Y	Y	Y	Y	N	Y	A	N	T/L
12	7/25/65	U	U	Y	U	U	U	N	N	N	Y	Y	N	A	N	C/N
13	8/10/65	Y	N	N	N	N	N	N	N	Y	N	N	Y	D	Y/N	T/N
14	8/18/65	U	U	U	U	U	U	N	N	N	Y	N	N	A	N	F/N
15	10/14/65	U	U	N	U	U	U	N	N	N	N	N	Y	A	N	C/N
16	10/3/65	U	U	U	U	U	U	N	N	N	Y	N	N	D	N	C/N
17	12/30/65	N	N	Y	N	N	N	Y	Y	N	N	Y	Y	C	Y/N	C/N
18	5/21/66	U	U	Y	U	U	U	N	N	N	N	Y	N	C	N	C/N
19	5/28/66	U	U	U	U	U	U	N	N	Y	N	N	Y	E	N	T/L
20	5/29/66	Y	N	N	N	N	Y	N	N	Y	N	N	Y	B	N	C/N
21	6/29/66	U	U	U	U	U	U	N	N	N	Y	Y	Y	A	N	C/N
22	7/11/66	U	U	U	U	U	U	U	Y	Y	N	N	N	Y	A	Y/N	T/L
23	8/13/66	Y	N	N	N	N	U	Y	Y	Y	N	N	Y	E	Y/N	T/L
24	8/17/66	U	U	U	U	U	U	N	N	Y	N	N	N	C	N	C/N
25	10/3/66	U	U	N	U	U	U	N	N	Y	N	N	Y	C	N	T/L
26	11/20/66	U	U	Y	U	U	U	N	N	N	N	Y	N	B	N	C/N
27	11/30/66	U	U	U	U	U	U	N	N	N	N	Y	Y	A	N	F/N
28	1/22/67	U	U	U	U	U	U	N	N	N	N	Y	N	A	N	T/N
29	2/5/67	U	U	U	U	U	U	N	N	N	Y	N	Y	D	N	C/N
30	2/28/67	U	U	N	U	U	U	U	U	U	N	Y	Y	A	N	C/N
31	3/4/67	U	U	N	U	U	U	N	N	N	Y	N	Y	C	N	C/N
32	4/24/67	U	U	U	U	U	U	N	N	Y	N	N	N	A	N	C/N
33	4/29/67	U	U	U	U	U	U	N	N	N	N	Y	N	C	N	C/N
34	1/15/68	U	U	U	U	U	U	N	N	N	N	Y	N	A	N	C/N
35	1/18/67	U	U	N	U	U	U	N	N	N	N	Y	N	A	N	C/N
36	2/18/68	U	U	U	U	U	U	N	N	N	Y	Y	N	D	N	C/N
37	3/14/68	U	U	U	U	U	U	N	N	N	Y	N	Y	B	N	C/N
38	5/4/68	U	U	U	U	U	U	N	Y	Y	N	N	Y	A	N	T/L
39	5/19/68	Y	U	N	U	U	U	Y	Y	Y	N	N	Y	A	N	T/L
40	6/12/68	Y	U	N	U	U	U	Y	Y	Y	N	N	Y	U	N	T/L
41	6/30/68	U	U	U	U	U	U	U	U	Y	N	N	Y	A	N	T/N
42	7/16/68	U	U	U	U	U	U	N	N	N	N	Y	N	A	N	T/L
43	8/12/68	U	U	U	U	U	U	N	N	N	Y	N	N	A	N	C/N
44	8/25/68	U	U	U	U	U	U	N	N	N	Y	N	Y	E	N	T/N
45	9/15/68	U	U	U	U	U	U	N	N	N	N	Y	Y	B	N	T/N
46	9/26/68	U	U	U	U	U	U	Y	Y	Y	N	N	Y	E	Y/N	T/N
47	10/5/68	U	U	U	U	U	U	N	N	N	N	Y	N	C	N	T/L
48	10/15/68	U	U	Y	U	U	U	N	N	Y	N	Y	Y	C	N	T/N
49	10/24/68	U	U	U	U	U	U	N	N	N	Y	N	N	D	N	C/N
50	4/13/69	U	U	U	U	U	U	N	N	N	N	Y	N	B	N	T/L
51	4/20/69	U	U	U	U	U	U	N	N	N	Y	Y	Y	A	N	C/N
52	4/27/69	U	U	U	U	U	U	N	N	N	N	Y	Y	C	N	T/L
53	4/29/69	U	U	U	U	U	U	N	N	N	N	Y	N	B	N	C/N
54	5/9/69	U	U	U	U	U	U	N	N	N	N	Y	Y	C	N	T/L
55	6/15/69	U	U	U	U	U	U	N	N	N	N	Y	N	C	N	C/N
56	6/21/69	U	U	U	U	U	U	N	N	Y	N	N	Y	A	N	C/N
57	6/22/69	U	U	U	U	U	U	N	N	N	N	Y	N	B	N	T/L
58	6/30/69	U	U	N	U	U	U	N	N	N	N	Y	N	D	N	T/L
59	7/10/69	U	U	Y	U	U	U	N	N	U	N	N	Y	C	Y/N	T/L
60	8/17/69	U	U	U	U	U	U	N	Y	Y	N	N	Y	C	N	C/N
61	2/23/72	U	U	U	U	U	U	N	N	N	U	U	U	A	N	T/N
62	3/26/72	U	U	U	U	U	U	N	N	N	N	Y	N	D	N	T/L
63	4/14/72	U	U	Y	U	U	U	N	N	N	Y	N	N	C	N	T/N
64	7/9/72	U	U	U	U	U	U	N	N	N	Y	N	Y	A	N	C/N
65	8/14/72	U	U	U	U	U	U	N	N	Y	N	N	Y	C	Y/N	T/N
66	10/6/72	U	U	U	U	U	U	N	Y	Y	N	N	Y	A	N	C/L
67	4/13/73	U	U	Y	U	U	U	N	N	N	Y	Y	Y	B	N	T/L
68	6/2/73	U	U	U	U	U	U	N	N	N	N	Y	Y	D	N	T/L
69	6/5/73	U	U	Y	U	U	U	Y	Y	Y	N	N	Y	D	Y/N	C/N
70	8/9/73	U	U	U	U	U	U	N	Y	N	U	U	N	B	Y/N	C/U
71	9/15/73	U	U	U	U	U	U	N	N	N	N	Y	Y	C	N	C/N
Totals																
Y		5	0	10	0	0	1	11	15	23	19	30	41	--	--	--
N		2	5	14	4	5	3	57	53	44	49	38	29	--	--	--
U		64	66	47	67	66	67	3	3	4	3	3	1	1	--	--
A		--	--	--	--	--	--	--	--	--	--	--	--	27	--	--
B		--	--	--	--	--	--	--	--	--	--	--	--	11	--	--
C		--	--	--	--	--	--	--	--	--	--	--	--	19	--	--
D		--	--	--	--	--	--	--	--	--	--	--	--	9	--	--
E		--	--	--	--	--	--	--	--	--	--	--	--	4	--	--
Y		--	--	--	--	--	--	--	--	--	--	--	--	--	9	--
Y/N		--	--	--	--	--	--	--	--	--	--	--	--	--	9	--
N		--	--	--	--	--	--	--	--	--	--	--	--	--	62	--
C/N		--	--	--	--	--	--	--	--	--	--	--	--	--	--	33
C/L		--	--	--	--	--	--	--	--	--	--	--	--	--	--	2
C/U		--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
T/N		--	--	--	--	--	--	--	--	--	--	--	--	--	--	13
T/L		--	--	--	--	--	--	--	--	--	--	--	--	--	--	20
F/N		--	--	--	--	--	--	--	--	--	--	--	--	--	--	2

LEGEND

1 Change in surface wind direction within ≤15 minutes 30°
2 Change in speed >10 knots
3 Gusts >10 knots or double (2)
4 Press jump 0.0005 inHg/minutes (0.0169 mil/minute)
5 Barometric change of 0.06 inHg/60 minutes (2.0314 mil/60 minutes)
6 Temperature jump 10° F between successive observations
7 Moderate or heavy rainshowers
8 Precipitation
9 Thunderstorm/squall within 5 nmi of runway and along aircraft flightpath
10 Induced wind anomalies due to major variations in terrain (orographic wind shear)
11 Induced wind anomalies due to localized variations in terrain (topographic wind shear)
12 Low-level wind shear, wind shift, or downdraft noted prior to the accident
13 Total pilot experience (A=>1000h, B=>500h, C=>200h, D=>100h, E=>50h)
14 Airport surface observation weather facilities available/included in docket
15 Aircraft type (C=conventional gear, T=tricycle, F=float, H=high wing, L=low wing)

Y = Yes N = No U = Unknown -- Not Applicable

6. Reported change in surface temperature of 10° Fahrenheit (F) between two successive hourly observations and/or special observations.

7. Reported moderate or heavy showers along the aircraft's flightpath.

8. Reported precipitation (rain, snow, or fog).

9. Reported thunderstorms, squalls, or heavy precipitation within 5 nautical miles (nmi) of the runway and along the aircraft's flightpath.

10. Induced wind anomalies due to major variations in the surrounding terrain (ie., mountains, canyons, etc.), herein referred to as orographic wind shear.

11. Induced wind anomalies due to localized variations in the surrounding terrain (ie., buildings, trees, ditches, body of water etc.), herein referred to as topographic wind shear.

12. Measured or observed low-level wind shear, significant wind shift, or downdraft which were recorded, reported, or known to be present prior to the accident.

13. Total pilot experience (A=>1000 hours (h), B=>500h, C=>200h, D=>100h, E=>50h).

14. Airport surface observation weather facilities available/included in docket.

15. Aircraft type (C= conventional gear, T=tricycle, F=float, H=high wing, L=low wing).

The majority of the dockets which were examined and not included in table 4 were excluded because of insufficient information on which a decision could be made. Thus, the fact that only 71 of the total of 249 are being evaluated is not in itself significant.

Table 4 indicates that in 64 of the accidents, information was not available relating to the magnitude of the change in wind direction, criterion 1. In the seven cases where information was available, five indicated a change in wind direction of 30° or more within 15 minutes before or after the time of the accident.

Information was missing in 66 of the accidents shown in table 4 regarding criterion 2. The remaining five accidents did not indicate a change in wind speed of greater than 10 knots.

Ten of the 24 accidents, which had information concerning gusts, indicated gusts which were greater than 10 knots or double the velocity of the steady-state wind, criterion 3.

Only four accidents had information relating to a short period barometric pressure change. None met the 4th criterion. Only five had information relating to the longer time frame concerning atmospheric pressure changes and none met criterion 5.

There were only four accident dockets which contained sufficient information relative to criterion 6. Only one of the four indicated a temperature change of 10°F or more between successive observations.

There were 11 accidents in which moderate to heavy rainshowers were observed or reported in close proximity to or along the aircraft's flightpath. In only three of the accidents was the information regarding criterion 7 missing. Fifteen of the 68 accidents had some form of precipitation reported or observed.

There were 23 accidents in which thunderstorm activity was reported within 5 nmi of the runway and along the aircraft's flightpath. One of these accidents which occurred on August 11, 1966 at Stapleton Airport was very similar in many respects to the large air carrier accident which occurred 9 years later on August 7, 1975.

Nineteen of the accidents occurred under conditions conducive to orographic shear and 30 under circumstances which preclude ignoring the possibility of topographic shear. In three of these accidents both possibilities existed.

One of the interesting pieces of information uncovered in this analysis was the identification by the pilot of wind shear as the cause of his inability to arrest the violent onset and subsequent continuance of an undesired rate of descent. This accident occurred on April 14, 1972, and was the result of an orographic phenomenon.

In 41 of the accidents, conditions conducive to a wind shear due to a thunderstorm, mountain wave, or other types of low-level, mechanically-induced wind shear were known by either the pilot involved, local pilots, or the fixed base operator prior to the accident. In the former case, most of these were in-flight observations of thunderstorm activity.

Although not considered in the two previous reports, references 4 and 5, several other factors were included in this study. The first was total pilot experience in excess of 50 hours. The results indicated that 27 pilots had over 1000 hours, 11 over 500, 19 had more than 200, 9 more than 100, and 4 pilots had more than 50 hours but less than 100 hours total experience. This indicates that 57 or 80 percent had more time than the minimum required to meet this requirement for a commercial pilot's license.

Nine of the airports had the capability of hourly surface weather observations. Notwithstanding this, copies of the applicable daily surface weather observation log were not in any of the dockets. In fact, in only five cases was there sufficient information to evaluate criteria 4, 5, and 6. In several additional accidents, there were offical surface weather observation stations within 10 nmi of the accident site, and here too, advantage was not taken of available information.

Finally, the general category of aircraft involved in these 71 accidents was evaluated. As shown in table 4, about 50 percent (35) were "tail draggers." This type aircraft presents a high angle-of-attack during the start and end of its ground roll and could, therefore, be more susceptible to low-level wind shears. Sixty-five percent (46) of the aircraft involved were high-wing as opposed to low-wing designs. This could influence their susceptibility to low-level wind shears or gusts in the upper portion of the surface boundary layer.

In both of the latter cases (general aircraft classification), the population and distribution of the population of aircraft and their usage would have significant impact on the types of aircraft involved in any category of accident. Since this type of information has not been incorporated into this report, caution should be exercised in drawing any statistical inference from the information in table 4.

