NAVAL AIR TRAINING COMMAND

NAS CORPUS CHRISTI, TEXAS CNATRA P-1245 (Rev. 8-97) PAT

INSTRUMENT RATING FLIGHT PROCEDURES

LESSON GUIDE

1997

T-45 LESSON GUIDE

CHANGE SUMMARY PAGE

CHANGE NUMBER	DATE ENTERED	CHANGE DESCRIPTION	INITIALS
1	9/99	Incorporated	TSC
2	4/11/06	Incorporated	TSC
3	9/8/2008	Incorporated	FTSC

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LESSON GUIDE
LIST OF EFFECTIVE PAGES

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FRONT MATTER	
Change 2, 3	i thru iv
IRFP-01	
Change 2, 3	Title page(s)
Original	1-1 thru 1-2
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IRFP-02	
Original	Title page(s)
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LESSON GUIDE

COURSE/STAGE: Instrument Rating Flight Procedures

LESSON TITLE: Metro Review

LESSON IDENTIFIER: IRFP-01

LEARNING ENVIRONMENT: CAI-01

ALLOTTED LESSON TIME: 1.0 hr

TRAINING AIDS

* **Figures**

Fig 1: Cold Front
Fig 2: Warm Front
Fig 3: Cold Front Occlusion
Fig 4: Warm Front Occlusion
Fig 5: Duration Characteristics of Microbursts
Fig 6: Microbursts
Fig 7: Microburst Windshear Probability Guidelines
Fig 8: Structural Icing
Fig 9: Polar and Subtropical Jet Streams
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Fig 11: Polar Jet Stream
Fig 12: Multiple Jet Streams
Fig 13: Jet Stream Clear Air Turbulence (CAT)
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Fig 17: Surface Analysis Chart
Fig 18: Standard Chart Symbols
Fig 19: Major Station Model Symbols
Fig 20: Weather Depiction Chart
Fig 21: Radar Summary Chart

(8-97) CHANGE 2

TRAINING AIDS (cont.):

STUDY RESOURCES:

*Meteorology for Naval Aviators, NAVAIR 00-8OU-24
*Meteorological Theory Workbook I, CNATRA P-303

LESSON PREPARATION: N/A

REINFORCEMENT: N/A

EXAMINATION: N/A

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LESSON OBJECTIVES

1.1.1.2.4
Recall definition of frontal systems

1.1.1.2.5
Recall weather associated with frontal systems

1.1.1.2.5.1
Recall reasons for and effects of direction and velocity of surface winds

1.1.1.4
Recall meanings of severe weather hazards

1.1.1.4.5
Recall hazards associated with thunderstorms

1.1.1.4.1.2
Recall meaning of microbursts

1.1.1.4.2
Recall causes and dangers of ice formation

1.1.1.4.3
Recall causes and dangers of fog formation

1.1.1.3.5
Recall features and hazardous conditions associated with jet streams

1.1.1.4.1.1
Recall meaning of clear air turbulence (CAT)

1.1.1.4.4
Recall causes and hazards of wake turbulence phenomena

1.1.1.1
Recall weather minimums

1.1.1.1.1.1
Recall weather minimums required IAW OPNAVINST 3710.7

1.1.1.3
Recall information contained/displayed on weather charts

1.1.1.3.1
Interpret surface charts (analysis/prognostic)

1.1.1.3.3
Interpret weather depiction charts

1.1.1.3.2
Interpret radar summary charts

1.1.1.3.4
Interpret prognostic charts

1.1.1.5
Recall information contained in forecasts

1.1.1.5.4
Recall information contained in METARs

1.1.1.5.3
Recall information contained in area forecasts

1.1.1.5.1
Recall information contained in terminal aerodrome forecasts

1.1.1.5.2
Recall information provided in winds aloft forecasts

1.1.1.4.6
Recall information contained in severe weather forecasts

1.1.1.4.7
Recall OPNAVINST severe weather restrictions

1.1.1.4.8
Recall CNATRA severe weather restrictions

1.1.1.11
Recall aviation in-flight weather advisories

1.1.1.11.2
Recall information provided in SIGMETs

1.1.1.11.1
Recall information provided in AIRMETs

1.1.1.9.1
Recall en route facilities/procedures for weather information and reporting

1.1.1.11.3
Recall information provided in PIREPs

1.1.1.11.3.1
Recall PIREP information to provide controlling agency

1.1.1.11.4
Recall information provided by flight weather packets

1.1.1.11.5
Recall information provided by Optimum Path Aircraft Routing System (OPARS)

1.1.1.11.6
Recall information provided by satellite imagery

9.7.1.1.5.2
Recall causes and hazards of Spatial Disorientation

MOTIVATION

As an aviator, you need to develop a natural routine in flight planning that takes weather into account and uses weather information correctly.

OVERVIEW

After reviewing significant weather phenomena, related weather hazards, weather minimums, maps, and forecasts, you will be able to connect a visual image of significant weather with information found in weather maps and forecasts to assist in flight planning.

In this lesson, we will review:

* Meteorological definitions
* Frontal systems and resulting winds
* Meteorological hazards
  - Thunderstorms
  - Microbursts
  - Structural ice
  - Fog
  - Jet streams
  - Clear air turbulence (CAT)
  - Wake turbulence
* Weather minimums directed by OPNAVINST 3710.7
* Weather charts (observed and prognostic)
  - Surface analysis
  - Weather depiction
  - Radar summary
  - Prognostics
* Printed reports and forecasts
* Sources for in-flight weather information, updates, and PIREPs
* Flight weather packets
* Optimum Path Aircraft Routing System (OPARS)
* Satellite imagery
* Spatial Disorientation

PRESENTATION

I. Meteorological definitions

A. Altitude

1. Indicated altitude: altitude read on an altimeter with current barometric setting

2. Calibrated altitude: indicated altitude corrected for instrument error

3. True altitude (QNH): height above mean sea level (MSL)

4. Absolute altitude: height above terrain (AGL)

5. Density altitude: pressure altitude corrected for temperature

NOTE: Density altitude is used to calculate takeoff roll, available thrust, and power settings. To compensate for it, the pilot uses the NATOPS performance charts by entering the chart with temperature deviation and pressure altitude.

6. Pressure altitude (QNE): altitude read on an altimeter with a barometric setting of 29.92

COMMON ERROR: Confusing pressure altitude with density altitude.

B. Coriolis force: deflective force created by the difference in rotational velocity between the equator and the poles of the earth

1. In the northern hemisphere, winds flow clockwise around areas of high-pressure and counterclockwise around areas of low-pressure

2. In the southern hemisphere, winds flow counterclockwise around areas of high-pressure and clockwise around areas of low-pressure

NOTE: In this lesson, descriptions are of weather phenomena occurring in the northern hemisphere.

C. Frontal system: discontinuity formed between two contrasting air masses of different characteristics **21.1.1.2.4**

1. Fronts affect ground speed, wind correction, and other planning factors

2. Several associated weather hazards

II. Fronts and resulting winds **21.1.1.2.5, 21.1.1.2.5.1**

Fig 1: *Cold Front*

A. Cold front

1. Characteristics

a. Predominantly cumuliform type clouds

b. Thunderstorms and occasional squall lines (seasonal)

c. Turbulence and unstable air

d. Strong, gusty winds

e. Showery precipitation

f. Clearing skies and good visibility after frontal passage

2. Wind changes

a. Before passage, wind flows parallel to (along) the front

b. After passage, wind flows perpendicular to front

(1). Follows prevailing wind in same direction as front movement (perpendicular to front)

(2). Generally stronger due to steeper pressure gradient of colder air mass

Fig 2: *Warm Front*

B. Warm front

1. Characteristics

a. Predominantly cirriform and stratiform type clouds

b. Predominantly stable air and little turbulence

c. Continuous precipitation ahead of front in wide area

d. Poor visibility from haze or fog

e. Icing conditions

2. Wind changes

a. Before passage, wind flows parallel to front from higher to lower pressure

b. After passage, wind flows perpendicular to front

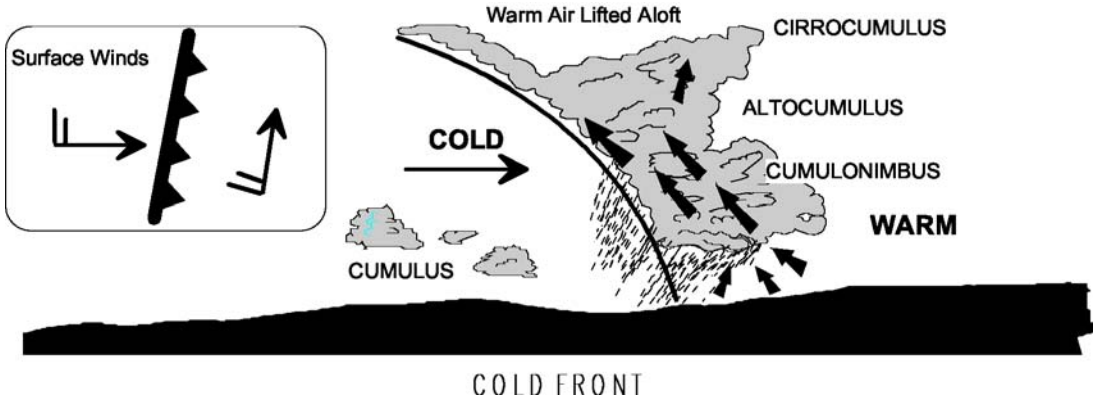


Figure 1: COLD FRONT

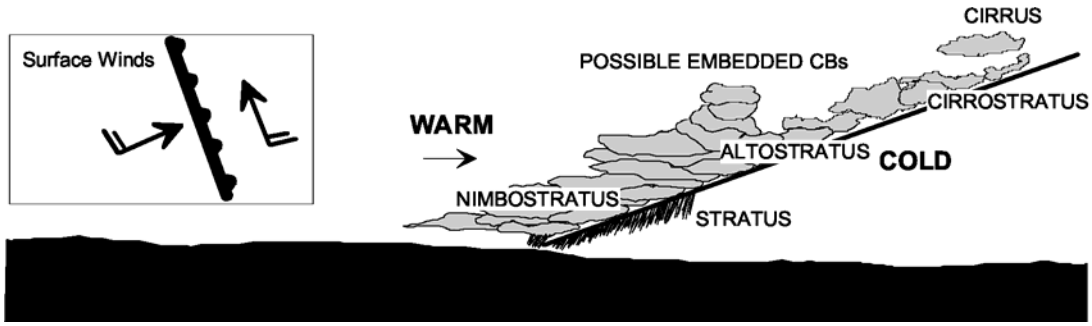


Figure 2: WARM FRONT

C. Stationary front

1. Characteristics: same as warm front, only less intense—can persist in an area for many days

2. Winds flow parallel to the front, but in opposite direction to each other—no prevailing wind to push front in any direction

D. Occluded fronts: form when faster-moving front overtakes a slower front

1. Cold front occlusion

a. Characteristics

(1) Rain or freezing rain

(2) Poor visibility from fog and low ceilings

(3) Embedded thunderstorms

b. Formation

(1) Forms when cold front contains air colder than the airmasses on both sides of the warm front and slides under the entire warm front

(2) Produces warm and cold front systems aloft, with the cold front extending to the surface

(3) Form predominantly over land

c. Wind changes

(1) Before passage, wind flows parallel to the front from higher to lower pressure

(2) After passage of overtaking cold front, wind flows perpendicular to overtaking front

Fig 3: *Cold Front Occlusion*

2. Warm front occlusion

a. Characteristics

(1) Rain or freezing rain

(2) Poor visibility from fog and low ceilings

(3) Embedded thunderstorms

Fig 4: *Warm Front Occlusion*

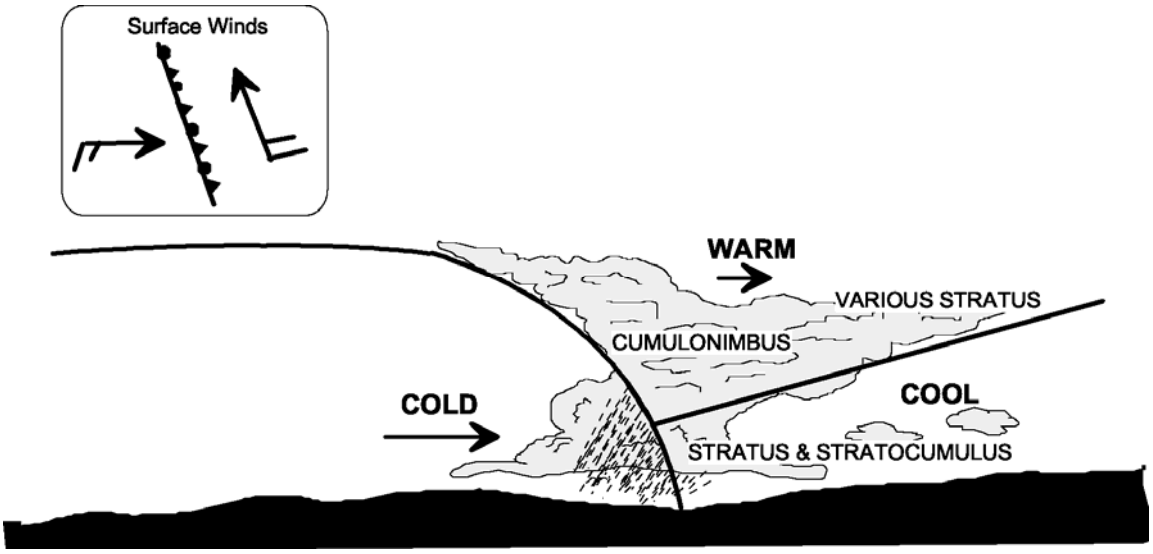


Figure 3: COLD FRONT OCCLUSION

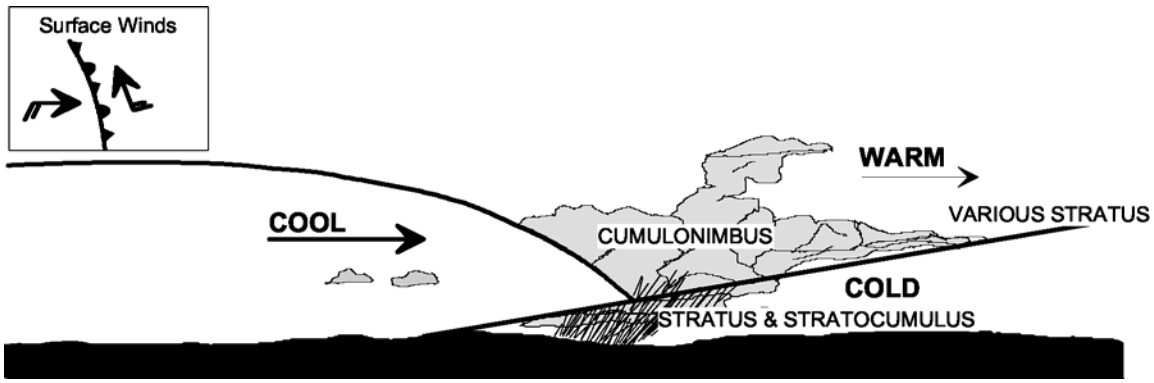


Figure 4: WARM FRONT OCCLUSION

b. Formation

(1) Forms when cold front contains air warmer than the “cold air side” of the warm front; cool air from the overtaking cold front slides under the warm air and over the cold air between the warm front airmasses

(2) Produces warm and cold front systems aloft, with the warm front extending to the surface

(3) Forms predominantly over water

c. Wind changes

(1) Before passage, wind flows parallel to the front from higher to lower pressure

(2) Behind warm front, wind flows perpendicular to the front, following prevailing wind in same direction as front

III. Meteorological phenomena and hazards **21.1.1.4**

A. Thunderstorms

1. Types

a. Air mass thunderstorms

(1) Convective air mass

(a) Generated by solar convection within unstable, moist air mass

(b) Generally isolated and scattered over wide area

(2) Orographic air mass

(a) Generated when unstable and moist air mass is lifted over hills or mountains

(b) Usually scattered among individual mountain peaks, but can cover larger areas

b. Frontal thunderstorms

(1) Cold front

(a) Generated by cold air sliding under moist warmer air, forcing it aloft—resulting in violent thunderstorms

(b) Usually narrow bands—50 to 100 miles along the front

(c) Often develop into uninterrupted lines that are difficult to circumnavigate

(2) Warm front

(a) Generated when a warm and moist air mass is lifted (slides over) a cold air mass

(b) Less common and less violent than cold front due to more stability and less lifting force within the air mass

(c) Often embedded or obscured in stratiform clouds, making them difficult to see and avoid

c. Squall line: band or line of severe thunderstorms

(1) Usually associated with fast-moving cold fronts

(a) Usually form 50 to 300 miles ahead of the front—but can also form in most unstable airmasses

(b) Generally caused by upper airflow disturbance

(c) Build rapidly and are most severe in late afternoon and early evening

(2) Uninterrupted lines of cells often too long and wide to avoid--can be too high to fly over (more than 55,000 ft)

(3) Characterized by severe steady-state thunderstorms or “supercells” that can contain tornadoes, hail, and other severe hazards to aviation

2. Thunderstorm hazards **21.1.1.4.5**

a. Turbulence

(1) Hazardous turbulence present in all thunderstorms

(a) Up and down drafts can obtain speeds of 200 ft per second

(b) Up drafts are usually stronger than down drafts

(2) Aircraft control difficult to impossible

(3) Can be severe enough to cause structural damage or failure

NOTE: The storms that create the most violent turbulence are often producers of hail.

b. Hail

(1) Can occur in any thunderstorm at all altitudes

(2) Can occur beneath or up to 20 miles in front of the anvil top of large thunderstorms—denoted by a distinct shade of blue

(a) Under the anvil is particularly hazardous

(b) Can be found anywhere around the storm (in clear air)

(3) Can cause severe structural damage

NOTE: The largest recorded hail stone was 17 inches in circumference and weighed 1.5 lbs.

c. Tornadoes

(1) Occur most often with steady-state thunderstorms associated with cold fronts or squall lines

(2) Very intense local phenomena with wind shears clocked at more than 26,000 fpm (260 kts)

(3) Can be embedded in thunderstorm and thus invisible to pilot

(4) Mostly a low-level phenomenon, does not penetrate the storm more than 1,000 to 2,000 ft up into the bottom of the clouds

NOTE: “Waterspouts” are tornadoes that occur over bodies of water.

d. Lightning

(1) Can cause temporary or permanent loss of vision

(2) Can puncture aircraft skin

(3) Can damage electronic equipment and compass

(4) Probability of strikes to aircraft

(a) Probability is highest near the tops of thunderstorms (near the anvil region) decreasing rapidly with altitude

(b) Highly electrified clouds can be advected many miles from the parent storm

NOTE: Avoid <u>any</u> clouds downwind of thunderstorms

(c) Areas of low precipitation and/or low turbulence indicates high probability of lightning; conversely, in areas of high precipitation and/or turbulence, the probability of lightning is low

NOTE: Storms with high rates of natural lightning indicate a low probability of aircraft strikes.

(d) There is a greater probability of lightning strikes to aircraft during storm's decaying stages

(e) The highest probability for direct lightning strikes to aircraft are in those parts of the storm where ambient temperature is lower than -40 degrees Celsius (pressure altitude off 38,000 ft to 40,000 ft)

(f) Most lightning strikes to aircraft are triggered by the aircraft itself

NOTE: When flying in or around thunderstorms, the probability of lightning strikes exist at all altitudes. Therefore, the only proven way to avoid lightning strikes is to avoid thunderstorms by a wide margin when possible.

3. Operational considerations regarding penetration of thunderstorms

NOTE: Thunderstorms present many hazards and should be avoided whenever possible. In the event penetration cannot be avoided, the following NATOPS procedures should be utilized to minimize the danger.

a. Before penetration

(1) Plan a course to take you through the storm in a minimum amount of time, and do not alter it

(2) Penetrate at an altitude where the outside air temperature (OAT) is colder than -15 degrees C or warmer than +15 degrees C

(3) HALT

(a) Heat

i. Pitot heat switch - CHECK ON

(b) Airspeed/Attitude

i. Maintain turbulence penetration airspeed of 250 KIAS

ii. Go on instruments and stabilize airspeed and attitude prior to penetrating the storm

iii. Adjust ADI reference

iv. Fly on a heading calculated to provide the quickest passage through the storm at an altitude affording the least turbulence and icing while clearing all ground obstacles by a wide margin

v. Avoid the upper 2/3 of a mature cell (turbulence and hail) and freezing level +/- 2,000 ft (lightning)

(c) Light

i. Turn all cockpit lights to bright including floodlights

(d) Tight

i. Lower the seat to the bottom to prevent striking the head against the canopy and to reduce the blinding effect of lightning and do not look outside of the cockpit

ii. Tighten lap belts

b. Upon penetration

(1) Fly constant power and pitch attitude by referencing the ADI; chasing the altitude or airspeed could result in unusual flight attitudes and/or structural overstress. Use the smallest pitch corrections possible

(2) Keep eyes on flight instrumentation and avoid looking outside because lightning flashes can cause temporary or permanent loss of vision

(3) Fly constant heading and do not attempt to turn around because the fastest way through a storm is a straight line, which also lessens the chance of becoming disoriented

(4) Be prepared for turbulence, hail, rain, and pitot static failure due to icing

B. Microbursts **21.1.1.4.1.2**

1. Description and composition

a. Intense and localized downburst of air that descends from a thunderstorm and, upon reaching ground, spreads horizontally

b. Usually found beneath thunderstorms with visible rain or virga

c. Usually 1 to 2 miles in diameter; wind speeds can exceed 100 kts (10,000 fpm) and be accompanied by rain or other obscuring phenomena; usually last less than ten minutes