SUMMARY OF RESULTS

1. Findings reveal that there were 71 small, single-engine aircraft accidents/incidents in the 8-year study in which the presence of low-level wind shear was possible. This is an annual rate of 8.88 accidents per year as compared with 2.08 and 2.25 for large aircraft and multiengine aircraft, respectively.

2. Thunderstorms were reported in 23 accidents or an annual rate of 2.88. This compares with an annual rate of 1.08 and 0.75 as shown in references 4 and 5, respectively.

3. It is likely that in 46 of 71 accidents, mechanically-induced, low-level wind shear was present. This is an annual rate of 3.83, as compared to 0.25 and 1.0 reported in references 4 and 5.

4. The percentage of accidents in which conditions conducive to wind shear were known or the information was available prior to the accident was 58 percent. This compares to 60 and 85 percent, respectively, as noted in references 4 and 5.

5. There is a significant difference in the amount and type of information which is available in the small aircraft accident dockets as compared to that found in the larger aircraft accident files.

6. Due to limited information available in the dockets, it was not possible to undertake a more detailed analysis of such factors as location, facilities, etc.

CONCLUSIONS

It is concluded that:

1. Wind shear may be involved in more accidents than previously identified.

2. Operating an aircraft in close proximity to a thunderstorm can result in a hazardous low-level wind-shear encounter.

3. Operating an aircraft in mountainous terrain can result in a hazardous low-level wind-shear encounter.

4. Operating an aircraft in a runway environment which is: located near tall buildings, trees, snow banks etc., can result in a hazardous low-level wind-shear encounter.

5. Orographic and/or topographic induced wind shears can be more of a hazard to the smaller aircraft than those shears related to thunderstorms. This may be due to the fact that general aviation pilots tend to avoid thunderstorms and operate more frequently in airport environments which are more conducive to mechanically-induced wind shear.

6. There was a lack of surface weather information, including known local wind anomalies, available to the pilots involved in the accidents which were reviewed.

7. There is a serious lack of information pertaining to the accident available in the accident docket. This is true even in those

cases where there was either or both a United States (U.S.) Weather Station and an FAA-operated tower or Flight Service Station.

8. Pilot flight experience does not appear to be an identifiable factor in low-level wind-shear encounters.

REFERENCES

1. Shrager, J., Wind Shear: A Literature Search, Analysis, and Annotated Bibliography, DOT/FAA/NAFEC, Atlantic City, New Jersey, Report No. FAA-RD-76-114, February 1977.

2. Byer, H. R., Braham, R. R. Jr., The Thunderstorm Report of the Thunderstorm Project, United States Department of Commerce, Washington, D.C., June 1949.

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4. Shrager, J., The Analysis of NTSB Large Fixed-Wing Aircraft Accident/Incident Reports for the Potential Presence of Low-Level Wind Shear, DOT/FAA/NAFEC, Atlantic City, New Jersey, Report No. FAA-RD-77-169, November 1977.

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6. Anonymous, Manual of Code Classifications, Aircraft Accidents and Incident, NTSB, Washington, D.C., June 1970.

7. Anonymous, Federal Meteorologial Handbook No. 1 Surface Observations, United States Department of Commerce, Washington, D.C., July 1, 1975.

APPENDIX A

WIND SHEAR DEFINITION

What constitutes wind shear and whether it is a vertical or horizontal wind shear depends upon the point of view of the observer or the reference used in describing the wind shear.

In the Boeing Airliner magazine of January 1977, wind shear is defined as, "a change in wind speed and/or wind direction over a short distance along the flightpath". This article further clarifies this definition by limiting wind shear to changes with respect to tailwind or headwind components and places updrafts and downdrafts in a separate category. Figure A-1 shows examples of this definition of wind shear.

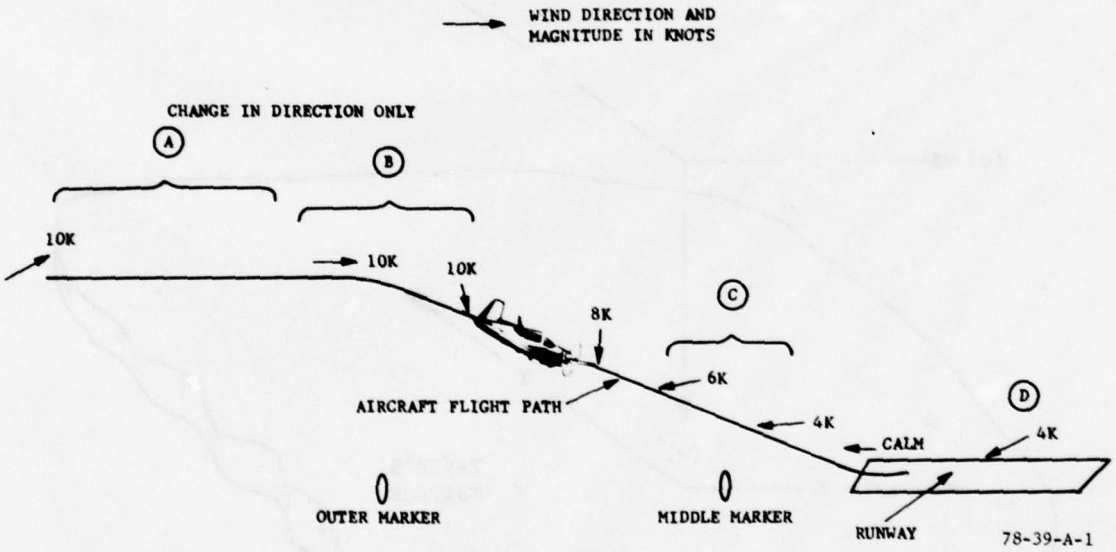

FIGURE A-1. WIND SHEAR DEFINITION WITH RESPECT TO FLIGHTPATH

In the hypothetical example shown in figure A-1, the aircraft encounters a horizontal wind shear due to change in wind direction only as it approaches the outer marker while flying at a constant altitude, (A). It experiences, next, a vertical wind shear due to a variation in wind direction only, (B). As it continues its descent, the aircraft encounters a wind shear which is

due to both windspeed and direction, (C) and (D). Updrafts and downdrafts associated with thunderstorms, which are defined in the Boeing article as, "intense vertical activity," would be superimposed on the examples shown in figure A-1.

Another definition of wind shear is that used in the FAA Report FAA-RD-76-114, dated February 1977. In this report, wind shear is any change in windspeed and/or wind direction over a short distance or time frame with respect to an earth reference. Using such a reference, horizontal wind shear is defined as a change in wind direction or velocity in a plane parallel to the earth's surface (du/dX, dv/dX, dw/dX), as shown in figure A-2. Vertical wind shear is defined as a change in wind direction or velocity in a plane perpendicular to the earth's surface (du/dZ, dv/dZ, dw/dZ).

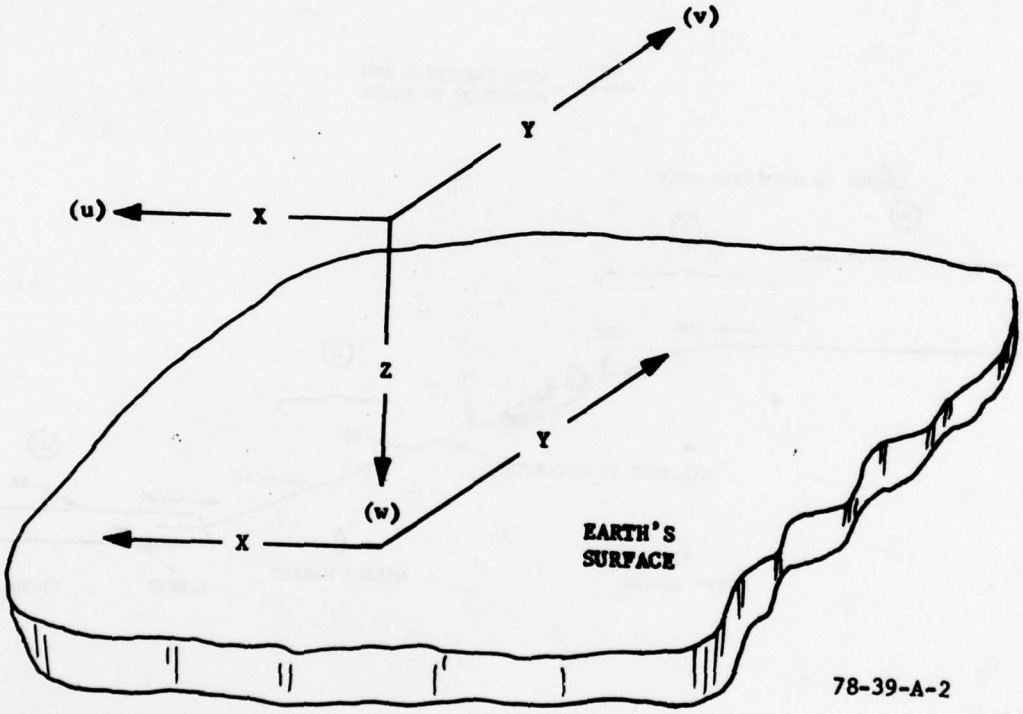

FIGURE A-2. RIGHT-HAND ORTHOGONAL COORDINATE SYSTEM

This definition would include as wind shears, those noted in the Boeing article, plus: (1) updrafts and downdrafts, (2) mountain waves (topographic), and (3) shifts in windspeed and or direction due to surface characteristics and surrounding structures (orographic). Figure A-3 shows examples of this definition of wind shear.

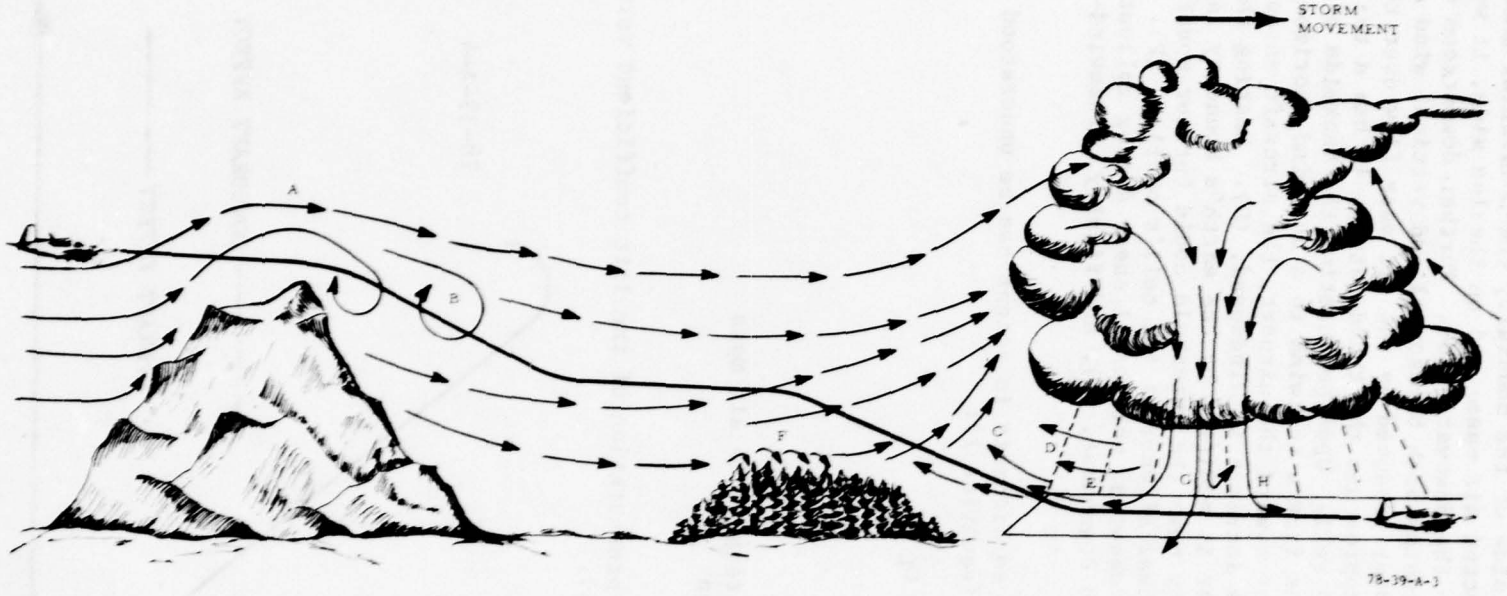

FIGURE A-3. WIND SHEAR DEFINITION WITH RESPECT TO EARTH REFERENCE

The aircraft experiences a horizontal shear as it encounters the mountain wave at (A) on the windward side of the mountain, the horizontal shear would be due to the upward deflected air mass; and on the lee side, it would encounter horizontal shear due to the downward flow. Further downstream of the mountain, the aircraft could encounter both horizontal and vertical wind shear as it descends through the rotor produced by the air mass flow over the mountain, (B). As the aircraft approaches the thunderstorm, it has a tailwind due to the air flow toward the cell. Upon penetrating the backside of the storm system, the wind changes from a tailwind to a headwind (horizontal shear), (C). During its descent toward the airport, the aircraft encounters a vertical shear due solely to the increase in windspeed, (D). Nearing the runway threshold, the vertical shear is modified by the earth's boundary layer, (E). In addition, the topography near the threshold could further modify both the vertical and horizontal shear effects of the cell's outflow, (F). The aircraft finally encounters a crosswind, horizontal shear during rollout due to the outflow associated with downburst, (G), and finally, crosswind-to-tailwind horizontal shear, (H).