Fig 5: *Duration Characteristics of Microbursts*

Fig 6: *Microbusrts*

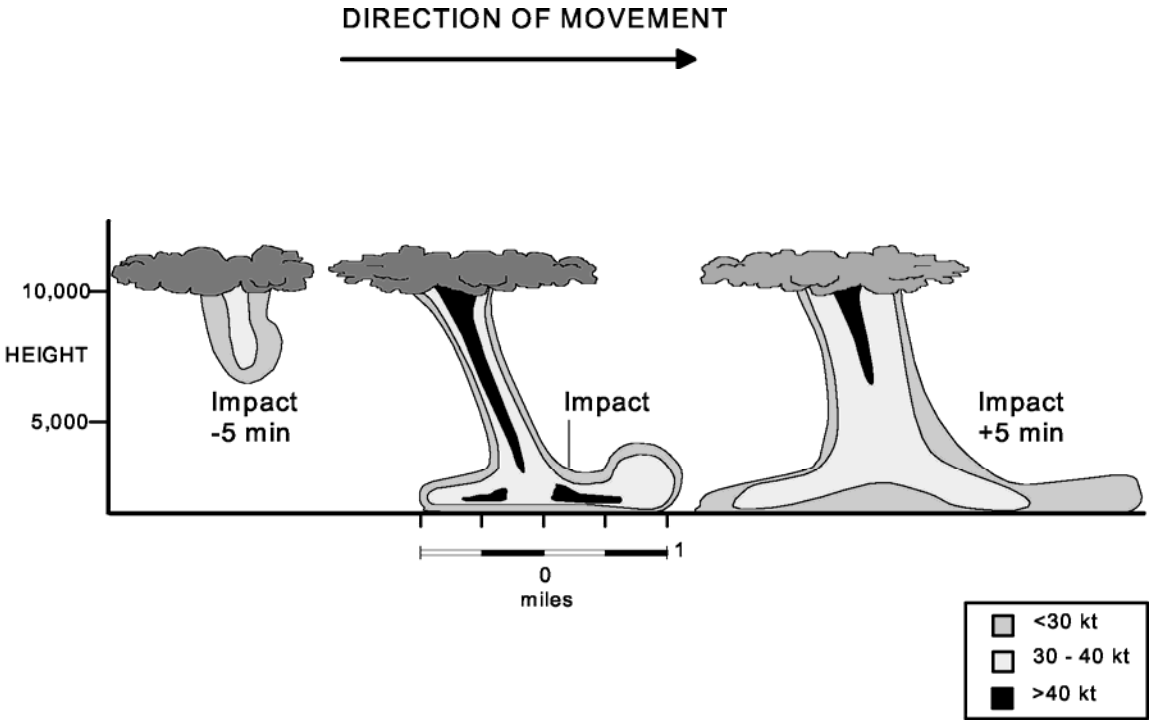


Figure 5: DURATION CHARACTERISTICS OF MICROBURSTS

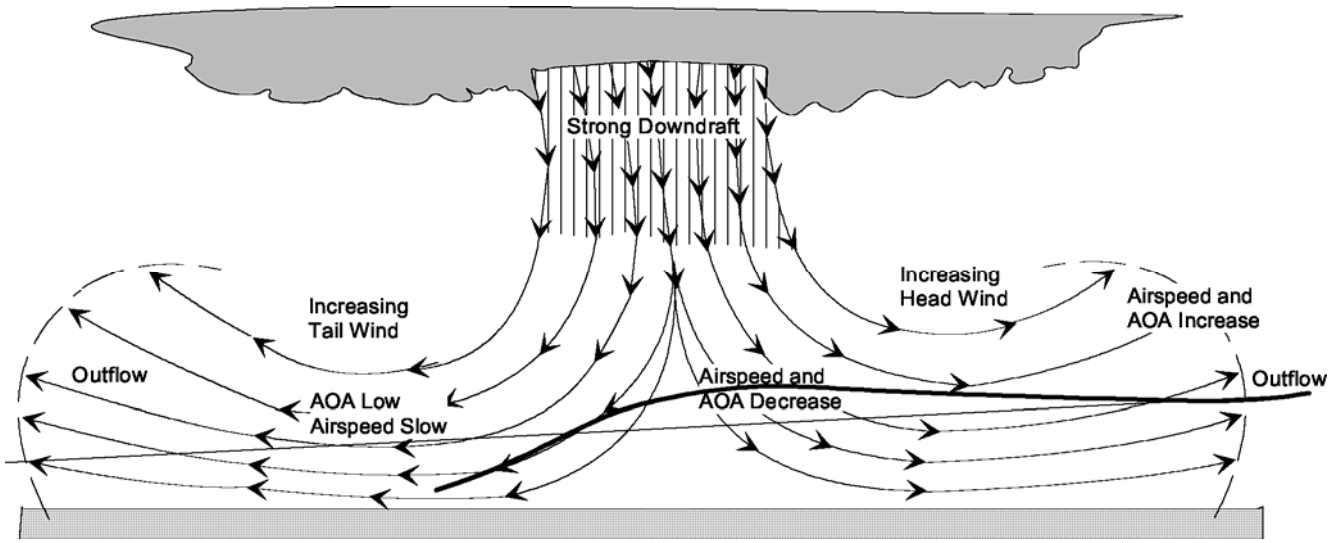


Figure 6: MICROBURSTS

d. Intense horizontal outflows at low altitudes result in extreme head wind to tail wind differentials that have been recorded in excess of 200 kts

e. Experience has shown that microbursts are not isolated, but usually occur in groups

2. Effects: a microburst approach scenario

Note: Microbursts can be encountered in the head wind, downdraft, or tail wind phase. The scenario below exemplifies an approach in which the aircraft enters a fully developed microburst at the rolling outflow. Pilot reactions depicted in the sequence are based on cockpit indications—with pilot unaware of the microburst.

a. Initial entry of aircraft into microburst (head wind and updraft)

(1) Conditions: airspeed and AOA increase, producing more lift and causing the aircraft to pitch nose high and to go high

(2) Indications: AOA indexer displays “slow” and glideslope shows high

(3) Normal pilot response: reduces power and AOA

(4) Effects: stops the climb and reestablishes descent rate and on-speed AOA

b. Outflow area prior to microburst core (head wind shifting to downdraft)

(1) Conditions

(a) Airspeed and AOA decrease due to shift in air mass movement, reducing lift

(b) Descent rate increases

(2) Indications: AOA indexer “fast,” VSI shows increased rate of descent, and airspeed begins to fall

(3) Normal pilot response

(a) Raises nose attitude to correct for “fast”

(b) Delays power application due to continued high indication

(4) Effects: energy loss is undetected

c. Microburst core (predominantly downdraft)

(1) Conditions

(a) Airspeed continues to drop and AOA continues to decrease due to continuing shift in air mass movement

(b) Descent rate continues to accelerate

(2) Indications

(a) High on glideslope and correcting

(b) "Fast" despite continued back stick

(3) Pilot response: continues to raise nose to arrest descent rate and to achieve on-glideslope and on-speed with minimum use of power

(4) Effects: continues unarrested descent in "fast" condition despite high nose attitude—pilot response is insufficient to keep up with shift of wind direction

d. Outflow area beyond microburst core (predominantly tailwind)

(1) Conditions

(a) Rapid wind shift from downdraft to tailwind causes sudden decrease in airspeed

(b) Aircraft "blows through" glideslope in a nose-high attitude

(2) Indications

(a) AOA rapidly changes from "fast" to "slow" due to excessively high nose attitude and loss of vertical component of wind—pilot "feels the bottom drop out"

(b) Airspeed continues to decrease

(c) Excessive descent rate

(3) Pilot response: pilot gauges altitude loss and realizes danger of situation—abandons approach, applies full power, and holds AOA above normal in effort to arrest descent

(4) Effects: airspeed and descent rate may stabilize—however, altitude loss will continue until aircraft accelerates to an airspeed that will yield a positive rate of climb (if possible)

Fig 7: *Microbursts Wind Shear Probability Guidelines*

MICROBURST WINDSHEAR PROBABILITY GUIDELINES

KEY: Low Probability - Consider the observation, but a decision to avoid is not generally indicated.
Medium Probability - Weight of observation is significant. Seriously consider decision to avoid.
High Probability - This observation requires critical attention. Decision to avoid is appropriate.

PILOT OBSERVATION	Probability of Windshear
Presence of convective weather near intended flightpath:	
With localised strong winds (tower reports or observed blowing dust, rings of dust, tornado-like features, etc)	High
With heavy precipitation (observed or radar indications of contour, red, or attenuation shadow)	High
With rainshower	Medium
With lightning	Medium
With virga	Medium
With moderate or greater turbulence (reported or radar indications)	Medium
With temperature/dew-point spread between 17 and 28 degrees Celsius	Medium
Onboard windshear-detection system alert (reported or observed)	High
Pirep of airspeed loss or gain	
15 knots or greater	High
Less than 15 knots	Medium
LLWAS alert or wind velocity change	
20 knots or greater	High
Less than 20 knots	Medium
Forecast of convective weather	Low

Note: These guidelines apply to operations in the airport vicinity (within three miles of the point of takeoff or landing along the intended flightpath and below 1,000 feet altitude). The clues should be considered cumulative. If more than one is observed, the probability weighting should be increased. The hazard increases with proximity to the convective weather. Weather assessment should be made continuously.

Caution: No quantitative means now exist for determining the presence or intensity of microburst windshear. Pilots are urged to exercise caution in determining a course of action.

There is a program underway to install Doppler Radar at major airfields. Doppler Radar can provide early warning by detecting microburts.

Figure 7: MICROBURST WIND SHEAR PROBABILITY GUIDELINES

3. Indications of microburst activity

   a. Blowing dust, dust devils, and gust fronts (down bursts will occasionally generate distinctive circular dust patterns)

   b. Thunderstorms in vicinity with visible areas of intense downdrafts indicated by rain or virga

   c. Sudden and unexplained increase in airspeed as noted on airspeed indicator accompanied by increased AOA—indicative of rolling outflow

   d. Sudden increase in rate of descent accompanied by a lower AOA—indicative of entry into microburst core

   e. Extreme variations in wind velocity and direction in short time

   f. Significant differences between winds at 1,500 to 2,000 ft AGL and the surface winds

   g. LLWAS (Low-Level Wind shear Alert System) alert

      NOTE: The LLWAS is comprised of a series of wind sensors located at various positions on the airport. The system senses wind shear occurrences through comparison of readings from the various wind sensors. LLWASs are installed at several major airports around the U.S. Unfortunately, some micro-bursts are so small that they can fit between the sensors. Doppler radar has proven effective in detecting microbursts and is being installed at major airports.

   h. PIREP of wind shear or airspeed gain or loss

      NOTE: Although PIREPs are important to alert other pilots of microbursts, microburst intensity can change rapidly, so even recent PIREPs may not reflect the true strength of a microburst—listen to the aircraft ahead or ask for PIREP information from ATC.

4. Avoidance

   a. Takeoff: delay departure

   b. Landing: delay approach, use alternate runway/approach, or proceed to nearby alternate

5. Response during landing

   a. Execute a missed approach immediately—response time is critical

   b. Recognize that excess airspeed is necessary to maintain flight beyond core of microburst--don't pull power

c. Report encounter to ATC as soon as possible

Note: With proper technique, high performance aircraft will be able to fly out of some microbursts, but not out of all. Avoidance is the best course of action, but if a microburst is encountered, recognition and reaction prior to being caught "low and slow" are the only safeguards.

C. Structural ice **21.1.1.4.2**

Fig 8: Structural Icing

WARNING: All structural ice, including frost, should be removed from all surfaces of the aircraft prior to takeoff.

1. Conditions of formation

a. Visible moisture must be present

b. Occurs most commonly near freezing level

c. Can form when flying through areas of

(1) Supercooled water droplets

(2) Freezing rain

(3) Wet snow

2. Types

a. Clear ice

(1) Found predominantly in convective/cumuliform clouds with large water droplets such as in thunderstorms

(2) Most common between 0 degrees C and -10 degrees C, but can occur as low as -25 degrees C

NOTE: In thunderstorms, icing can be found at any altitude above the freezing level, creating an additional known hazard.

(3) Also formed by freezing rain

(4) Smooth, clear appearance—very hard and heavy

(5) Very dangerous

(a) Accumulates rapidly

(b) Resistant to deicing systems

(c) Slow to sublimate or melt in non-icing environment

(d) Alters shape of wing--decreases lift, increases drag

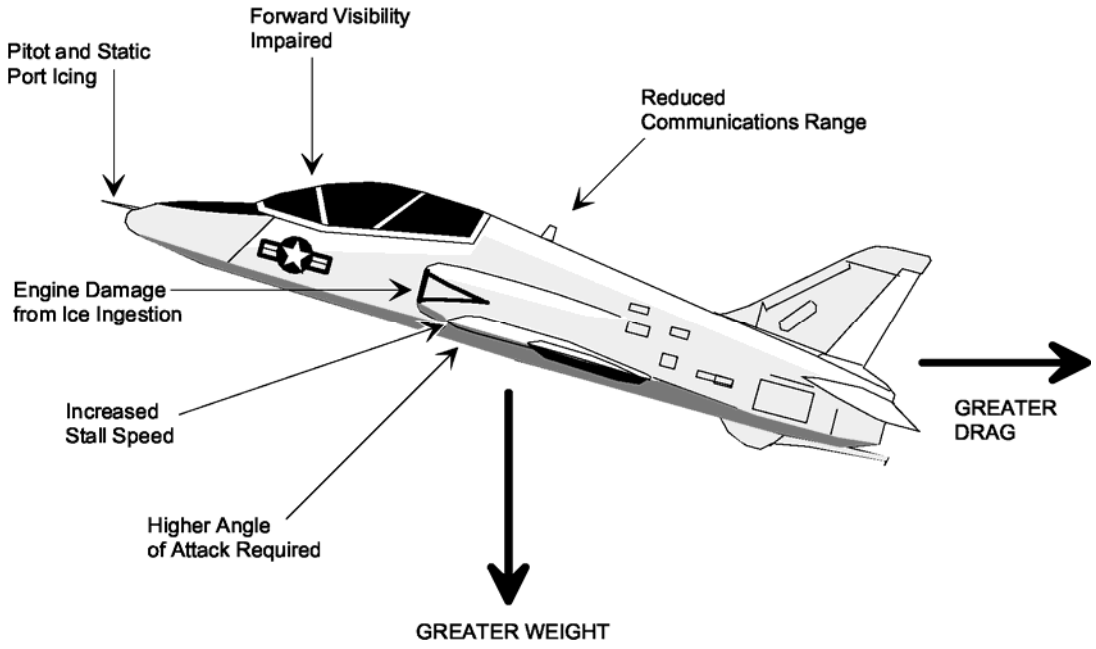


Figure 8: STRUCTURAL ICING

b. Rime ice

(1) Found predominantly in stratus cloud formations

(2) Most common between -10 degrees C and -20 degrees C

(3) Results from instantaneous freezing of water droplets

(4) Opaque and rough appearance

(5) Continuous icing in these conditions

(6) Tends to erode or blow off quicker than clear ice in non-icing environment

(7) Dangerous—alters shape of wing surfaces, decreasing lift and increasing drag

c. Mixed Icing

(1) Forms in mixed atmospheric conditions that contain both clear and rime ice

(2) Forms from water droplets of different sizes or when droplets intermingle with snow or ice particles

(3) Occurs at high altitudes within thunderstorms

(4) Conglomerate appearance, with adverse qualities of both rime and clear ice

d. Frost

(1) Forms on aircraft at night when temperature and dew point are within a few degrees of each other and temperature falls below freezing

(2) Can form during a rapid descent from subfreezing temperatures

(3) Rough texture greatly inhibits smooth airflow over wing surface, especially when present on leading edge of wing

(4) Any disruptions of laminar airflow over wing surface create the effect of a completely new airfoil

(5) Reduces lifting surface of the wing and adds drag

3. Hazards

a. Increases drag and weight

b. Decreases lift and increases stall speed: level flight requires higher angle of attack (AOA)

c. Effects on thrust production

(1) Propeller-driven aircraft

(a) Ice destroys smooth airflow over propeller surface, reducing propeller efficiency

(b) In some engine designs, induction system icing limits available air, therefore reducing available thrust

(2) Jet aircraft: large pieces of ice thrown free by airflow or deicing systems can be ingested by engines, resulting in engine damage or failure

d. Other considerations

(1) Pitot and static sources can clog, affecting reliability of Mach/airspeed indicator, altimeter, and vertical speed indicator (VSI)

(2) Visibility impaired due to windshield icing

(3) Engine sensors can clog, resulting in improper throttle and fuel control

(4) Radio range reduced

D. Fog **21.1.1.4.3**

1. Common conditions when fog can form: temperature and dewpoint must be within 3 degrees C/5 degrees F of each other

2. Fog might not form even under conductive conditions

3. Types

a. Radiation (ground fog): forms in saturated air when the temperature nears dew point and a light breeze is present

(1) Usually dissipates or “burns off” 1 to 4 hours after sunrise

(2) Wind more than 8 kts prevents or dissipates fog

NOTE: Radiation fog is common to NAS Meridian.

b. Advection: forms when moist air moves over surface cool enough to reduce temperature to near dew point (more frequent in winter than summer)

(1) Occurs usually near coastal regions of the southeastern United States, the Gulf Coast, and the Pacific Northwest

(2) Intensity increases rather than lessens with wind

NOTE: Advection fog is common to NAS Kingsville.

c. Precipitation: formed by rain or drizzle evaporating and adding moisture to air

(1) Usually associated with warm front where warm rain falls into colder air

(2) Can form quickly and cover a wide area

(3) Can be very dense and can continue for several days

d. Upslope (closely related to advection fog)

(1) Occurs along windward slopes of mountain ranges when saturated air ascends up a mountain slope and condenses

(2) The wider the spread between temperature and dew point at the base of the mountain, the farther up the slope it will form

e. Steam—forms when cold air moves overmuch warmer water, causing intense evaporation and raising dew point to near ambient temperature

f. Ice

(1) Formed by ice crystals suspended in air

(2) Decreases visibility in bright sunlight

(3) Most common in arctic regions

4. Hazards

a. Low to extremely low visibility

b. Can form quickly

c. Can affect a widespread area

Fig 9: *Polar and Subtropical Jet Streams*

E. Jet stream **21.1.1.3.5**

1. Forms in tropopause - the boundary between the troposphere and the stratosphere

   a. Height varies from 65,000 ft at the equator to 25,000 ft or less at the poles

   b. Tropopause drops by steps between arctic and polar air masses and another drop between the polar and tropical air masses

   c. Between the polar and arctic “layers,” the Polar Front Jet Stream forms; between the polar and tropical “layers,” the Subtropical Jet Stream is formed

      (1) Polar jet stream is the primary North American jet stream

      (2) Subtropical jet stream found between 25 degrees and 30 degrees North latitude

      NOTE: From the Hawaiian Islands eastward to southern Florida, the Subtropical Jet Stream sometimes drifts north and merges with the Polar Jet Stream.

Fig 10: *Jet Stream Profile*

2. Jet stream characteristics

   a. They area narrow, shallow band of strong westerly winds of 50 kts or more

      (1) Strength of the jet stream is stronger in the winter than in the summer

      (2) Wind speeds up to 300 kts have been recorded

         (a) Summer: average 75-100 kts

         (b) Winter: average 150-225 kts

Fig 11: *Polar Jet Stream*

   b. Jet streams wander vertically and horizontally around the hemisphere in wavelike patterns.