How wind shears affect an aircraft in flight can be understood by examining the equation for lift (equation 1):

$$F_L = 1/2\ \rho V^2\ C_L\ \ S \qquad (1)$$

where:

F_L = Lift
ρ = Air density
V = Velocity with respect to air mass
C_L = Lift coefficient
S = Wing area

and a typical graphic presentation of the lift coefficient versus angle of attack (α) (figure A-4).

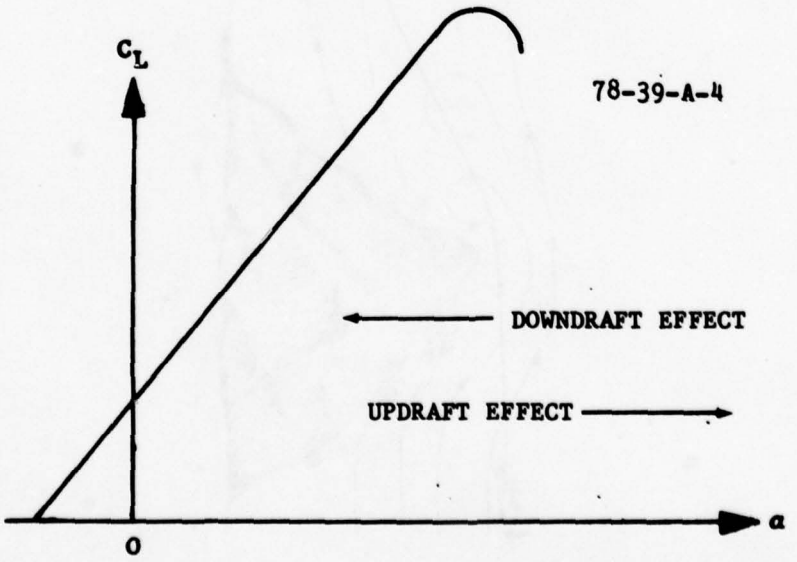

FIGURE A-4. VARIATION IN LIFT COEFFICIENT WITH ANGLE-OF-ATTACK

The wing angle-of-attack is the vector summation of the aircraft's pitch attitude, corrected for the wing's angle-of-incidence and the direction of the prevailing wind. Thus, an encounter with an updraft or downdraft when an aircraft is moving toward the runway during an approach (horizontal wind shear) would change this vector. The result would be a change in angle-of-attack which would affect the lift coefficient (C_L) term in the lift equation (equation 1). This could cause the aircraft to either "balloon" or result in a hard landing. If the change in angle-of-attack is severe enough, it can result in an overshoot or undershoot depending upon whether it is an updraft or downdraft.

Encountering any wind influences the velocity term (V) of the lift equation, (equation 1). This term is a squared quantity, and therefore, small changes in "u" would make large changes in lift (F_L). In addition, changes in u also affect flightpath and this in turn would influence groundspeed and/or vertical speed. Thus, a vertical wind-shear encounter would alter both the vertical and horizontal components of the aircraft's flight profile during an Instrument Landing System (ILS) approach.

APPENDIX B

LETTER TO AVIATION COMMUNITY SOLICITING SUGGESTIONS FOR ACCIDENT/INCIDENT ANALYSIS RELATING TO LOW-LEVEL WIND SHEAR HAZARD

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

NATIONAL AVIATION FACILITIES
EXPERIMENTAL CENTER
ATLANTIC CITY, NEW JERSEY 08405

DATE:

IN REPLY REFER TO: ANA-430

SUBJECT: Wind Shear Accident Analysis, Project 154-451-000

FROM: Acting Chief, Aircraft & Airports Safety Division, ANA-400

TO:

The National Aviation Facilities Experimental Center (NAFEC) has recently undertaken a project whose stated technical objective is:

> "Investigate the factors involved in wind shear accidents/ incidents and their relationship to the severity of the hazard and evaluate procedures designed to increase operational tolerance to wind shear."

The approach to this study will be to develop the meteorological factors and accident data factors which can be used in a computer program to select and evaluate accident/incident data which may be available from NTSB, FAA, and DOD safety centers, covering the period from 1964-1974. This information and related meteorological data will be evaluated to develop a hazard profile definition.

The criteria used in the development of the computer program will be based on discussions and/or recommendations of the various interested segments of the aviation community, including:

1. Aircraft manufacturers (GAMA and commercial aircraft).
2. Aircraft users' and operators (ATA, airlines, air taxi).
3. Pilot organizations (ALPA, NPA, AOPA).
4. Government laboratories and agencies (NOAA, NASA, FAA, NTSB, DOD).
5. Aviation safety foundations and laboratories (FSF, University of Illinois, etc.).

The results of this analysis will be used to identify an updated model of the operational wind shear hazard which could be used to assess the efficacy of proposed technological and procedural countermeasures to the wind shear problem.

Your gratuitous suggestions and recommendations in developing the meteorological and accident/incident factors for initial automatically screening of existing pertinent digitally-stored data and approach in evaluating the available data would be greatly appreciated.

The NAFEC project manager assigned to this program is Jack J. Shrager, ANA-430. He may be reached by phone as follows:

Commercial: 609-641-8200, Extension 2665/2644
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We would appreciate your response in our effort to achieve a meaningful aviation safety-oriented analysis of historical data which would produce cost-effective results with respect to the low-altitude wind shear problem.

GEORGE P. BATES, JR.

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APPENDIX C

EXTRACTS FROM AVAILABLE DOCKET EXAMINATIONS OF ACCIDENTS/ INCIDENTS LISTED IN TABLE 5

DOCKET NO. 3-0067

The Luscombe 8E accident which happened in Fort Benton, Montana on January 6, 1964, occurred at 16:00 Mountain Standard Time (MST), 23:00 Greenwich Mean Time (GMT), during an observed sudden wind squall. The nonfatal accident transpired during a VFR landing on runway 22 at the Fort Benton Airport. The airport is located to the west of the Missouri River with the runway parallel to the river. The northeast/southwest river valley is about 16-miles wide at this point with slightly elevated terrain (approximately 200 feet) along the north, east, and west limits of the river valley.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Witness	16:00	25	20	29	25	--	--	--	35	--

The fixed-base operator of the airport witnessed the accident and reported that the aircraft was struck by a "wind shift squall" during the landing roll. He reported that during the approach and touchdown the wind was aligned with the runway (approximately 220°), and suddenly shifted to 270°.

The pilot reported that a sharp gust raised the right wing but that the aircraft was moving too slow to effect a safe recovery.

It is not possible to discount low-level wind shear as a potential weather factor. However, the cause of the wind shift cannot be determined from the information available in the accident file.

The pilot involved in the accident had 900 hours of total experience, 300 of which were in this aircraft make and model.

DOCKET NO. 3-0628

The Cessna 172 accident which happened in Farmers, Kentucky on March 16, 1964, occurred at 15:55 Central Standard Time (CST), 21:55 GMT, during conditions conducive to downdraft. The nonfatal accident transpired during a VFR approach and landing on runway 23 at the Morehead Rowan County Airport. The airport is located on top of a 845 foot hill. The rough terrain rises to a height of 1,435 feet 4 miles due east of the airport. The terrain slope gradient at the runway threshold is approximately 15°.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Witness	15:55	--	--	27	15	20	--	--	--	--
Pilot	15:55	--	--	26	15	25	--	--	--	Gusty

The location of this airport is shown in the Cincinnati sectional aeronautical chart, which shows it to be on a hill with downsloping terrain at each end of the runway. The pilot reported encountering a downdraft approximately 1,000 feet short of the runway. This encounter of orographically-induced, low-level wind shear is not unexpected in hilly or mountainous terrain. Since the pilot had departed this airport for a local flight, it is assumed that he should have had some knowledge of the influence of the terrain on the local air mass. However, the pilot's knowledge or experience in the local area does not alter the potential for the presence of a low-level wind shear at the time of the accident.

The pilot involved in the accident had 220 hours of total experience, 15 of which were in this aircraft make and model.

DOCKET NO. 3-0787

The Stinson 108 accident which happened in Oroville, California on April 2, 1964, occurred at 15:45 Pacific Standard Time (PST), 23:45 GMT, during a sudden wind shift. The nonfatal accident transpired during a VFR takeoff on runway 30 at the Oroville Municipal Airport. There was an observed thunderstorm east of the airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:45	--	30 T	36	25	--	--	--	60	Sudden wind shift
Witness	15:45	--	--	36	--	--	--	--	--	Sudden wind shift from 360° to 090° and becoming gusty

The pilot reported that he encountered a sudden wind shift just at liftoff due to a squall line and the aircraft went out of control.

The pilot involved in the accident had 1,100 hours of total experience, all of which were in this model of aircraft.

DOCKET NO. 3-0828

The Fairchild 24W accident which happened in Bellaire, Michigan on April 5, 1964, occurred at 17:20 CST, 23:20 GMT, during alleged downdraft conditions. The nonfatal accident transpired during a VFR approach and landing on runway 2

at the Antrim County Airport. The airport is located in an area of gently rolling terrain. The current (May 1978) Airport/Facility Directory has notations which indicates trees along all of the approachs (02-13-20-31).

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	17:20	Clear	15	7	15	30	--	--	44	Strong downdraft

The pilot reported that he encountered turbulence during his approach over 60-foot high pine trees into a right quartering headwind. This relatively small municipal airport is protected along all of the approachs by pine trees. During high winds, this type of topography can produce variability in wind direction and speed within the "protected" area and downdrafts or updrafts in close proximity to the tree line. Therefore, topographic wind-shear conditions cannot be discounted as a weather factor.

The pilot involved in the accident had 1,980 hours of total experience, 500 of which were in this aircraft make and model.

DOCKET NO. 3-1144

The Piper PA-24 accident which happened in Woodland, California on May 3, 1964, occurred at 18:05 PST, 02:05 GMT, during sudden wind shift conditions. The nonfatal accident transpired during a VFR approach and landing on runway 36 at the Woodland/Watts Field. There was an observed thunderstorm 2 miles north of the airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	18:05	Clear	5	33	15	30	--	--	50	Sudden windshift from 090° to 330° with strong updraft followed by strong downdraft

The pilot reported that the air was unstable at pattern altitude and he observed the wind tee change from 090° to 330° during the downwind leg. He elected to make a no flap approach at a higher than normal airspeed because of the observed wind conditions (110 IAS). At a distance of 1/4 mile from the threshold the aircraft was lifted to an altitude of 400 feet (this would represent a rapid increase in altitude of 100 to 150 feet if the aircraft

were on a 3° glide slope). The aircraft then encountered a downdraft which caused it to hit the gravel (altitude loss was 400 feet during which the aircraft had moved forward only 150 feet).

Witnesses who were at the airport before, during, and after the time of the accident report that the wind changed from a south wind, to calm, and then to a northerly wind about the time of the accident. These witnesses also reported seeing a heavy "rain curtain" and thunderstorms north of the airport. The pilot's report, substantiated by statements of independent witnesses confirmed the existence of conditions which could be the result of a gust front or outflow associated with thunderstorm activities.

The pilot involved in the accident had 690 hours of total experience, 590 of which were in this aircraft make and model.

DOCKET NO. 3-1204

The Cessna 170 accident which happened in Baker, Nevada on May 8, 1964, occurred at 13:00 PST, 21:00 GMT, turbulent wind conditions. The nonfatal accident transpired during a VFR takeoff and initial climb on an east/west secondary road 3 miles west of Baker (8 miles northwest of Garrison Utah). The elevation of the takeoff site was approximately 6,400 feet. The takeoff was in the direction of Mount Wheeler (13,063 feet high) which was 7 nmi to the west.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	13:00	--	--	27	25 +	--	--	--	--	--

The pilot took off from a secondary road with an uphill gradient into a moderate to strong headwind. A right turn at 100 feet was slowly initiated to avoid rapidly rising terrain. Although entering a gradual right turn, the aircraft suddenly "stood" on its left wing. The pilot's report indicated that he attributed this sudden change of altitude to a strong gust. The aircraft's relatively low altitude and close proximity to rapidly rising very-high terrain would have placed the aircraft on the lee side of a strong orographic shear. The aircraft's response suggests that in fact this may have occurred.

The pilot involved in the accident had 900 hours of total experience, 800 of which were in this aircraft make and model.

DOCKET NO. 3-1798

The Piper PA-18 accident which happened in Sidney, New York on June 24, 1964, occurred at 18:45 Eastern Standard Time (EST), 23:45 GMT, during gusty wind conditions. The nonfatal accident transpired during a VFR landing and initial climb on runway 25 at the Sidney Municipal Airport. There is a low tree-lined downslope on the left side of the runway and taller trees on the same side beyond the lower ones.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
USWB	17:57	E 50 ⊕	15	33	18	23	--	29.83	69	Binghamton weather 28 nmi sw of Sidney
USWB	18:32	E 50 ⊕	15	--	--	--	--	--		Binghamton weather
Pilot	18:45	Clear	Unlimited	27	6	--	--	--	70	--
USWB	18:56	E 55 ⊕	15 +	33	11	--	--	29.87	66	Binghamton weather

The pilot reported that he compensated for the slightly right crosswind and encountered a severe gust in the early portion of the landing roll. The aircraft pitched up and yawed to the left. The pilot immediately applied power to execute a go-around. The aircraft remained airborne and drifted over the downslope and low tree line. When it became obvious that the aircraft would not avoid or clear the higher trees, the pilot executed a full stall landing in the trees. An eye witness to the accident reported that the aircraft encountered a strong gusting wind condition on both the approach and during the initial rollout. The former encounter appeared to reduce both the sink rate and ground speed to zero prior to flare, and the second gust lifted the aircraft several feet into the air with the right wing high. There is insufficent information in the accident files to identify the cause of these high gusts. However, the terrain and low tree line on the left side of the runway would be conducive to the production of a downflow, thus decrease an aircraft's rate of climb. The pilots and eye witness's statements support this possibility. Therefore, topographic wind shear cannot be precluded.