      (1) Jet streams in northern hemisphere are matched in southern hemisphere

      (2) They are stronger in some areas than others

      (3) They rarely encircle entire globe as a continuous river of wind

         (a) Most frequently found in 1,000- to 3,000-mile segments

         (b) 100- to 400-mile width

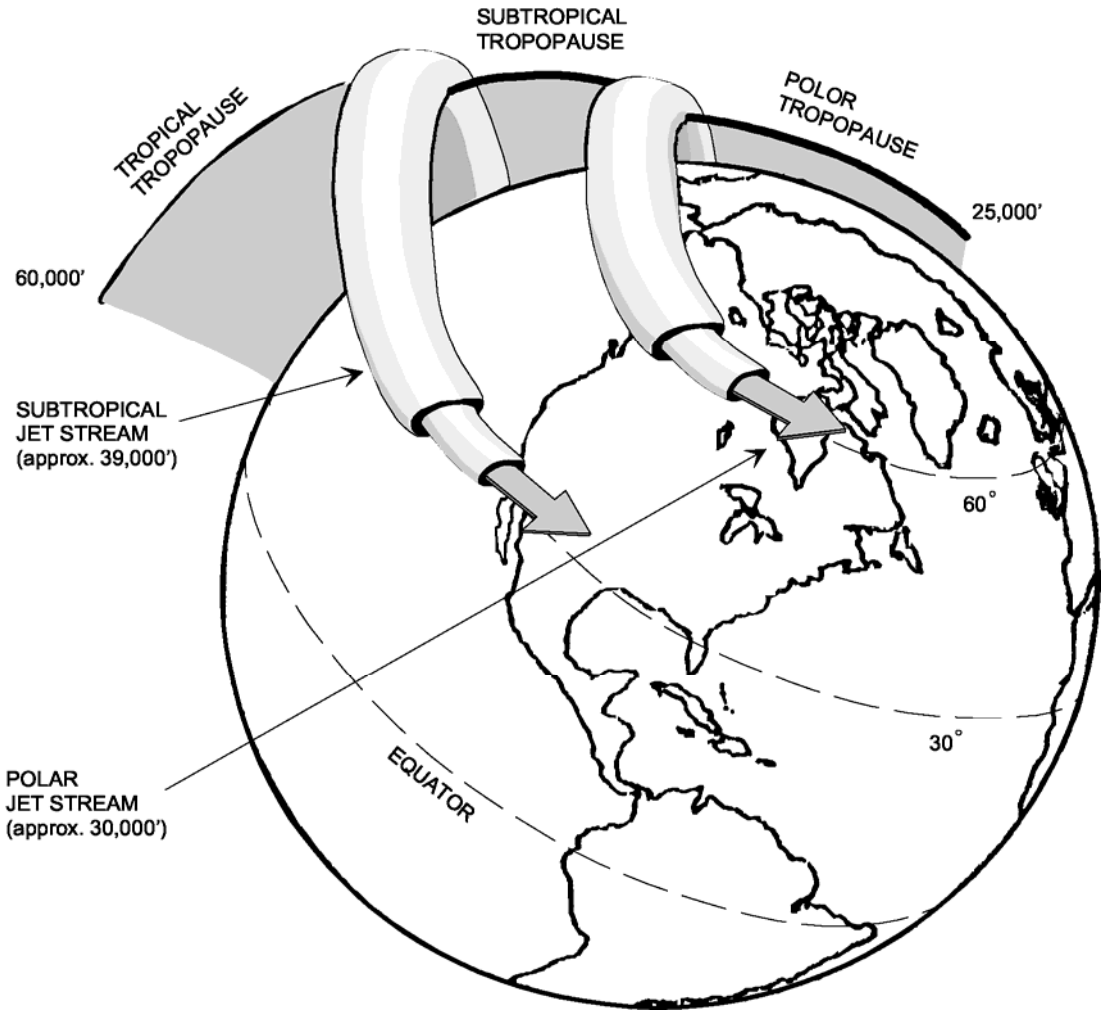


Figure 9: POLAR AND SUBTROPICAL JET STREAMS

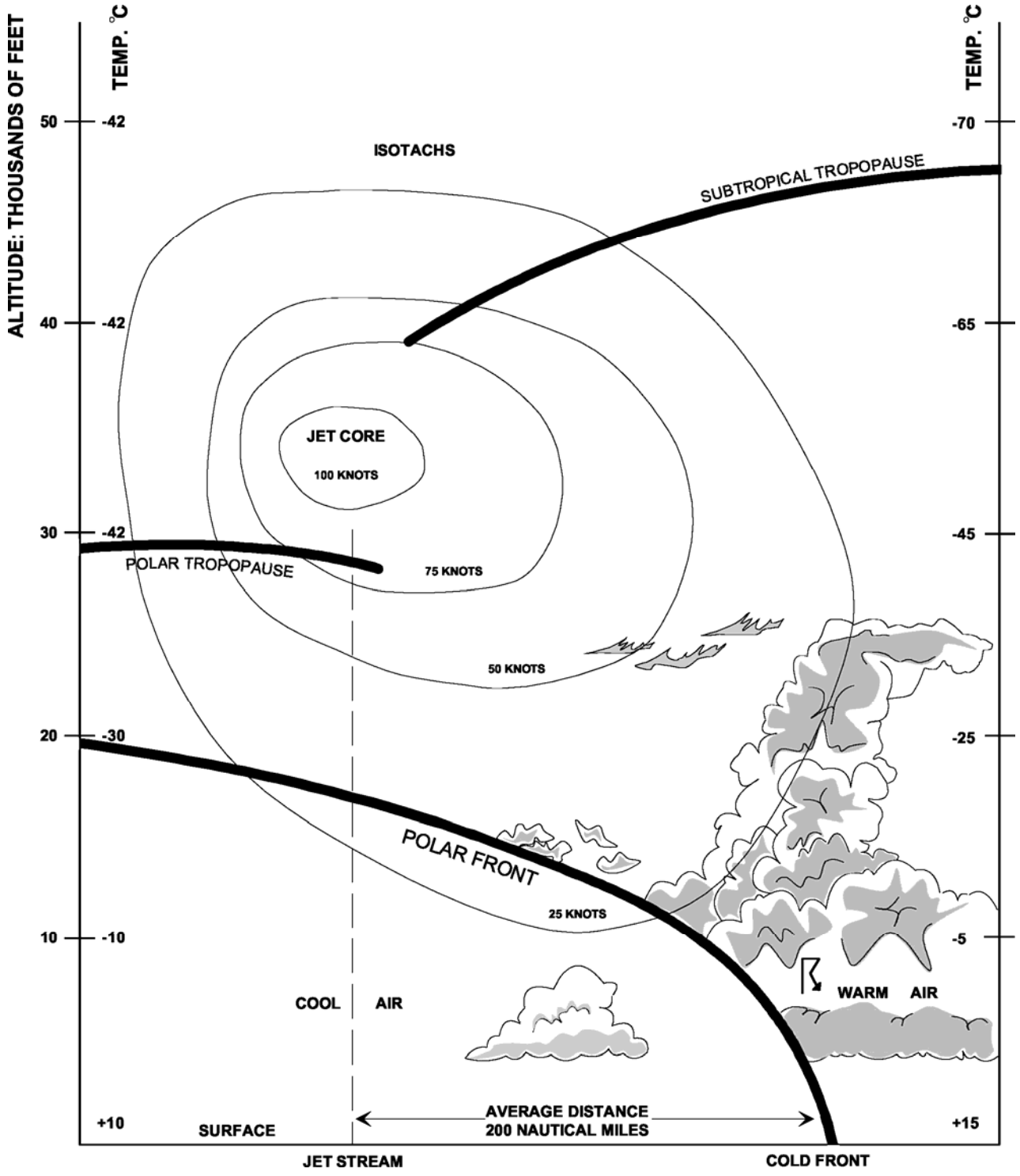
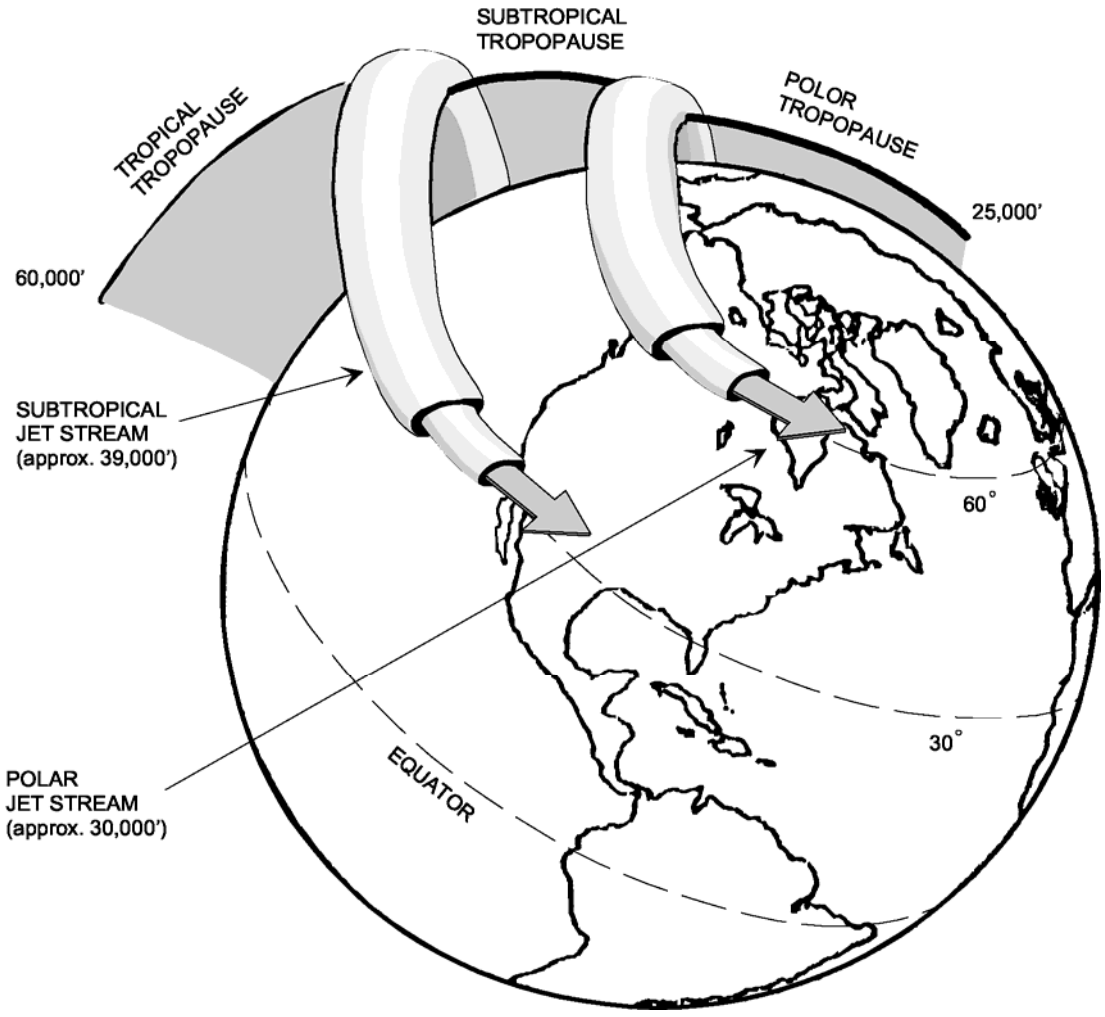


Figure 10: JET STREAM PROFILE



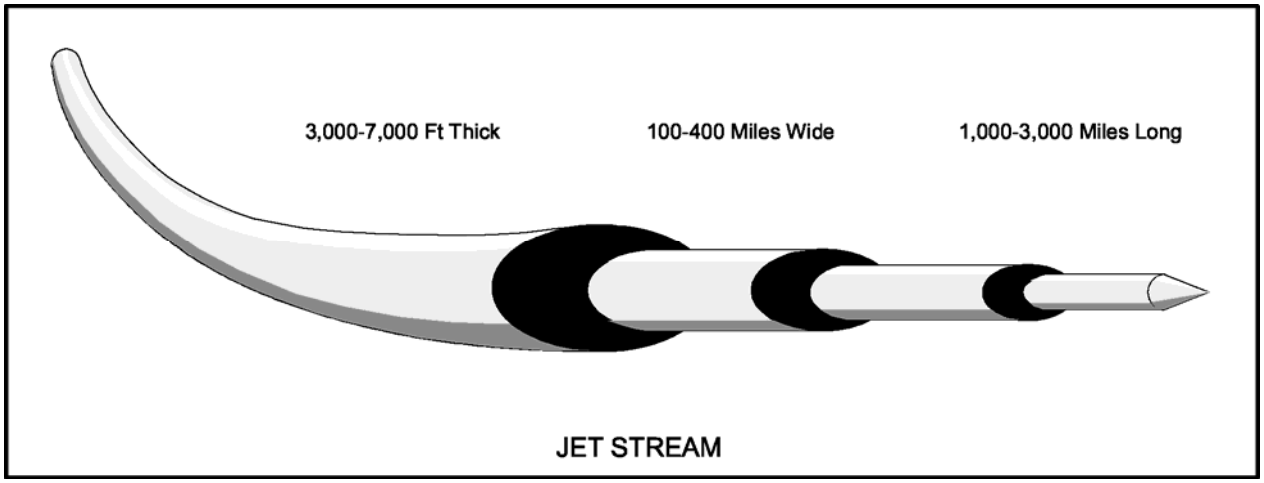


Figure 11: POLAR JET STREAM

(c) 3,000 to 7,000 ft in depth

(4) Mean position of Polar Jet Stream shifts south in winter and north in summer with polar front

(5) As polar front moves south, jet stream cores rise to higher altitudes and average speed increases

NOTE: The Polar Jet Stream appears to have a life cycle of formation, intensification, movement, and dissipation related to the polar front. The core of the strongest winds is generally found between 25,000 ft and 40,000 ft depending on latitude and season.

c. There are as many jet stream occurrences in the summer as in the winter

Fig 12: *Multiple Jet Streams*

d. Two jet streams can exist over the continental United States simultaneously

NOTE: When two are present, the southern one will usually be higher and have the strongest winds.

3. Flying the jet stream

a. Flying from west to east, speed and range can be greatly increased

b. Flying east to west decreases range and ground speed

(1) If caught in adverse wind flow, climb or descend to a colder air mass or take a more northerly track

(a) Wind speeds decrease rapidly on the north (polar) side and slowly on the south

NOTE: The average rate of change in wind speed is 100 kts for every 100 miles to the north of the core and 25 kts for every 100 miles to the south of the core.