The pilot involved in the accident had 300 hours of total experience, 6 of which were in this aircraft make and model.

DOCKET NO. 3-2761

The Piper PA-16 accident which happened in Cotulla, Texas on September 4, 1964, occurred at 15:00 MST, 22:00 GMT, during thunderstorm activity. The nonfatal accident transpired during a VFR landing on runway 36 at the Rancho Felice Strip (5 miles south of Cotulla).

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:00	60	25 RW -	Calm	--	--	--	--	85	Strong downdraft

The pilot made a precautionary landing at a private airport due to very heavy rain showers in the immediate area. The public airport at Cotulla was already "socked in" by rain. On final approach the pilot observed the wind sock on the south end of the runway was limp. At the touchdown the wind picked up and was gusty. During rollout the wind shifted to a right quartering tailwind and the pilot was unable to maintain directional control. The sequents of events and the observed meteorological conditions suggest a low-level wind shear encounter that was associated with thunderstorm activity and heavy rainshowers.

The pilot involved in the accident had 500 hours of total experience, 30 of which were in this aircraft make and model.

DOCKET NO. 3-3668

The Piper PA-22 accident which happened in Taylorville, Illinois on September 22, 1964, occurred at 15:00 CST, 21:00 GMT, during shifting wind conditions associated with thunderstorm activity. The nonfatal accident transpired during a VFR landing on runway 36 at the Taylorville Municipal Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:00	40	15	36	5	--	--	--	75	Sudden windshift
USWB	15:00	--	--	--	--		--	--	--	Weather unstable in Springfield/Taylorville area-thunderstorm activity (Springfield weather bureau)

The pilot reported a sudden windshift from 360°/5 kn to 180°/35 kn. He observed a rainstorm about 4 miles south of the airport. The FAA investigator contacted the U.S. Weather Bureau at Springfield (26 nmi northwest of Taylorville) and they reported a very unstable air mass in the Springfield Taylorville area with thunderstorms and related strong shifting wind conditions.

The pilot involved in the accident had 2,700 hours of total experience, 60 of which were in this aircraft make and model.

DOCKET NO. 3-2511

The Cessna 182A accident which happened approximately 30 miles south southwest of Browning, Montana on June 27, 1965, occurred at 17:00 MST, 24:00 GMT, during reported strong gusty wind conditions. The nonfatal accident occurred during a second VFR landing attempt on runway 35 of the Schafer U.S. Forrest Station Airport. The first landing was aborted due to strong updrafts.

The pilot and witnesses estimate of prevailing weather conditions at the time of the landing was:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot and Witness	17:00	Clear	50	270	30	35	--	--	--	Strong updrafts and downdrafts

The accident location is in a very mountainous terrain where the strong updrafts and downdrafts under high-wind conditions are often cause for professional pilots to refuse a given trip. Orographic wind shear can not be ruled out as a weather factor.

The pilot involved in the accident has a total of 1,941 hours experience with at least 900 hours in this make and model aircraft.

DOCKET NO. 3-1978

The Piper PA-24 accident at Lucy, New Mexico on July 23, 1965, occurred at 13:30 MST, 20:30 GMT, during reported downdrafts and a wind shift associated with thunderstorm activity. The nonfatal accident occurred during a right crosswind takeoff and initial climb from runway 4 of the Berry Ranch.

The pilot's estimate of the local weather at the time of the accident was:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	13:00	20	10	14	15	--	--	--	85	TRW + 2 nmi north

After leaving the airplane, the pilot observed a wind shift of approximately 180° followed very shortly by a rainstorm.

The pilot's diagram of the terrain and accident site shows a hill to the right of the takeoff path which would have placed the initial climb on the lee side of the airmass. The reported downdraft and change in both wind direction and windspeed reported by the pilot could have been due to either orographic

shear, a gust front associated with the thunderstorm and heavy rainshower, or both. Thus, the possible presence of a low-level wind shear cannot be ruled out.

The pilot/owner involved in the accident had over 2,000 hours total experience with at least 1,800 hours in this make and model aircraft.

DOCKET NO. 3-2707

The Cessna 170B accident which happened near Takotna, Alaska on July 25, 1965, occurred at 08:00 Alaskan Standard Time (AST), 18:00 GMT, during reported strong wind conditions. The nonfatal accident transpired during a VFR takeoff and initial climb in a southerly direction of a north/south 700-foot long sand bar. There was a tree line along the east side of the sand bar and the river hooked to the left under the departure path of the aircraft.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	08:00	30 + ⊕	16	18	10	20	--	--	--	Gusty

Based on the reported direction of the wind, this would have the aircraft taking off in the direction of the lee side of an airmass system anchored by Mt. Joaquin (3,002 feet high) located to the southwest and Mt. Takotna (3,203 feet high) located to the southeast. In addition, the aircraft departure path was over the river which at the time of the accident would be cooler than the surrounding landmass. Both of these conditions would complicate a short field takeoff procedure even though the aircraft was at approximately the best angle of climb speed.

An evaluation of the information in the docket and the topography of the accident site area as shown in the McGrath sectional aeronautical chart suggests that orographic and/or topographic low-level wind shear may have been a weather factor.

The pilot involved in the accident had 12,000 hours of total experience, 300 of which were in this aircraft make and model.

DOCKET NO. 3-2545

The Cessna 182H accident which happened in Butte, Montana on August 10, 1965, occurred at 15:15 MST, 22:15 GMT, during reported thunderstorm activity. The nonfatal accident transpired during a VFR approach and landing on runway 15 at the Bert Mooney Silverbow County Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
USWB	15:00	100 ⊕	30 T	15	8	--	--	30.12	83	TS
Pilot	15:15	84 ⊕	20 T	33	16	20	--	--	70	Sudden windshift
USWB	15:15	100 ⊕	30 T	33	12	--	--	30.12	83	Gusty

The pilot reported that he encountered a sudden wind shift and downdraft just as he rounded out. The aircraft hit the ground at a higher than normal airspeed and the pilot elected to go around. The second landing was uneventful.

The accident investigator reported that the accident was in part due to the pilot's inexperience in coping with the sudden wind shift which was due to the gust front associated with local thunderstorm activity. Based on this information, the exsistance of a gust-front-associated, low-level wind shear cannot be precluded.

The pilot involved in the accident had 140 hours of total experience, 4 of which were in this aircraft make and model.

DOCKET NO. 3-4018

The Cessna 180F accident which happened in the Agiak Lake, Alaska on August 18, 1965, occurred at 15:15 AST, 01:15 GMT, during possible orographic wind shear conditions. The nonfatal accident transpired during a VFR takeoff on a southerly water departure at the Agiak Lake. The southerly takeoff followed an aborted easterly takeoff. The abort was due to a sudden wind shift during the attempted easterly takeoff.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:15	50	30	18	15	--	--	--	45	--

The accident occurred during a takeoff which would have placed the departure path on the lee side of a mountain peak which was approximately 3,300 feet above the lake's elevation and 4 miles to the south. The lake is located in a very mountainous area. There was a low ridge on the south side of the lake which could have also influenced the airmass. Therefore, it is not possible to rule out the presence of an orographic shear.

The pilot involved in the accident had 4,000 hours of total experience, 2,000 of which were in this aircraft make and model.

DOCKET NO. 3-2976

The Boeing E-75 accident which happened in Hereford, Texas on October 14, 1965, occurred at 07:15 CST, 13:15 GMT, during reported warm frontal activity. The nonfatal accident transpired during a VFR initial climb following a departure at the Hereford Municipal Airport. The sharp downdraft was encountered at an altitude of 200 feet approximately 1/2 mile west of the airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	07:15	30 ●	15	32	20	--	--	--	60	Gusty
Witness	07:15	--	--	32	25	30	--	--	--	Turbulence, strong downdraft

There were two aircraft involved in this planned agricultural spray activity. The pilot observed the lead aircraft start to lose altitude and dump his spray which allowed the aircraft to recover. By this time his aircraft encountered the same downdraft but the spray did not discharge before the aircraft hit the ground.

The information contained in the accident docket suggests a headwind-to-tailwind shear due to the warm front may have been a weather factor. Thus, a low-level wind shear due to frontal activity cannot be precluded.

The pilot involved in the accident had 10,000 hours of total experience, 9,500 of which were in this aircraft make and model.

DOCKET NO. 3-3316

The Aeronca 7GCB accident which happened in Twin Lakes, Alaska on October 3, 1965, occurred at 13:30 AST, 23:30 GMT, during strong northeast gusty wind conditions. The nonfatal accident transpired during a VFR takeoff on a northeast heading at the west lake of Twin Lakes. The reported wind direction would place the takeoff path on the lee side of a mountain peak which rises 3,000 feet above the lake and is less than 2 miles northeast of the lake.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	13:30	Clear	20	5	30	40	--	--	40	Gusty

The investigator's report confirmed that strong northeast winds in the Merrill Pass area would produce "strong, erratic, gusty winds". Based on the accident

report and on evaluation of the surrounding terrain shown on the McGrath Sectional Aeronautical Chart, low-level orographic wind shear was a possible weather factor.

The pilot involved in the accident had 166 hours of total experience, 9 of which were in this aircraft make and model.

DOCKET NO. 2-1020

The Cessna 170B accident which happened in Pendleton, Oregon on December 30, 1965, occurred at 12:30 PST, 20:30 GMT, during variable and strong crosswind conditions. The fatal accident transpired during a VFR takeoff and initial climb on runway 25L at the Pendleton Municipal Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
USWB	11:58	50 Ⓓ 80 Ⓑ	40	21	15	--	--	29.54	45	Heavy cumulus and showers all quadrants
USWB	12:31	50 Ⓓ E 80 Ⓑ	40	24	17	--	--	29.54	--	Heavy cumulus and showers all quadrants
USWB	12:58	50 Ⓓ E 80 Ⓑ	40	22	17	--	--	29.54	46	Heavy cumulus and showers all quadrants
LCS	12:29	--	--	21	15	25	--	29.54	--	

The information in the accident files indicate that the pilot was given a departure on which would have given him a 40° left quartering headwind with gusts to 25 knots. The departure runway assigned to the pilot was 25L which was 4,300 feet shorter than 25R and it is in parallel to a line of buildings which is approximately 300 feet to the left of 25L centerline. Local pilots reported they have experienced turbulent eddy currents on 25L generated by wind flowing around the hangers and terminal building. Based on the reported winds, it is not possible to preclude the presence of topographic wind-shear conditions at the time of this accident.

The pilot involved in the accident had 408 hours of total experience, 150 of which were in this aircraft make and model.

DOCKET NO. 3-1156

The Cessna 175 accident which happened in Anthony, New Mexico on May 21, 1966, occurred at 17:30 MST, 00:30 GMT, during reported and observed strong and turbulent wind conditions. The nonfatal accident transpired during a VFR approach and landing on north/south runway at the Fred Smith Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	17:30	60 ⊕ ●	50	27	20	35	--	--	90	Heavy turbulence and shifting winds

The accident occurred following a delayed arrival at the single strip Fred Smith Airport. The arrival was delayed by the pilot initially landing at an alternate public airport due to the high winds encountered en route to Fred Smith Airport. At the threshold of the runway there is a 3-foot-high dike and a 6-foot-deep ditch. With the strong winds, the topography at the threshold could have aggravated the reported turbulent conditions. Thus, topographic shear conditions cannot be precluded.

The pilot involved in the accident had 474 hours of total experience, 474 of which were in this aircraft make and model.

DOCKET NO. 3-1912

The Piper PA-28-140 accident which happened in Jacksonville, Florida on May 28, 1966, occurred at 16:00 EST, 21:00 GMT, during reported and observed thunderstorm activity. The nonfatal accident transpired during a VFR approach and landing on runway 25 at the Herlong Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
USWB	16:30	30 ●	10	15	14	--	--	976	83	Cumulus E.S.W.
Pilot	16:00	25	8 T	20	12	20	--	--	80	Squall line approaching airport

According to the accident report, the student pilot encountered a sudden wind shift with a resultant strong crosswind just before touchdown. The Jacksonville Weather Bureau (13 miles northeast of Herlong) reported cumulus buildups in that general location in their 16:30 report. Therefore, the presence of thunderstorm-associated, low-level wind shear at the time of the accident was possible.

The pilot involved in the accident had 18.5 hours of total experience, all of which were in this type of airplane.

DOCKET NO. 3-1330

The Cessna 170B accident which happened in La Porte, Texas on May 29, 1966, occurred at 16:25 CST, 23:25 GMT, during reported thunderstorm activity.

The nonfatal accident transpired during a VFR landing on runway 12 at the La Porte Municipal Airport. Cumulus buildups were reported by the Houston U.S. Weather Bureau in their regular report at 15:58. This station is approximately 12 miles west of La Porte.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
USWB	15:58	45 ⓓ E 120 ⓞ	12	26	8	--	105	983	86	(Houston)
USWB	16:30	M 45 ⓞ 120 ⓕ ⓞ	12	16	11	--	--	984	--	(Houston)
USWB	16:57	M 40 ⓞ 120 ⓞ	12 T	16	15	--	108	984	76	TS NE moving SE (Houston)
USWB	17:30	M 40 ⓓ E 120 ⓞ	12	09	12	--	106	--	78	(Houston)
Pilot	16:25	45 ⓞ	12	18	26	30	--	984	86	--

The pilot indicated that as he entered his downwind leg, the wind was from 130°, but at the time of his landing the wind shifted to 180° at 26 kn with gusts to 30 kn. The thunderstorm activity noted in the 16:57 Houston U.S. Weather Bureau's surface observations would be in the approximate location of the La Porte Airport. Therefore, it is impossible to rule out the presence of low-level wind shear normally associated with thunderstorm activity.

The pilot/owner, who was involved in the accident, indicated that he was current in this type and make of aircraft. However, he did not indicate on the Form 453 the exact time-in-type.

The pilot involved in the accident had 600 hours of total experience.

DOCKET NO. 3-2311

The Helio H-250 accident which happened in Northville, New York on June 29, 1966, occurred at 14:45 EST, 19:45 GMT, during reported turbulent and gusty wind conditions. The nonfatal accident transpired during a VFR takeoff and initial climb on a southwest departure at the Sand Lake. The lake is surrounded by mountains with trees as high as 80 feet at the departure end of the lake. The purpose of the flight was a checkout of a professional pilot for commercial operations in the area.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	14:45	Clear	--	27	12	18	--	--	80	--

The lake had 6- to 8-inch waves due to the local wind conditions. The takeoff was made with a left quartering gusty headwind. The high trees at the edge of the lake could have produced topographic wind shear in their vicinity. In addition, the mountainous terrain could have produced orographic shear. The investigator indicated that this could be considered a calculated-risk-type operation. The presence of low-level wind shear conditions as a contributing weather factor cannot be ignored.

The pilot involved in the accident had 1,851 hours of total experience, 6 of which were in this aircraft make and model.

DOCKET NO. 3-2414

The Beechcraft A-35 accident which happened in Denver, Colorado on August 11, 1966, occurred at 16:45 MST, 23:45 GMT, following a rainshower. The nonfatal accident transpired during a VFR takeoff and initial climb on runway 35 at the Stapleton International Airport. The departure was delayed 30 minutes at the pilot's request because of a heavy rainshower.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Witness	16:45	10 TRW + 80©	3	10	20	--	--	29.40	80	Gusty

Following a delayed departure, the aircraft was stabilized on a 400 foot per minute rate of climb at 105 mph indicated airspeed. The rate of climb diminished to a sink rate of 700 feet per minute. Minimum control speed was maintained but sink rate could not be arrested at maximum power. The aircraft impacted a clear area on the airport. The FAA investigator reported that he was on an ILS approach at Stapleton immediately prior to the accident and encountered strong downdrafts and a wind shift. Fortunately he had sufficient power to climb away. The official weather information was not in the docket.

This accident has many of the characteristics of another accident which occurred at this airport 9 years later, August 7, 1975. In that air carrier accident, low-level wind shear was identified as the probable cause of the B727 accident.

The pilot involved in the accident had 4,000 hours of total experience, 300 of which were in this aircraft make and model.

DOCKET NO. 3-2064

The Navion NA-1 accident which happened in Oklahoma City, Oklahoma on August 13, 1966, occurred at 16:20 CST, 22:20 GMT, during reported gusty and shifting wind conditions. The nonfatal accident transpired during a VFR landing on runway 12 at the Will Rogers Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
LCS	16:05	20	4	35	20	--	--	--	--	--
USWB	16:22	E 15⊕ 27⊕	10 RW	8	17	26	--	992	--	--
USWB	17:00	M 25⊕	12	8	13	--	--	993	--	--
Pilot	16:20	20⊕	4 TRW -	35	20	30	--	--	71	--

The local controller initially advised the pilot that runway 3 was in use. After the aircraft was observed southeast bound, the controller advised the pilot to enter a downwind for runway 12, wind 080° at 18 kns. The change in the active runway is indicative of a variable wind condition at the time of the accident. With the presence of thunderstorm and rainshower activity at the time, the presence of a low-level wind shear can't be discounted.

The pilot involved in the accident had 100 hours of total experience, 85 of which were in this aircraft make and model.

DOCKET NO. 3-3357

The Cessna 170B accident which happened in Maple Lake, Minnesota on August 17, 1966, occurred at 17:00 CST, 23:00 GMT, during an observed sudden wind shift. The nonfatal accident transpired during a VFR landing on runway 28 at the Maple Lake Municipal Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	17:00	Unlimited	Unlimited	28	5	--	--	--	80	Sudden wind shift
USWB	--	--	--	--	--	--	--	--	--	Minneapolis weather bureau reported thunderstorm activity in the vicinity of Maple Lake
Investigator	--	--	--	32	5	13	--	--	--	--

The pilot reported that on the downwind leg of his approach to runway 28, the windsock went limp. Prior to this time the windsock showed the light wind to be aligned with the runway. Just at roundout, a severe gust caused the aircraft to drift toward the left. The FAA investigator indicated that the Minneapolis Weather Bureau reported thunderstorms in the vicinity of Maple Lake and to the west and southwest of Minneapolis. Based on this information, low-level wind shear conditions which may be associated with thunderstorm activity cannot be ruled out as a weather factor.

The pilot involved in the accident had 297 hours of total experience, 60 of which were in this aircraft make and model.

DOCKET NO. 3-3316

The Piper PA-24-250 accident which happened in Sheboygan, Wisconsin on October 3, 1966, occurred at 12:30 CST, 18:30 GMT, during reported gusty wind conditions. The nonfatal accident transpired during a VFR landing on runway 13 at the Sheboygan County Memorial Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	12:30	60	10	17	22	28	--	--	68	--
USWB	12:20	8 80 ●	15 T	21	15	20	--	--	--	Gusts throughout area between 20 and 27 kns (Milwaukee special weather report 40 miles to south)
LTC	12:00	--	--	--	--	--	--	--	--	Milwaukee radio report pilot weather report (PIREP) of severe thunderstorm 25 miles southwest of Best Bend moving northeast

According to the accident docket, the pilot reversed his planned course due to the reported thunderstorm activity. The pilot reported encountering strong gusts during the landing which contributed to the accident.

The reported thunderstorm activity, which would have been in the Watertown area, was in the Milwaukee area 20 minutes later. The distance between Watertown and Milwaukee is about 35 miles. The distance between Watertown and Sheboygan is approximately 53 miles. Thus, the possibility of a gust front from the reported thunderstorm being in the Sheboygan area cannot be precluded.

The pilot involved in the accident had 286 hours of total experience, 38 of which were in this aircraft make and model.

DOCKET NO. 3-3770

The Maule M-4 accident which happened in Mount Pleasant, Pennsylvania on November 20, 1966, occurred at 16:20 EST, 21:20 GMT, during reported downdrafts. The nonfatal accident transpired during a VFR approach and landing on runway 14 at the Mount Pleasant Scottdale Airport. The airport is located on the top of rising terrain, to the east of which is a deep ravine.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	16:20	50	10 +	9	5	--	--	--	--	--
Witness	16:20	50	10 +	14	5	10	--	--	40	--

The pilot indicated that he encountered a downdraft approximately 100 feet short of the runway while on a stabilized approach. This is the approximate location of a 100-foot-deep ravine. This was the first time the pilot had flown into this airport.

The accident investigator's report indicated that the terrain in the approach zone was such that it, "probably created a mechanical or convectional down current just short of the runway." Based on the pilot and investigator's reports, a low-level wind shear due to the topography could have been a factor in this undershoot accident.

The pilot involved in the accident had 500+ hours of total experience, 15 of which were in this aircraft make and model.

DOCKET NO. 3-4350

The Piper PA-14 accident which happened 12 miles east of Homer, Alaska on November 30, 1966, occurred at 15:15 AST, 01:15 GMT, during strong winds with associated updrafts and downdrafts. The nonfatal accident transpired during a VFR takeoff and initial climb on a frozen lake at the Grewingk Glacier. To the west of the lake is rapidly rising terrain.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:15	Clear	Unlimited	30	20	30	--	--	--	Strong updrafts and downdrafts

The pilot took off into the wind and reported encountering a gust which lifted the aircraft a few feet before setting the aircraft down again on the frozen lake bed. As the takeoff roll continued, the aircraft encountered a second strong updraft which took the aircraft up to an altitude of approximately 200 feet. This was approximately the height of the terrain surrounding the immediate vicinity of the lake. The aircraft then encountered an equally strong downdraft about 15 feet from the end of the lake and landed on a 45° rising snow-covered slope.

Based on the report of the pilot, the passenger witness statement, and the topography of the accident site as shown on the Steward sectional aeronautical chart, the possible presence of a topographic low-level wind shear encounter cannot be ignored.

The pilot involved in the accident had 1,263 hours of total experience, 320 of which were in this aircraft make and model.

DOCKET NO. 3-0185

The Cessna 305A accident at Cedar Hill, Texas on January 22, 1967, occurred at 13:05 CST, 19:05 GMT, during strong gusty crosswind conditions. The nonfatal accident occurred during a VFR landing on runway 17 of the TSA Gliderport.

The limited weather information contained in the docket contained the pilot's estimate of conditions at the time of the accident which was:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	13:05	Clear	15 +	210	30	40	--	--	75	Turbulent-gusty

The pilot's sketch of the airport and runway shows a group of hangers and a large building along the right side of runway 17. These structures terminate just about where the aircraft started to drift to the left. These structures are so located that they could have influenced the flow field of the airmass. Thus, the possibility of a low-level wind shear due to topography cannot be precluded.

The pilot involved in the accident had over 1,200 hours total experience of which at least 200 were in this type of aircraft.

DOCKET NO. 3-0404

The Porterfield LP-65 accident which happened in Agua Dulce, California on February 5, 1967, occurred at 11:30 PST, 19:30 GMT. The nonfatal accident transpired during a VFR takeoff and initial climb from runway 5 at the Agua Dulce Airpark. The airport which has an elevation of 2,680 feet is located 4 nmi south southwest of a 5,217-foot mountain.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	11:30	Clear	30 +	NE	15	--	--	--	65	--

The pilot reported encountering a strong downdraft at 200 feet and an indicated airspeed of 60 mph. There is rapidly rising terrain less than 1 mile northeast of the airport which is known to produce severe downdrafts. The pilot's report indicates that the aircraft was in a descent rate of 300 feet per minute which he was unable to arrest. The airmass flow over the hill northeast of the airport could present a low-level orographic wind shear under the conditions reported in the accident docket.

The pilot involved in the accident had 183 hours of total experience, 6 of which were in this aircraft make and model.

DOCKET NO. 3-0745

The Champion 7GCBC accident which happened near Savageton, Wyoming on February 28, 1967, occurred at 12:15 MST, 19:15 GMT, during gusty wind conditions with strong downdrafts. The nonfatal accident transpired during a VFR takeoff and initial climb near Pumpkin Buttes at a radio tower construction site. The takeoff was from the table top of the 6,000-foot-high butte which fell away fairly rapidly to a hilly terrain that had an average height of 5,000 feet mean sea level (msl).

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	12:15	Clear	--	25	25	30	--	--	40	Windy and gusty

The pilot encountered strong downdrafts and gusty wind conditions immediately after liftoff. The aircraft started to descend into a ravine more rapidly than the rate of terrain dropoff. The aircraft struck a tree about 6 feet below the top, which sheared off and temporary lodged in the landing gear. The pilot was able to regain control of the aircraft and proceeded to the nearest public airport Gillette, (42 nmi to the northeast). En route, the sheared portion of the tree was dislodged and the aircraft landed without further incident. According to the FAA investigator, winds are often severe and gusty in that part of Wyoming. The local topography in the area of the takeoff could have produced localized low-level wind shear conditions.

The pilot involved in the accident had 3,000 hours of total experience, 250 of which were in this aircraft make and model.

DOCKET NO. 3-0864

The Taylorcraft DCO accident which happened in Soledad, California on March 4, 1967, occurred at 12:00 PST, 20:00 GMT, during orographic wind-shear conditions. The nonfatal accident transpired during a VFR approach and landing on a missed approach for runway 5 at the Pinnacle Airstrip. This airport is no longer shown on any of the current aeronautical charts. However, Soledad is in a very hilly area at a mean elevation of 1,600 feet with mountain peaks 2 to 4 nmi in all directions at heights of 4,200 feet.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	12:00	Clear	Unlimited	36	15	20	--	--	55	Turbulent

The pilot was attempting a landing with a wind coming over a hill. Due to the airmass movement, it became obvious to the pilot that the touchdown point on the 2,500 foot long runway would be too far down the length. A go-around was initiated. Upon passing the end of the runway, the pilot encountered a downdraft due to the influence another hill was having on the local airmass. Recognizing that the aircraft would not clear the hilly terrain, the pilot exectuted an emergency landing on the side of the hill. The FAA investigator indicated that the conditions reported by the pilot were substantially correct and the pilot did a commendable job under the circumstances.

The pilot involved in the accident had 450 hours of total experience, 450 of which were in this aircraft make and model.