(b) A decrease of 30 to 40 kts in 1,000 ft above or below the core of maximum winds is not uncommon

4. Jet Stream Meteorology

a. 200 (summer) and 300 (winter) millibar constant pressure charts are analyzed for lines of equal wind speeds (isotachs)

(1) Areas of 70 kts or greater are shaded and are equivalent to the horizontal limits of the jet stream

(2) Highest winds running through the axis of this area is the core

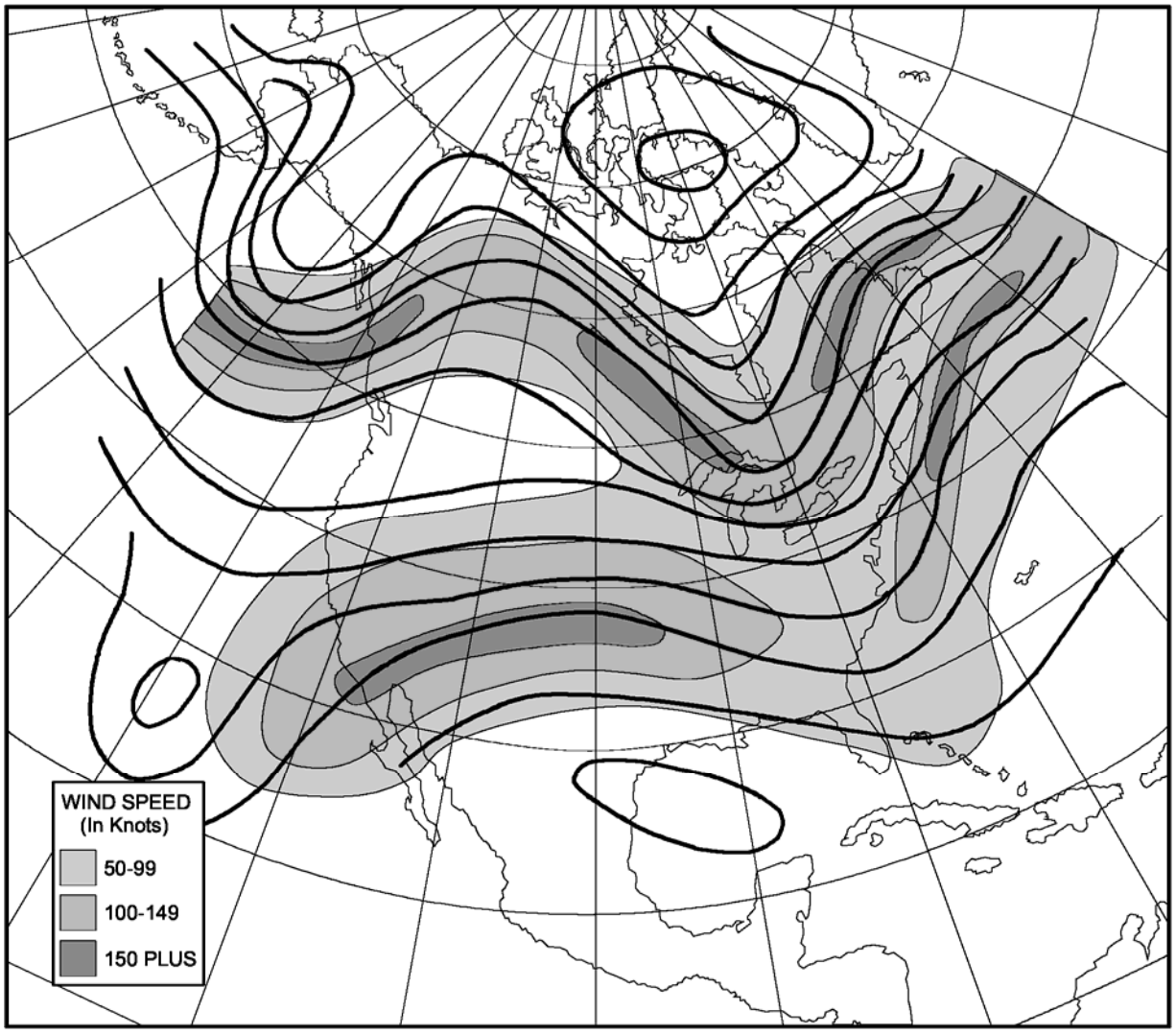


Figure 12: MULTIPLE JET STREAMS

(a) Vertical limits of the highest winds are usually 3,000 to 4,000 ft above and below the jet stream core

b. Satellite photos can give strong clues as to the jet stream locations

NOTE: Although there are few clouds at the jet stream core level, there is often considerable cloudiness below. These clouds are long and strung out along the jet stream.

Fig 13: *Jet Stream Clear Air Turbulence (CAT)*

F. Clear air turbulence (CAT) **21.1.1.4.1.1**

1. Types

a. Jet stream CAT

(1) CAT external to jet stream

(a) Especially severe when jet stream interacts with large mountain range or deep low-pressure system

(b) Can be anticipated when curving jet stream occurs on polar side of deep low-pressure system--greatest turbulence found on low-pressure side of jet stream and when wind speed exceeds 110 kts

(c) Can be anticipated along the jet stream north and northeast of a rapidly deepening low-pressure system

(d) Occurs frequently on inside of curve where jet stream turns sharply

Fig 14: *Areas of Probable CAT in Jet Stream*

(2) CAT internal to jet stream

(a) Can be found most often in areas of rapidly changing wind speeds

(b) Common near areas of highest wind velocity within jet stream, on polar side and below core

NOTE: Remember that the jet stream moves north in summer and south in winter.

b. Mountain wave CAT

Fig 15: *Mountain Wave Clear Air Turbulence (CAT)*

(1) High velocity airflow over mountain range is disrupted and causes turbulence over and downwind of range

(2) Produces large “waves” of air with strong updrafts and downdrafts

(3) Can extend to 5,000 ft above tropopause and to 300 miles or more downwind of range

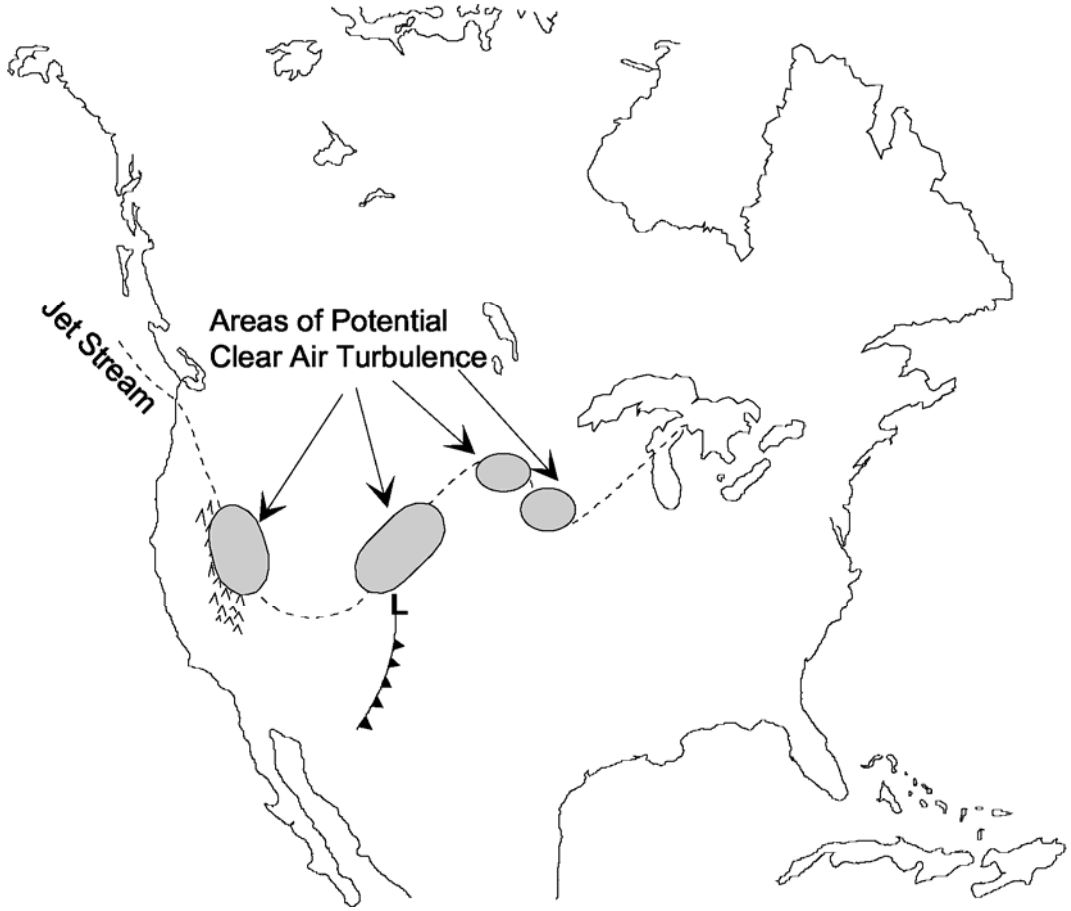


Figure 13: JET STREAM CLEAR AIR TURBULENCE (CAT)