DOCKET NO. 3-1325

The Boeing E75 accident which happened near Gueydan, Louisiana on April 24, 1967, occurred at 15:30 CST, 21:30 GMT, during reported thunderstorm activity. The nonfatal accident transpired during a VFR takeoff and initial climb on a southerly heading at the Carl Hoffpauir Airstrip. The private agricultural airstrip is 7 nmi west northwest of Gureydan (approximately 24 nmi on the 100 radial of the Lake Charles (LCH) very high frequency omnirange station (VOR), and 35 nmi on the 240 radial of the Lafayette (LFT) VOR.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:30	Clear	Unlimited	5	--	--	--	--	75 +	Turbulent
LCH	15:00	M 38●	7	11	6			30.00	86	Weather bureau at Lake Charles
LCH	16:00	E 40●	10	8	9	--	--	29.99	84	--
LFT	15:00	40 ⊕	7	13	13	--	--	30.01	86	Weather bureau at Lafayette
LFT	16:00	E 4●/●	7	3	13	--	--	30.00	85	--

The pilot reported an abrupt wind shift just about the time of liftoff and the aircraft settled back in a pastured rice field. The official weather stations to both the east and west of the accident site reflect a wind shift between their normal hourly surface observations. Thus, a possible low-level wind shear which would be associated with thunderstorm activities cannot be ruled out.

The pilot involved in the accident had 2,000 hours of total experience, 1,500 of which were in this aircraft make and model.

DOCKET NO. 3-1346

The Aeronca 7AC accident which happened in Dodge City, Kansas on April 29, 1967, occurred at 19:00 CST, 01:00 GMT. The nonfatal accident transpired during a VFR approach and landing on runway 14 at the Wilroads Garden Airport. This private airport has one NW/SE (32/14) sod runway 2,000 feet long by 100 feet wide. The airport is surrounded by trees over 40 feet in height.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	19:00	Clear	8	14	40	--	--	--	55	Gusty and turbulent

The pilot was holding a heading of 180° on final above the trees. As he dropped below the trees, the aircraft became difficult to control. The aircraft hooked it's left wing and damaged the left strut. The FAA investigator indicated that under the prevailing wind conditions there would be severe turbulence below the tree tops. Topographic wind shear conditions can't be precluded.

The pilot involved in the accident had 235 hours of total experience, 80 of which were in this aircraft make and model.

DOCKET NO. 3-0053

The Piper PA-11 acident at Earlville, Illinois on January 15, 1968, occurred at 13:00 CST, 19:00 GMT, during reported gusty wind conditions. The nonfatal accident occurred during a VFR takeoff on the northwest runway of the Boston Strip Airport.

The pilot's report was the only weather information contained in the docket which indicated the following:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	13:00	Clear Unlimited	4	36	25	32	--	30.07	30	--

The pilot's accident report indicates that a right quartering headwind was encountered during the takeoff roll after the aircraft passed beyond the shielding effect of the building. These buildings, which were adjacent to the right side of the runway, resulted in the aircraft effectively encountering a topographic wind shear which forced the aircraft to slide off the left side of the snow covered runway into a plowed area.

The pilot involved in this accident was a high-time pilot (1,600 hours) with considerable experience in this make and model of aircraft (700 hours).

DOCKET NO. 3-0068

The Cessna 170B accident at Harding, South Dakota on January 18, 1968, occurred at 11:00 CST, 17:00 GMT, during reportedly strong right quartering headwinds. The nonfatal accident occurred during a VFR landing on the south end of the N-S strip of the +J ranch.

The pilot's report of weather information at the time of the accident was limited to the following:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	17:00	Clear	30	22.5	30	35	--	--	50	--

The pilot's accident report indicates that the landing was to the left of a row of hay stacks and a line of standing timber. The ground loop occurred when encountering a funneled direct crosswind which was produced by cattle sheds which were north of the standing timber located east of the runway. The topographic shear was encountered as the aircraft rolled past the end of the hay stacks that were to the right of the runway.

The pilot involved in this accident was a high-time pilot (3,500 hours) with at least 180 hours experience in this make and model aircraft.

DOCKET 3-0817

The Cessna 180 accident at Skagway, Alaska on February 18, 1968, occurred at 10:30 PST, 18:30 GMT, during reported high-wind conditions. The nonfatal accident occurred during a VFR takeoff on runway 01 of the Skagway Airport.

The limited weather information contained in the docket was supplied by the pilot which indicated:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	10:30	80⊕	15	36	30	--	--	--	28	--

The pilot's accident report indicates that there was a shift in the wind acting on the aircraft after lift-off which was blowing the aircraft toward the right. Efforts to correct for the right drift and climb above the trees on the right of the runway were futile. The aircraft's right wing struck the low sapplings and landed in the trees.

A review of the Juneau sectional aeronautical chart and the airport facilities record, FAA-29A, indicates that the airport is located on the southeast side of a small river which is a narrow canyon that lays in a northeast southwest direction. The terrain to the east rises to a height of 5,645 feet and to the north at a more gradual rate to a height of 6,650 feet. The facilities record indicates that there are dangerous turbulent conditions northeast of the airport.

Based on the information reported by the pilot and the topography in the vicinity of the airport, the possibility of an orographic shear due to the downward airmass flow on the leeward side of the northern mountainous terrain and turbulent topographic shears associated with the canyon, wind shear cannot be precluded as a factor.

The pilot involved in this accident had a total of 192 hours flight experience of which 110 hours was in this make and model aircraft. The pilot was a resident of the Juneau, Alaska area, and therefore, it is presumed that he was experienced in mountainous terrain aircraft operations.

DOCKET NO. 3-0492

The Piper PA-18 accident near Cimarron, New Mexico on March 14, 1968, occurred at 06:15 MST, 13:15 GMT, during high winds and turbulence which were reported by existing Airmen's Meteorological Information (AIRMETS). The nonfatal

accident occurred during a VFR takeoff from the McDaniel Ranch Airport located approcimately 5 miles southeast of Cimarron.

The limited weather information contained in the docket was supplied by the pilot's report which indicated:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	06:15	Clear	--	36	25	40	--	--	30	--

The pilot's accident report indicates that following a short field takeoff procedure (runway was approximately 2,000 feet long), the wind change brought the airplane back to the ground. This was immediately followed by a gust which lifted the left wing that required full aileron to correct. The aircraft's right drift from the narrow runway brought the aircraft in contact with deep snow (4 inches) and then irrigation dikes.

A strong north wind could have had associated with it an orographic shear due to the mountains which were to the north and northwest of the airport.

In view of the AIRMET in existance at the time and the inability of the FAA inspector to land in the area to conduct an on-the-scene investigation due to the extreme turbulence, orographic wind shear cannot be ruled out as a weather factor.

The pilot involved in the accident had over 500 hours of which more than 350 were in this make and model aircraft.

DOCKET NO. 3-4593

The Ercoupe 415-D accident near Lynnwood, Washington on May 4, 1968, occurred at 17:35 Pacific Daylight Time (PDT), 00:35 GMT, during reported gust front activity which was associated with a squall line. The fatal accident occurred during a VFR approach to runway 16 of the Martha Lake Airport.

The limited weather information contained in the accident docket indicated the estimated weather conditions to be:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	17:35	40 ●	15	14 TRW -	15	20	--	29.93	--	--

The fixed-base operator cancelled all student solo flying appointments for this date due to the adverse flying conditions. He further reported difficulties in trying to fly below the overcast due to a squall line or shear at the edge of the cloud layer. The squall line was south of the field at 16:00 PDT and appeared to be moving north at 3 miles per hour. At 17:00 PDT there was a 180° wind shift. At 17:30 PDT the clouds overhead and to the northwest were knotted and boiling in appearance.

Based on the reports of several witnesses, some of whom were qualified pilots, and that of the fixed-base operator, the presence of low-level wind shear that is normally associated with thunderstorm activity cannot be ruled out as a weather factor.

The pilot/owner of the aircraft involved in the accident was a high time pilot (1,500 hours).

DOCKET NO. 3-1401

The Piper PA-24 accident at Bailey's Crossroads, Virginia on May 19, 1968, occurred at 15:40 Eastern Daylight Time (EDT), 19:40 GMT, during observed thunderstorm activity and rain. The nonfatal accident occurred during a VFR landing on runway 17 of the Washington Virginia Airport.

The limited weather information contained in the docket was the pilot's observations which were:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:40	35 ⊕	10 T	18	10	15	--	--	--	Sudden wind shift

The pilot and other witnesses reported that there was a wind shift to 050° at about 12 kns about the time of the landing. The pilot reported that the storm arrived at the airport from the west just about the time of touchdown and rollout. Based on these observations, low-level wind shear which is normally associated with thunderstorm activity cannot be discounted.

The pilot/owner involved in the accident is a high time pilot (1,783 hours) with 490 hours in this make and model aircraft.

DOCKET NO. 3-1822

The Piper PA-32 accident at Amarillo, Texas on June 12, 1968, occurred at 16:10 Central Daylight Time (CDT), 21:10 GMT, during observed heavy rain and thunderstorm activity. The nonfatal accident occurred during a VFR landing on runway 17 of the Tradewind Airport. This was the second landing attempt for this runway, the first being a missed approach due to turbulence which was apparently associated with the local thunderstorm activity.

The weather report taken 10 minutes before the accident indicated:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	16:10	60 ●	15 TRW	11	8	--	--	30.10	82	Rainshowers N,S, and W

Reports indicate that a wind shift occurred after the aircraft touchdown. Coincident with the wind shift was the arrival of the thunderstorm over the airport. Based on the preceding information, low-level wind shear could not be ruled out as a weather factor.

DOCKET NO. 3-1941

The Cessna 182 accident at Enid, Oklahoma on June 30, 1968, occurred at 21:00 CST, 03:00 GMT, during reported and observed thunderstorm activity. The nonfatal accident occurred during a VFR landing attempt on runway 12 of the Enid Woodring Municipal Airport.

The following weather information was extracted from the accident files:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
ATC	20:20	40 ⊕	10	--	--	--	--	--	70	TW N and NW OKC
ATC	20:25	--	--	--	--	--	--	--	--	Weather deteriorating suggest Enid
Enid Unicom	21:00	--	--	14	36	--	--	--	--	Recent wind shift
Pilot	21:00	40 ⊕	10	14	36	--	--	--	70	Turbulent

The pilot's accident report indicates that two approachs were attempted for runway 18 which was the apparently active runway (runway lights), but the crosswind correction was beyond the capability of the aircraft. The third approach was attempted for runway 12; however, the aircraft was lifted back into the air during the initial landing roll by a gust and then was dropped back to the runway. Flying speed was reacquired during the resultant bounce by quick application of power and, following a go-around, the aircraft landed safely on runway 12.

The reported wind shift and turbulence encountered by the pilot during his third approach could have been due to a gust front associated with the observed thunderstorm activities in the general area.

The pilot/owner involved in the accident had over 1,200 hours total experience with more than 200 hours in this make and model aircraft.

DOCKET NO. 3-2352

The Mooney M20C accident at Lakeview, Arkansas on July 16, 1968, occurred at 12:00 CST, 18:00 GMT, during reported gusty wind conditions. The nonfatal accident occurred during the approach and landing over a dike for runway 27 of the Gaston Airport.

The limited information contained in the docket indicates the pilot's estimate of the weather to be:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	12:00	Clear	15	22	15	20	--	--	90	Gusty

The pilot/owner reported encountering a downdraft within 50 feet of the runway which resulted in an excessive sink rate. The owner/operator of the airport, which is located in rough terrain, reported that since the airport is located below a dam, any approach under high gusty conditions requires precise maneuvering. Based on these statements, topographic wind shear cannot be precluded.

The pilot/owner involved in the accident had over 1,200 hours experience with at least 700 hours in this make and model aircraft.

DOCKET NO. 3-3896

The Piper PA-18 accident near Melville, Montana on August 12, 1968, occurred at 10:10 MST, 17:10 GMT, during reported high gusty wind conditions. The nonfatal accident occurred during the initial climb phase of a takeoff to the northwest (approximately 320°), of the Decock ranch.

The limited information in the docket shows the pilot's estimate of the local weather conditions to be:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	10:10	Clear	Unlimited	32	10-30	35	--	--	85	Downdrafts

The pilot reported attaining an altitude of 150 feet before encountering a downdraft which returned the aircraft to the ground. It should be noted that the direction of takeoff was toward a blind canyon which rises approximately 1,000 feet above the airport elevation of 5,000 feet. The direction of the takeoff would place the aircraft on the lee side of the Crazy Mountains.

The reported gusts could be associated with rotors related to orographic wind shear conditions.

The pilot involved in the accident is reported to be a very high-time commercial pilot (over 17,000 hours) with over 10,000 hours in this make and model aircraft.

DOCKET NO. 3-4073

The Cessna 172 accident 24 miles from Soldotna, Alaska on August 25, 1968, occurred at 18:45 AST, 04:45 GMT, during downdraft conditions associated with mountain flying. The nonfatal accident occurred during a VFR takeoff from an unprepared surface located between two mountains.

The pilot's estimate of the local weather conditions was:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	18:45	48 ⊕	40	16	12	--	--	--	48	Downdrafts

The aircraft was forced to land from an altitude of 400 feet above the terrain due to downdrafts. After discharging the two passengers, the pilot attempted a takeoff from an unprepared surface but was forced back to the ground by downdrafts.

The site of the accident is between two mountains, one 4,750 and the other 6,250 feet high according to the Seward sectional aeronautical chart. The terrain elevation approximately 1,500 feet in the area of the accident site and rises rapidly to 5,000 feet in the direction of the takeoff. Thus, the prevailing wind would place the aircraft on the lee side of the rising terrain coupled with the lee flow associated with the 6,250 foot mountain located east southeast of the accident site. Under these conditions, orographic wind shear cannot be ruled out.

The pilot involved in the accident is a relatively low-time pilot (76 hours) with all his experience in this make and model aircraft.

DOCKET NO. 3-3811

The Cessna 150 accident at Blakely Island, Washington on September 15, 1968, occurred at 15:30 PDT, 22:30 GMT, during reported downdraft conditions. The nonfatal accident occurred during a VFR approach and landing for runway 36 which has an upgradient slope of 3° to 4° and is located on top of a 50-foot high bluff.

The pilot's estimate of weather conditions at the time of the accident were:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:30	Unlimited	20	34	8	--	--	--	70	Turbulence, downdrafts

Commercial pilots operating mail and airtaxi aircraft reported that downdrafts and turbulence exist at either end of the runway for all but calm wind conditions. The fixed-base operator at Blakely forbids rental pilots to land on any of the strips in the San Juan Island Group without dual checkout and authorization for each strip by a qualified flight instructor. In lieu of these reports, the existance of a topographic wind shear cannot be ruled out.

The pilot involved in the accident had a total of 884 hours experience with 21 hours in this make and model aircraft.

DOCKET NO. 3-3269

The Cessna 172 accident at Raleigh, North Carolina on September 26, 1968, occurred at 18:15 (EDT), 22:15 GMT, during a reported wind shift which was associated with thunderstorm activity. The nonfatal accident occurred during a VFR landing on runway 32 of the Raleigh Municipal Airport.

The only weather information in the docket was the pilot's report of existing weather conditions. His report indicates:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	18:15	2 @	4 TWR +	15	5	--	--	--	73	Very heavy rained gusts

The low-time pilot had been released to practice takeoff and landing not withstanding observable heavy weather buildups in the general area. The FAA investigator was in the process of entering the traffic pattern at Raleigh Durham Airport when the accident occurred. He reported 6 cells in the immediate vicinity on the airborne weather radar in the aircraft he was operating. Under these documented condition, low-level wind shear which is associated with thunderstorm activity cannot be ruled out as a weather factor.

The pilot involved in the accident was a student pilot with 25 hours total time, 2 1/2 hours of which was in this make and model airdraft. The pilot had his 3rd class medical for approximately one year (13 months) at the time of the accident.

DOCKET NO. 3-4110

The Piper PA-24 accident at Montauk, New York on October 5, 1968, occurred at 09:30 EST, 14:30 GMT, during reported gusty crosswind conditions. The nonfatal accident occurred during a VFR approach and landing on runway 24 of the Sky Portel Airport.

The reported weather at 11:00 EST which was obtained from Suffolk Air Force Base (AFB) (40 miles SW) was:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
AFB	11:00	Unlimited	8	33	11	20	--	30.11	53	Cumulus all quadrants

The pilot's report of the weather conditions at the time of the accident was:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	09:30	Unlimited	8	31	20	--	--	--	60	Downdraft

The pilot reported that he encountered a downdraft when he passed in the vicinity of some 50-foot high sand dunes which were to the right of the runway. Based on the reported wind direction and magnitude, there could have been topographic low-level wind shear. The airmass flow over the dunes could have produced the reported downdrafts.

The pilot/owner involved in the accident had 275 hours of experience of which 74 are in this make and model aircraft.

DOCKET NO. 3-3730

The Cessna 172 accident at Wakeeney, Kansas on October 15, 1968, occurred at 18:15 CST, 00:15 GMT, during reported high winds and thunderstorm activity. The nonfatal accident occurred during the approach and landing on runway 18 of the Gallaway Airport.

The limited weather information in the docket was submitted by the pilot and indicated:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	18:15	--	10 T	16	55	68	--	--	70	Turbulence and cell activity

The FSS at Hill City (25 miles south of Wakeeney) reported winds 25 to 30 kns with gusts to 33 kns. The owner of the airport at Wakeeney estimated the gusts at the time of the accident to be 60 to 80 mph.

There was a line of trees near the runway and, according to the pilot's statement, the tree line altered the airmass flow which resulted in flipping the aircraft over within 10 feet of the ground. The aircraft was found inverted with no fresh tracks, marks, or gouges in the soft earth surrounding the airplane. The possible presence of a low-level topographic wind shear cannot be precluded in this accident.

The pilot/owner of the aircraft had a total of 333 hours experience of which 321 were in this make and model aircraft.

DOCKET NO. 3-3327

The Piper PA-18 accident at El Paso, Texas on October 24, 1968, occurred at 10:00 MST, 16:00 GMT, shortly after the passage of a weak cold front. The nonfatal accident occurred during a VFR landing on runway 8 of the Hueco Airport.

The weather information in the accident docket indicates:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
USWB	09:00	High	30	9	11	--	--	30.34	62	Weak cold front passage
Pilot	10:00	--	Unlimited	29	15	25	--	--	55	--

The pilot reported a wind gust and wind shift just prior to touchdown which caused the aircraft to yaw to the left. The Hueco Airport is close to the Hueco Mountains (foot hills 1 1/2 miles northeast of airport rising to about 1,000 feet above airport ground level). Wind circulation from 090° would be leeward (downdraft) and turbulent, where as circulation from 290° would be windward (updraft) and turbulent. Thus, orographic wind shear cannot be precluded.

The pilot/owner in this accident had 200 hours total experience but only 5 hours in this make and model aircraft.

DOCKET NO. 3-1074

The Piper PA-24 accident which happened in Alliance, Ohio on April 13, 1969, occurred at 15:00 EST, 20:00 GMT, during turbulent wind conditions. The nonfatal accident transpired during a VFR takeoff and initial climb on runway 36 at the Alliance Airport. This airport has trees which are 40 feet or higher on the left of the last third of runway 36 and a small rise on the right side of the departure end of runway 36.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:00	Clear	15	32	2	10	--	--	70	Light turbulence

At an altitude of about 30 feet, a gust of wind dropped the right wing causing the aircraft to lose most of its altitude. The aircraft did not have sufficient altitude to clear the brush and low tree growth at the end of the runway. It should be noted that above the high tree line, the wind would be a 40° left crosswind thereby placing the departure path on the lee side of the trees.

The FAA investigator indicated that the aircraft came under the influence of lee-side turbulence following an extended takeoff roll due to the slight upgrade and sod runway. Thus, topographic shear was a factor in this accident.

The pilot involved in the accident had 928 hours of total experience, 40 of which were in this aircraft make and model.

DOCKET NO. 3-1027

The Cessna 180A accident which happened in Weeping Water, Nebraska on April 20, 1969, occurred at 16:10 CST, 22:10 GMT, during strong variable wind conditions. The nonfatal accident transpired during a VFR landing on runway 17 at the Brown Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Offutt AFB	16:00	225	12	23	16	28	--	29.75	75	Gusty 20 miles north northeast of Brown Airport
USWB	16:00	--	--	22	21	30	--	--	--	Eppley Airfield, Omaha, 31 miles northeast of Brown Airport
USWB	16.00	--	--	23	16	26	--	--	--	35 miles west of Brown Airport

The pilot indicated that he had been monitoring the radio during his flight and was aware of the strong wind conditions. He indicated that he considered landing at an alternate but that the destination runway had equally good orientation with reported wind direction and satisfactory length. A review of the Omaha aeronautical sectional charts indicates that this is true for

[redacted] airports within a 50-mile radius of Brown Airport who's runway alignment is shown. The aircraft was struck by a strong gust during the flare which [redacted] the aircraft. In view of the prevailing wind conditions and the airport's location, topographic or orographic wind-shear conditions cannot be ignored.

The pilot involved in the accident had 5,224 hours of total experience, 39 of which were in this aircraft make and model.

DOCKET NO. 3-1085

The Piper PA-28-140 accident which happened in Centre, Alabama on April 27, 1969, occurred at 08:45 EST, 13:45 GMT, during conditions conducive to topographic wind shear. The nonfatal accident transpired during a VFR takeoff and initial climb on runway 9 at the Centre Municipal Airport. The airport diagram shown on CAB form 485, page 3, indicates that there are 50-foot-high trees lining each side of the single 9/27 runway with 60-foot-high trees just beyond the departure end of runway 9.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	08:45	Clear	Unlimited	18	12	--	--	30.12	76	--

The pilot indicated that the takeoff was normal with an indicated climb speed of 85 mph until an altitude of approximately 30 feet. The aircraft stopped climbing and started to settle as it came under the influence of the wind shift above the tree line. Although the aircraft was reestablished on the maximum angle-of-climb speed (75 mph), the aircraft would still not climb properly. The takeoff was aborted and damage to the aircraft occurred during the landing.

The pilot involved in the accident had 204 hours of total experience, 139 of which were in this aircraft make and model.

DOCKET NO. 3-0982

The Piper PA-20 accident which happened in Steamboat Springs, Colorado on April 29, 1969, occurred at 13:10 MST, 20:10 GMT, during conditions conclucive to topographic wind shear. The nonfatal accident transpired during a VFR landing on runway 32 at the Routt County Airport. Item 13 of the NTSB form 6120.1 shows a diagram of the airport and accident site. There is a high bank on the right side of runway 32.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	13:10	--	40	29	5	15	20	--	55	Moderate turbulence

The pilot's report indicates a gust encounter during the landing roll which raised the right wing and he was unable to prevent the left drift of the aircraft off the runway because the right wheel was also off the runway. The aircraft was in the vicinity of the high bank located on the right side of runway 32. The FAA investigator indicated that the right wing was raised by the 290° wind "bouncing" off the bank. The Cheyenne sectional aeronautical chart shows this airport to be in hilly terrain approximately 10 nmi west of Soda Mountain which is 10,804-feet high (4,200 feet above the airport's elevation).

The pilot involved in the accident had 600 hours of total experience, 70 of which were in this aircraft make and model.

DOCKET NO. 3-1037

The Piper PA-32 accident which happened in Marysville, Kansas on May 9, 1969, occurred at 10:30 CST, 16:30 GMT. The nonfatal accident transpired during a VFR approach and landing on runway 33 at the Marysville Municipal Airport. Runway 33 is an upsloping runway with high lines and trees along the approach. There is a hollow and a creek short of the threshold.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	10:30	Clear	15 +	33	15	25	--	30.06	67	--

The pilot reported encountering a downdraft short of the threshold which resulted in the aircraft impacting on the sharply rising slope from the creek bed to runway 33's threshold. The aircraft was on a normal stepped approach to clear high trees and still make maximum use of the short runway. The FAA investigator's report indicates that downdrafts in the area of the accident are not unknown, and further, pilots must exercise caution to clear high trees and wires near the threshold of runway 33. Topographic wind shear as a weather factor cannot be precluded.

The pilot involved in the accident had 321 hours of total experience, 138 of which were in this aircraft make and model.

DOCKET NO. 3-1715

The Luscombe 8F accident which happened in Willow Creek, California on June 15, 1969, occurred at 12:05 PST, 20:05 GMT. The nonfatal accident transpired during a VFR approach and landing on runway 13 at the Willow Creek Airport. The Klamath Falls sectional aeronautical chart shows this airport to be in mountainous terain (4-5,000 feet high) with the approach being in a valley running along the plane of 160°/340° magnetic heading. There is another intersecting valley southwest of the airport.

The weather information contained in the accident docket was as follows.

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	12:05	Clear	15 +	Calm	--	--	--	29.80	95	--

The Willow Creek Airport was an alternate to the pilot's original destination of Shelter Cove due to the coastal area being obscured by fog. The pilot made a short field valley approach and encountered a downdraft and struck the ground 50 feet short of the runway. The runway length at the date of the accident was 1,600 feet. In view of the mountainous terrain, it is not possible to rule out low-level topographic shear as a possible weather factor.

The pilot involved in the accident had 260 hours of total experience, 16 of which were in this aircraft make and model.

DOCKET NO. 3-1905

The Stinson 108-3 accident which happened in Venice, Florida on June 21, 1969, occurred at 09:00 EST, 14:00 GMT, during reported and observed thunderstorm activity. The nonfatal accident transpired during a VFR approach and landing on runway 31 at the Venice Municipal Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	08:50	20 Ⓓ	10	33	--	--	--	--	90	Thunderstorm 10 miles north of Venice moving southeast
Pilot	09:00	20 Ⓓ	--	Variable	--	35	--	--	90	Sudden strong gusts and directional variable winds

The pilot reported encountering sudden strong gusts from the right and a sudden wind shift at flare on the second landing attempt. About the same time a small sailboat was capsized offshore. Shortly after the accident, the active runway was changed from 31 to 9 due to a change in wind direction. Low-level wind shear cannot be ruled out as a weather factor.

The pilot involved in the accident had 1,019 hours of total experience, 882 of which were in this aircraft make and model.

DOCKET NO. 3-1793

The Piper PA-24 accident which happened in Dora Lake, Minnesota on June 22, 1969, occurred at 14:25 CDT, 19:25 GMT, during gusty right quartering headwind conditions. The nonfatal accident transpired during a VFR approach and landing on runway 28 at the Dora Lake Private Airport. Item 13 of the NTSB form 6120.1 shows a diagram of the airport and accident site. There are tall trees on the right side of the threshold area of runway 28 followed by a break in the tree line then there is a line of low pine trees. The left side of the runway has low pines along its first half.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	14:25	--	12 H	34	15	25	--	--	65	--

The pilot reported that the aircraft encountered a strong gust from the right just as he reached the break in the line. The aircraft drifted to the left and struck trees lining that side of the runway. The FAA investigator's report indicates that the trees under the existing wind conditions were a contributing factor. Thus, the possibility of a topographic wind shear cannot be ignored.

The pilot involved in the accident had 632 hours of total experience, 471 of which were in this aircraft make and model.