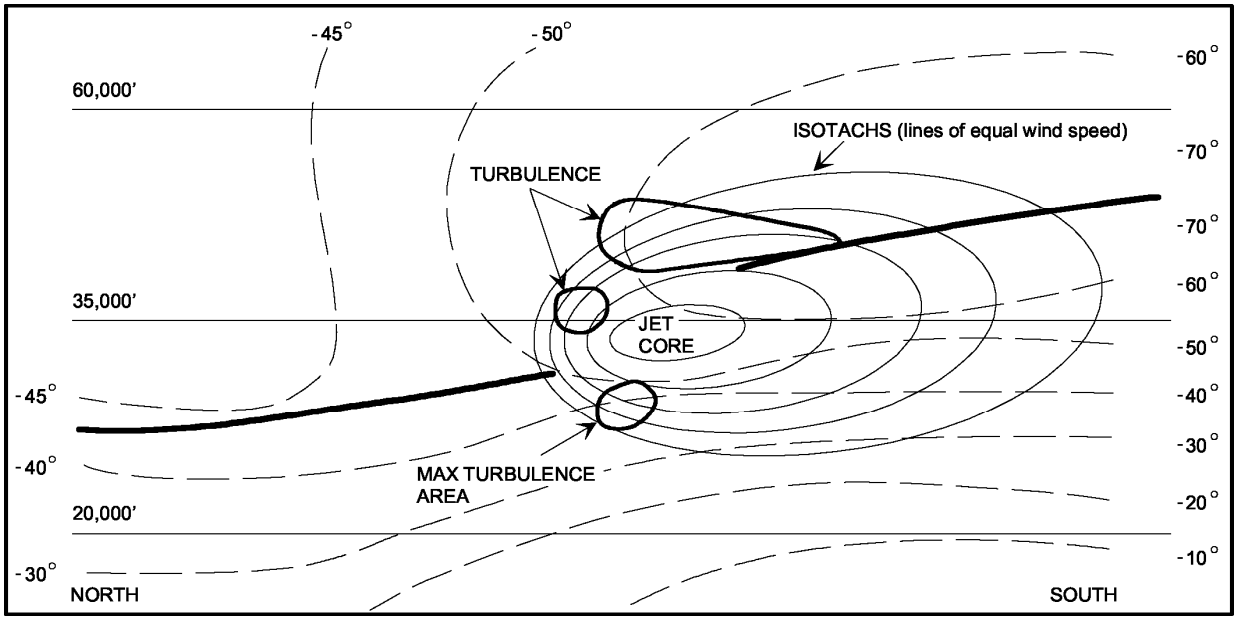


Figure 14: AREAS OF PROBABLE CAT IN JET STREAM

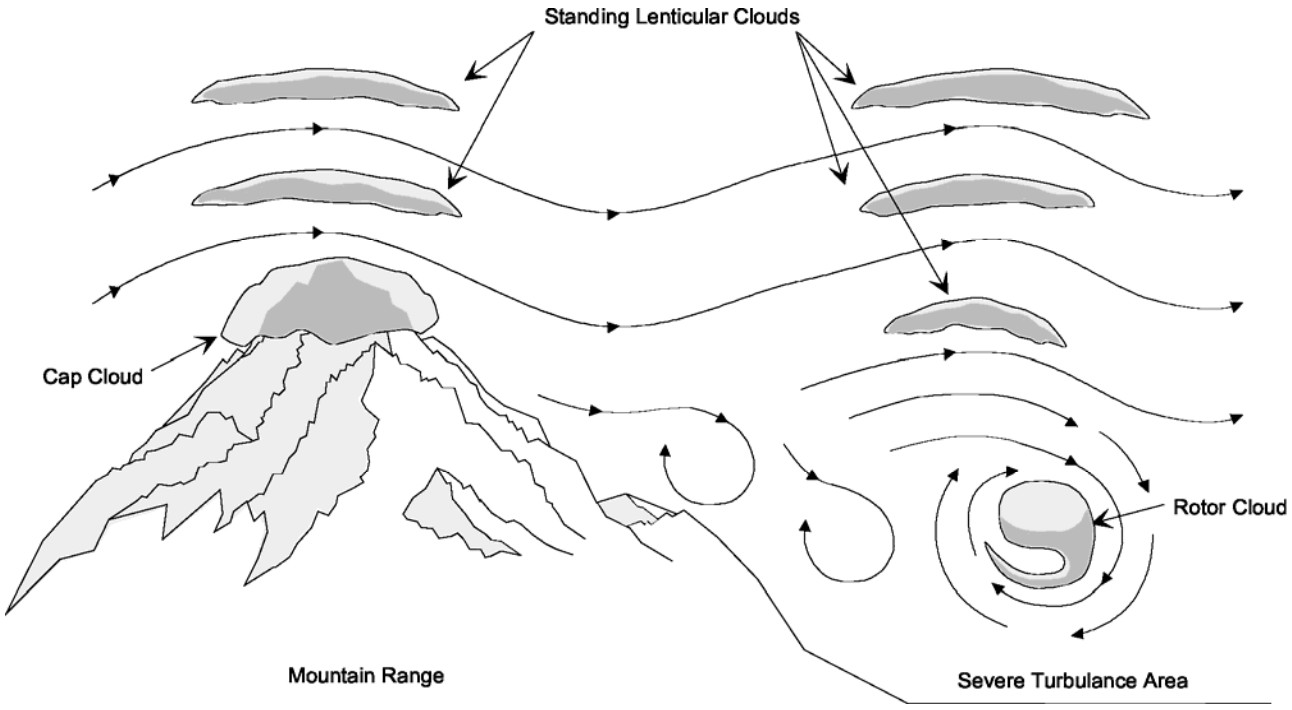


Figure 15: MOUNTAIN WAVE CLEAR AIR TURBULENCE (CAT)

(4) Rotor turbulence very severe below tops of mountains, especially near rotor cloud formation—similar to turbulence associated with thunderstorms but much stronger

(5) Can be identified by cap clouds on mountain top or standing lenticular clouds along the crests of the flow if moisture is sufficient

c. Other areas: can develop in areas where large differences exist in air mass temperature (e.g., inversions)

2. Operational considerations

a. To prevent structural damage, maintain appropriate speed (250 KIAS)

b. Severe downdrafts require higher terrain clearance minimums

c. Avoid rotor clouds, which have enough strength to literally break aircraft apart

G. Wake turbulence **21.1.1.4.4**

1. Characteristics

a. By-product of lift as aircraft takes off or before aircraft touches down, generated by pressure differential between upper and lower wind surfaces, causing air under wing to “roll up” around end of the wing, forming a vortex

NOTE: During landing, wingtip vortex disappears as the aircraft touches down.

b. Heavy and slow aircraft generate greatest vortex strength

NOTE: Tangential velocities of wingtip vortices have reached 133 kts in tests.

c. Vortices spread downward at approximately 400 to 500 fpm from the flight path and outward at approximately 5 kts, leveling off about 900 ft below flight path

d. Persists several minutes after generating aircraft is out of sight

e. Calm or light surface wind can carry vortices into next aircraft's flight path—light quartering tail wind requires maximum caution

2. Operational considerations

a. Plan a landing approach above approach path of previous aircraft and land beyond touchdown point

b. Plan to touch down before lift-off point of departing aircraft

c. Plan your lift-off point to occur before lift-off point of previous aircraft and climb out above its flight path

d. Delay your lift-off until beyond touchdown point of landing aircraft

IV. Weather minimums **21.1.1.1**

A. OPNAVINST 3710.7 destination weather **21.1.1.1.1.1**

NOTE: Weather at ETA +/- 1 hour dictates alternate weather requirements.

1. If destination is 0-0 up to but not including published minimums, then alternate must be 3,000-3 or better

2. If destination is at published minimums up to but not including 3,000-3 (single-piloted absolute minimums 200-1/2)

a. Then for non-precision approaches, alternate must be published minimums plus 300-1

b. Then for precision approaches, alternate must be published minimums plus 200-1/2

NOTE: ILS only authorized precision approach that can be used at an alternate, i.e., not a PAR.

NOTE: In the case of single-piloted aircraft, or other aircraft with only one operable UHF/VHF transceiver, radar approach minimums may not be used as the basis for selection of an alternate airfield.

3. If destination is 3,000-3 or better, no alternate is required

NOTE: CNATRA requires an alternate be filed for all cross-country flights, regardless of weather.

Fig 16: *Weather Miinimums Required IAW OPNAVINST 3710.7*

V. Weather charts **21.1.1.3**

A. Observed-weather charts

1. Surface analysis charts **21.1.1.3.1**

a. Based on hourly observed weather information

b. Provide ready means of locating pressure systems, fronts, and stations with potentially poor weather conditions

c. Disseminated every 3 hours

Fig 17: *Surface Analysis Chart*

<table>
<tr><td>DESTINATION WEATHER
ETA plus and minus one (1) hour</td><td colspan="3">ALTERNATE WEATHER
ETA plus and minus one (1) hour</td></tr>
<tr><td>0-0 up to but not including published minimums</td><td colspan="3">3,000-3 or better</td></tr>
<tr><td rowspan="3">Published minimums up to but not including 3,000-3 (single-piloted absolute minimums 200-1/2)</td><td rowspan="2">NON-PRECISION</td><td colspan="2">PRECISION</td></tr>
<tr><td>ILS</td><td>PAR</td></tr>
<tr><td>* Published minimums plus 300-1</td><td>Published minimums plus 200-1/2</td><td>*Published minimums plus 200-1/2</td></tr>
<tr><td>3,000-3 or better</td><td colspan="3">No alternate required</td></tr>
<tr><td colspan="4">*In the case of single-piloted or other aircraft with only one operable UHF/VHF transceiver, radar approach minimums may not be used as the basis for selection of an alternate airfield.</td></tr>
</table>

Figure 16: WEATHER MINIMUMS REQUIRED IAW OPNAVINST 3710.7

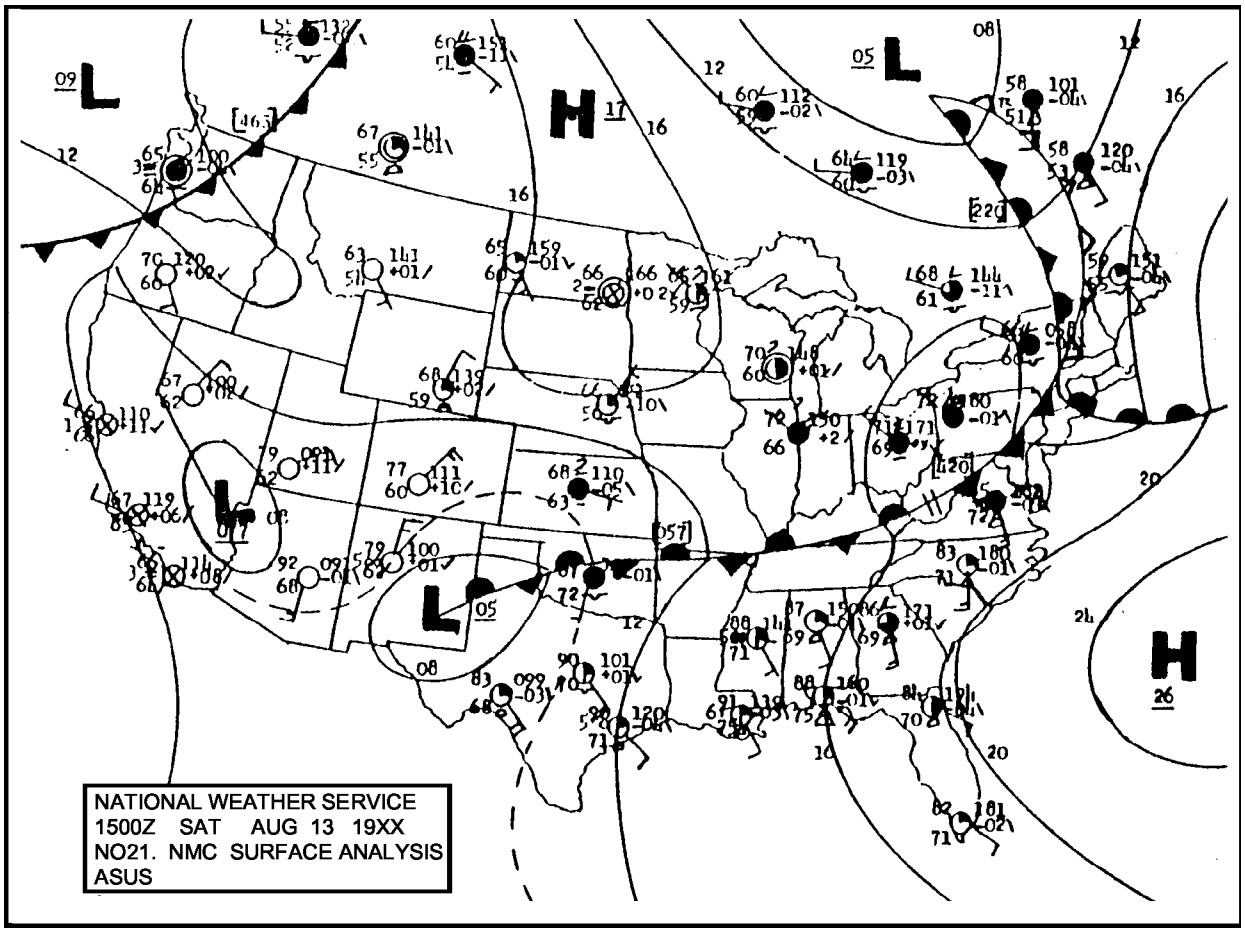


Figure 17: SURFACE ANALYSIS CHART

Fig 18: *Standard Chart Symbols*

Fig 19: *Major Station Model Symbols*

Fig 20: *Weather Depiction Chart*

d. Symbology

(1) Standard symbols depict fronts

(2) “H” or “L” and isobars denote pressure systems

(3) Station model includes information on sky coverage, wind direction and speed, temperature, dew point, precipitation, and other related information

2. Weather depiction charts **21.1.1.3.3**

a. Compiled from hourly surface aviation reports

b. Quickly identify positions of fronts and areas of VFR, marginal VFR (MVFR), and IFR weather

(1) MVFR (marginal visual flight rules) weather between 1,000 ft ceiling/3 miles visibility and 3,000 ft ceiling/5 miles visibility

(2) MVFR has no bearing on the civilian or military pilot but warns of poor flying conditions

(3) Chart contains a legend for clarity

c. Disseminated 8 times a day, every 3 hours starting at 0100Z

d. Symbology

(1) Standard symbols depict fronts (as on surface analysis chart)

(2) Contoured unshaded areas indicate MVFR weather with ceilings of 1,000-3,000 ft AGL and/or visibilities of 3-5 sm

(3) Contoured shaded areas indicate IFR weather with ceilings of less than 1,000 ft AGL and/or visibility of less than 3 sm

(4) The weather depiction chart station model contains no wind, temperature, or pressure information.