DOCKET NO. 3-2061

The Piper PA-28 accident which happened in Palo Alto, California on June 30, 1969, occurred at 18:30 PST, 02:30 GMT. The nonfatal accident transpired during a VFR approach and landing on runway 30 at the Palo Alto Airport. Item 13 of NTSB form 6120.1 shows a side profile of the threshold area of runway 30. There is a 6-foot-high earthen dike located 120 feet short of the threshold which falls off to a 2-foot depression, 60 feet short of the threshold.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
LCS	18:30	Clear	30	32	15	20	--	29.97	70	Palo Alto Tower

The pilot had been practicing takeoffs and landings prior to the accident. On the last landing he reported that the downdraft associated with the dike and depression caused the aircraft to land short of the runway. While the pilot should have been aware of the downdraft conditions, its presence precludes negating its influence as a weather factor.

The pilot involved in the accident had 115 hours of total experience, 104 of which were in this aircraft make and model.

DOCKET NO. 3-2101

The Piper PA-28-180 accident which happened in Rapid City, South Dakota on July 10, 1969, occurred at 11:45 CST, 17:45 GMT, during observed thunderstorm activity. The nonfatal accident transpired during a VFR takeoff on runway 14 at the Rapid City Regional Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
LCS	11:45	--	--	5	25	42	--	--	--	Control Tower
USWB	11:45	E 30 ⊕ 60 ⊕	20	5	34	42	642	29.99	73	CB NW moving E special observation

According to the information in the accident file, the deteriorating weather conditons including the approaching thunderstorm was known to the pilot, local controllers, and weather personnel prior to the aircraft taxing to the runway. The pilot was cleared to runway 14 by the tower even though runway 01 was available for usage. The tower advised the pilot of the strong 90° cross-wind and cleared the aircraft for takeoff.

The pilot indicated that the aircraft lifted out quickly but then encountered either sudden calm or tailwind. The aircraft lost all of its altitude very quickly. The airplane came to rest 200 feet to the right of runway 14. A low-level wind shear due to frontal activity cannot be precluded.

The pilot involved in the accident had 411 hours of total experience, 154 of which were in this aircraft make and model.

DOCKET NO. 3-3607

The Cessna 175A accident which happened in Columbia, Ohio on August 17, 1969, occurred at 14:15 EDT, 18:15 GMT, during reported thunderstorm activity. The nonfatal accident transpired during a VFR landing on runway 18 at the Columbia Lu Dot Airport.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	14:15	E 30@	10 TRW -	20	--	--	--	--	--	--

The accident report indicates that there was turbulent gusty wind conditions with a large roll cloud over the airport at the time of touchdown. The pilot indicated that near the end of his landing roll he encountered a sudden windshift which caused the aircraft to overrun the runway. A low-level wind shear associated with frontal activity cannot be negated as a weather factor.

The pilot involved in the accident had 433 hours of total experience, 21 of which were in this aircraft make and model.

DOCKET NO. 3-1303

The Cessna C-172 accident which happened in Indian Well, Arizona on February 23, 1972, occurred at 16:10 MST, 23:10 GMT. The nonfatal accident transpired during a VFR landing on a gravel and dirt road often used as a landing strip at the Trading Post. This road has a magnetic heading of approximately 280°. This would result in the aircraft landing into a left quartering headwind.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	16:10	Clear	15	21	10	25	--	--	50	--

The pilot and passenger indicated that the touchdown and initial rollout was normal. The aircraft encountered a sharp gust from the right which caused the aircraft to move to the left and hit a dirt bank. The passenger observed papers being blown about by an apparent "dust devil" on the right side just before the gust encounter. The surface dirt was not blowing about as it had rained about 10 hours before the accident, which would have reduced this tendency.

The area is known for having "dust devils" during this time of the year. Therefore, it is not possible to preclude a low-level wind shear conditions. The meteorological causes for the shear are not documented.

The pilot involved in the accident had 1,951 hours of total experience, 600 of which were in this aircraft make and model.

DOCKET NO. 3-1032

The Navion A accident which happened in Jackson, California on March 26, 1972, occurred at 11:45 PST, 19:45 GMT, during strong gusty wind conditions. The nonfatal accident transpired during a VFR approach and landing on runway 35 at the Westover Field. The airport is located on the top of a flat-topped hill with an elevation of 1,694 feet. The approach end of the runway has a steep drop-off.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Witness	11:45	--	--	27	18	--	--	--	--	Gusty
Pilot	11:45	Clear	50	25	18	--	--	--	--	--

The pilot reported he was on a stabilized approach and encountering moderate turbulence due to the crosswind when "the bottom seemed to drop out" and the aircraft developed a very high rate of descent. He suspected that he encountered a sudden downdraft. The fixed-base operator witnessed the accident and independently substantiated the pilot's statements. The FAA investigator indicated that due to the physical arrangement of Westover Field (local topography), winds from the west or northwest at the reported velocity would very likely produce strong downdrafts at the approach end of runway 35. Based on these statements, topographic low-level wind shear could have been a weather factor.

The pilot involved in the accident had 165 hours of total experience, 32 of which were in this aircraft make and model.

DOCKET NO. 3-1496

The Cessna 172 accident which happened in Inyokern, California on April 14, 1972, occurred at 07:30 PST, 15:30 GMT, during a reported wind-shear encounter. The nonfatal accident transpired during a VFR approach and landing on runway 33 at the Inyokern Kern County Airport. The airport is located approximately 10 nmi east of Walker Pass (5,245 feet above msl), which is about 2,800 feet above the airport's elevation. Walker Pass is located in the Sierra-Nevada Mountains and is shown on the Los Angeles aeronautical sectional chart.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	07:30	Clear	15	33	20	30	--	--	70	--
Airport Mgr.	--	Clear	15 +	33	20	30	--	29.96	70	--

The pilot reported encountering a sudden, rapid descent rate which he was unable to arrest. The sudden sink rate was so violent that the pilot's hand bent the throttle shaft thereby preventing power application. The pilot's statement attributed the sudden sink rate to a "wind shear." The investigator's report supports the pilot's statement.

The only other information which was available relates to the airports location. An extension of the runway centerline shows an 8,453 foot mountain which is 10 nmi northwest of the 2,457 foot high runway. Thus, the possibility of the wind shear being due to orographic conditions cannot be precluded.

The pilot involved in the accident had 408 hours of total experience, 30 of which were in this aircraft make and model.

DOCKET NO. 3-3030

The Cessna 180H accident which happened near Wyola, Montana on July 9, 1972, occurred at 16:00 MST, 23:00 GMT, during a VFR approach and landing on the side of a mountain. The attempted landing site was at the 5,200 foot elevation of a 5,500 foot high ridge. The landing area is located on the lee side of the ridge.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	16:00	Clear	--	14	10	--	--	--	92	Downdrafts

The pilot elected to land on the side of the mountain in an apparently level area because of the aircraft inability to maintain altitude due to downdrafts. The reported wind conditions and accident location would have placed the aircraft under the influence of orographic shear (lee side of the mountain).

The pilot involved in the accident had 1,072 hours of total experience, 971 of which were in this aircraft make and model.

DOCKET NO. 3-2852

The Cessna 210F accident which happened in Montgomery, Alabama on August 4, 1972, occurred at 19:00 EST, 24:00 GMT, during observed thunderstorm activity. The nonfatal accident transpired during a VFR landing on runway 33 at the Dannelly Field. This is a controlled airport with both a tower and a Flight Service Station.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	--	9 H	--	34	30	--	--	--	--	Thunderstorm just north of the airport

The pilot reported encountering a sudden wind just at the flare which first lifted the aircraft then set it down hard. Due to the close proximity of the reported thunderstorm, wind shear cannot be excluded as a possible weather factor.

The pilot involved in the accident had 247 hours of total experience, 110 of which were in this aircraft make and model.

DOCKET NO. 3-3669

The Grumman G-164 accident which happened in Wynnburg, Tennessee on November 6, 1972, occurred at 15:40 EST, 20:40 GMT, during observed thunderstorm activity. The nonfatal accident transpired during a VFR landing on the east/west runway at the private airport in Wynnburg. A thunderstorm moved into the airport during the landing roll.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	15:40	10 ⊕	3 TRW -	26	8	45	--	30.08	60	--

The pilot indicated that high gusts associated with a local thunderstorm blew the aircraft off the runway during the landing roll. The presence of low-level wind shear/gust conditions due to thunderstorm activity cannot be ignored.

The pilot involved in the accident had 6,500 hours of total experience, 600 of which were in this aircraft make and model.

DOCKET NO. 3-0885

The Grumman AA-1 accident which happened in Colville, Washington on April 13, 1973, occurred at 17:05 PST, 01:05 GMT, during reported strong downdrafts. The nonfatal accident transpired during a VFR initial climb on runway 4 at the Colville Municipal Airport. The airport is located near the Colville River in mountainous terrain. The runway is aligned with an elevated pass (approximately 2,500 feet high) which is between two 5,700-foot mountains. This pass is approximately 4 nmi northeast of the airport. The airport elevation is 1,878 feet.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	17:05	100 Ø	20 +	2	20	30	--	--	50	--

The pilot reported encountering strong downward gusts at about an altitude of 100 feet during the initial climb. The accident files indicate that this type of condition is known to local pilots when there are strong northeasterly winds. These downdrafts which are due to the local topography and the airport being in the lee flow of strong winds coming from the Little Pond Orville Wildlife Refuge (orographic shear) were not known to the pilot.

The pilot involved in the accident had 605 hours of total experience, 375 of which were in this aircraft make and model.

DOCKET NO. 3-1319

The Beech A-23 accident which happened in Schenectady, New York on June 2, 1973, occurred at 13:00 EST, 18:00 GMT, during reported downdrafts. The nonfatal accident transpired during a VFR approach and landing on runway 28 at the Schenectady County Airport. The threshold of runway 28 of this controlled airport is less than 1 mile west of the bend of the Mohwak River.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
LCS	13:00	Clear	Unlimited	29	20	--	--	30.08	80	Gusty

The pilot reported that the aircraft suddenly dropped during the flare maneuver. According to the FAA investigator's report, local pilots indicated that they were aware of downdrafts at the approach end of runway 28. With the close proximity of runway 28 to the Mohawk river and the reports of local

pilots concerning the approach to this runway, low-level, horizontal wind shear conditions cannot be discounted.

The pilot involved in the accident had 200 hours of total experience, 52 of which were in this aircraft make and model.

DOCKET NO. 3-1287

The Luscombe 8-A accident which happened in Lufkin, Texas on June 5, 1973, occurred at 08:30 CST, 14:30 GMT, during reported thunderstorm activity. The nonfatal accident transpired during a VFR landing on runway 15 at the Angelina County Airport. The airport is served by a Flight Service Station which is located at the airport and does make local surface weather observation.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	08:30	10 Ⓓ	15 T	04	20	30	--	30.07	--	--
FSS	08:30	80 Ⓒ	6 RW	02	18	28	--	--	--	Gusty
FSS	08:30	--	T	Shifting	--	30	--	--	--	--

The pilot elected to make a precautionary landing at the airport due to deteriorating weather conditions including thunderstorm development. The aircraft was not equipped with a radio and, therfore, was not aware of the prevailing surface weather observations. The reported shifting wind conditions and thunderstorm activity precludes ignoring the potential presence of low-level wind shear conditions.

The pilot involved in the accident had 186 hours of total experience, 129 of which were in this aircraft make and model.

DOCKET NO. 3-2544

The McDonald S-20 accident which happened in Moriarty, New Mexico on August 9, 1973, occurred at 13:45 MST, 20:45 GMT, during reported light rain shower activity. The nonfatal accident transpired during a VFR takeoff and initial climb on runway 8 at the Moriarty Airport. The Moriarty Airport is 1/2 nmi west of a riverbed.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	13:45	150 Ⓓ	50 RW -	9	5	--	--	--	--	--
USWB	14:15	E 150 Ⓒ	25	7	6	--	--	--	78	--

The pilot reported that he encountered a strong downdraft during the initial climb which resulted in a negative rate-of-climb. Following this involuntary descent from 150 feet to 10 feet above the ground, the pilot elected to make a controlled precautionary landing in rough terrain. The exact cause of the downdraft was not documented. Thus, it is not discernible whether the downdraft was associated with the shower activity or the riverbed.

The pilot involved in the accident had 531 hours of total experience, 30 of which were in this aircraft make and model.

DOCKET NO. 3-2888

The Luscombe 8A accident which happened in Big Delta, Alaska on September 15, 1973, occurred at 11:15 AST, 21:15 GMT. The nonfatal accident transpired during a VFR initial climb on a single dirt strip on a heading of 300° at an airport at or near Big Delta. The single-strip dirt runway was lined on the left side with trees 50 to 70 feet in height.

The weather information contained in the accident docket was as follows:

Source	Time (LST)	Sky and Ceiling (x100 ft)	Visibility and Precip. (nmi)	Wind Direction (x10°)	Speed (kts)	Gusts (kts)	S. L. Press (millibar)	Alt Setting (inHg)	Temp (°F)	Remarks
Pilot	11:15	Clear	Unlimited	30	5	10	--	--	--	--
Pilot	11:15	Clear	Unlimited	9	12	20	--	--	50	Moderate turbulence

The pilot and witness statements indicated that a sudden wind shift to the left was encountered as the aircraft was climbing through 20 to 25 feet of altitude. According to one of the investigative reports, the shift in wind direction as the aircraft rises above the trees is not uncommon at this airport. Experienced local pilots hold the aircraft low to the runway to build up speed prior to climbing out. The pilot involved in this accident had very little experience at this airport. The effect of topographic shear due to the tree line cannot be ignored.

The pilot involved in the accident had 214 hours of total experience, 14 of which were in this aircraft make and model.