NOTE: The following items are depicted: sky coverage, height of lowest cloud layer (or ceiling height, if present) in ft AGL, visibility if 6 sm or less, and form of weather obscuring the visibility (as in Figure 20).

(5) Sky coverage symbols are different from those used for the surface analysis charts

(6) Some weather symbols used on the surface analysis are used on the weather depiction chart

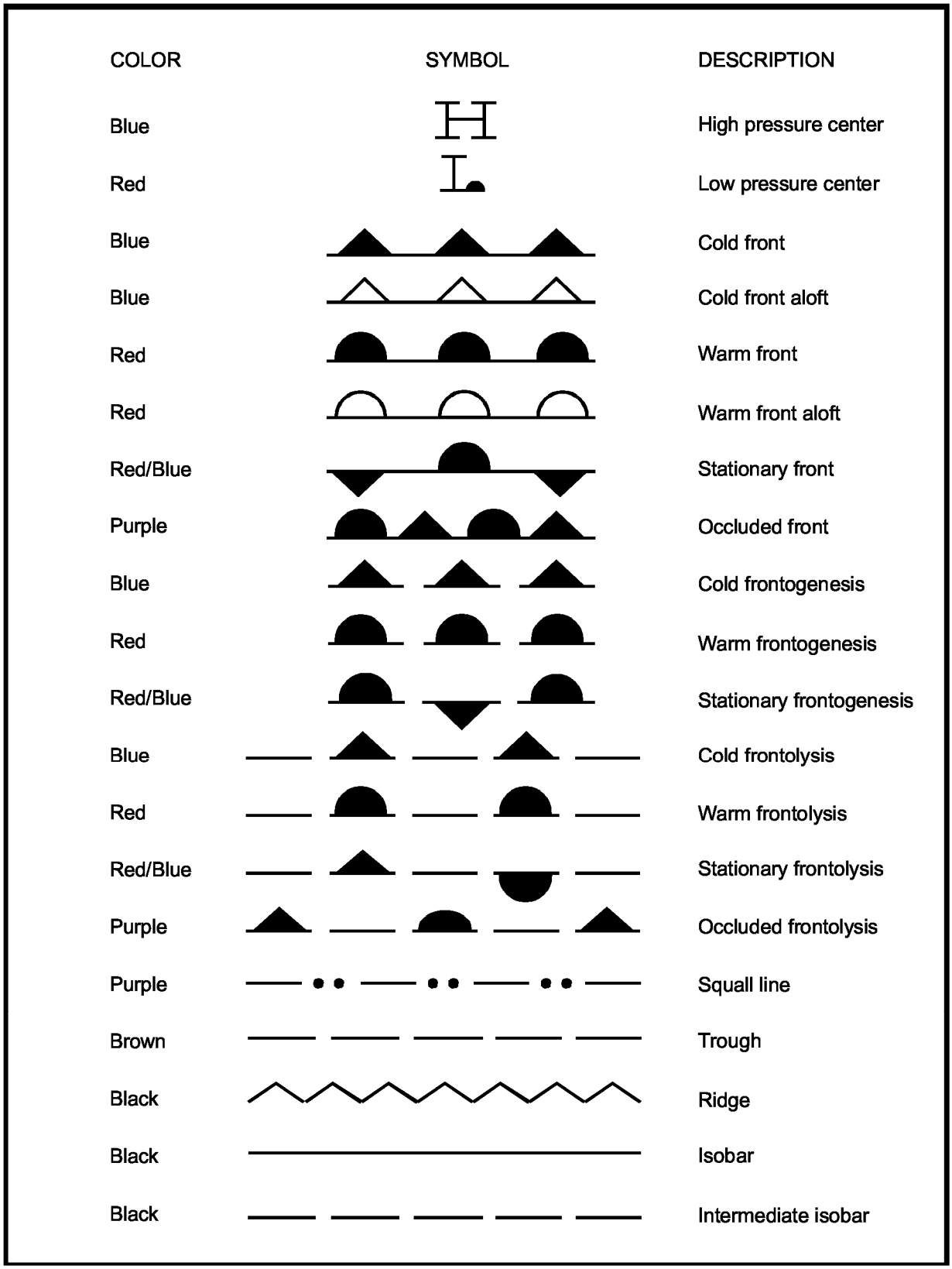
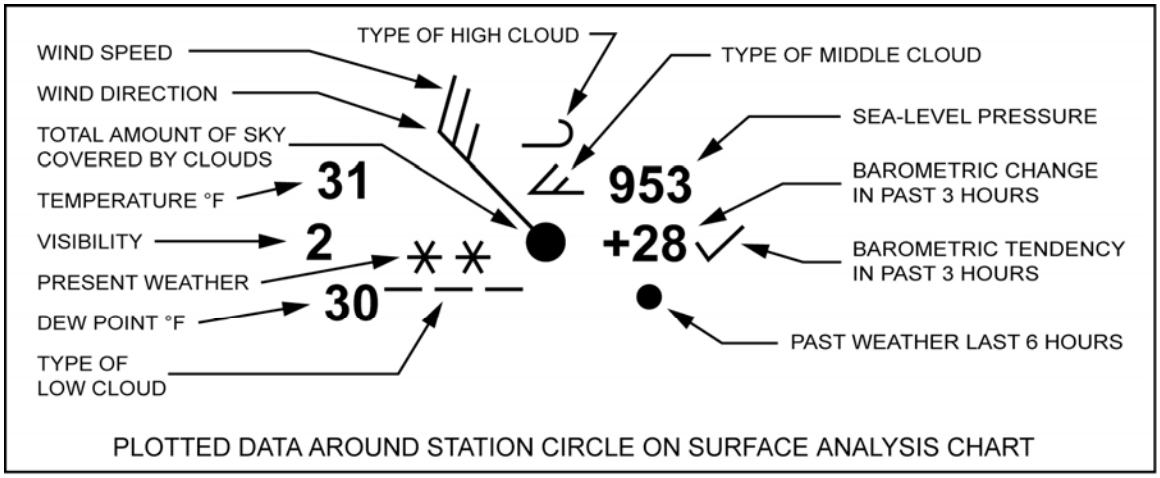


Figure 18: STANDARD CHART SYMBOLS

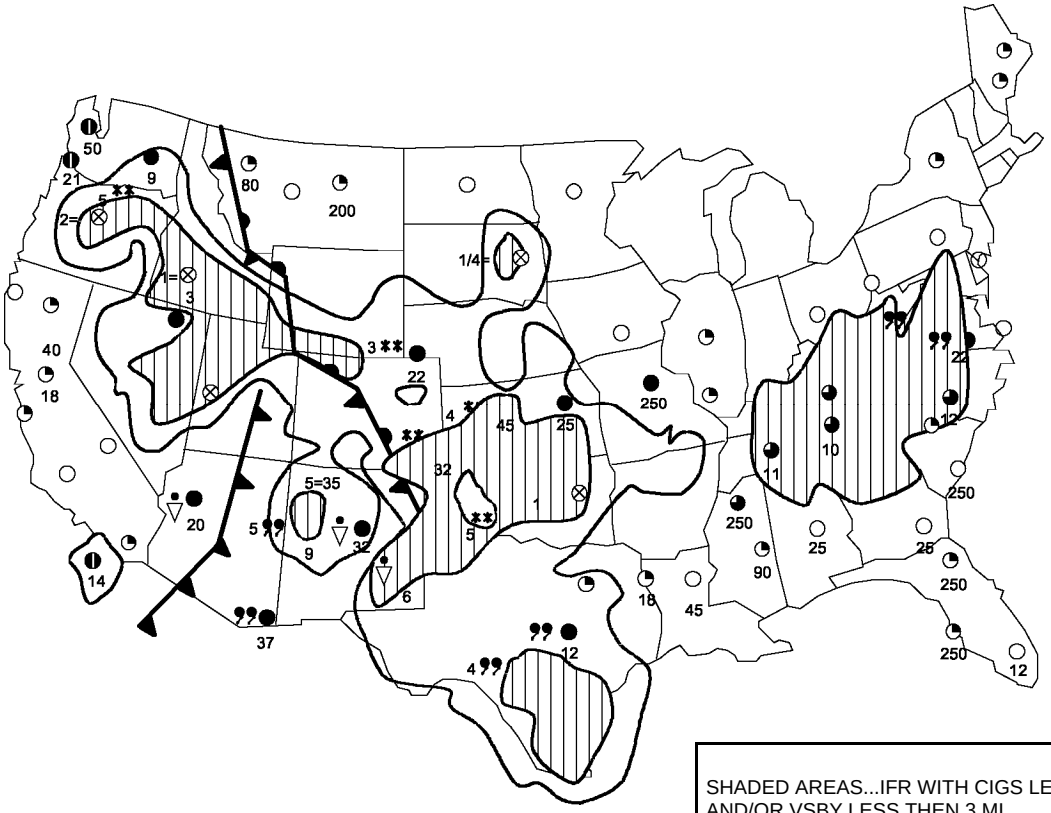


PLOTTED DATA AROUND STATION CIRCLE ON SURFACE ANALYSIS CHART

SKY CONDITION	PRESENT WEATHER		PRESSURE TENDENCY	CLOUDS
CLEAR	RAIN	RAIN SHOWER	RISING, THEN FALLING (+)	St
1/10 OR LESS	DRIZZLE	HURRICANE	RISING AND STEADY (+)	Sc
2/10 TO 3/10	SNOW	SQUALL	RISING (+)	Ns
4/10	ICE PELLETS	FUNNEL CLOUD	FALLING, THEN STEADY (+)	Cu
5/10	HAIL	BLOWING SNOW	STEADY	Cb
6/10	THUNDERSTORM	FOG	FALLING, THEN RISING (-)	Ac
7/10 TO 8/10	FREEZING DRIZZLE	BLOWING DUST OR SAND	FALLING, THEN STEADY (-)	As (THIN)
9/10	FREEZING RAIN	DUST DEVIL	FALLING (-)	Cl
COMPLETE OVERCAST	SNOW SHOWER	SMOKE	RISING, THEN FALLING (-)	Cc
OBSCURATION	THUNDERSTORM AND RAIN	HAZE	(+) HIGHER THAN 3 HOURS AGO (-) LOWER THAN 3 HOURS AGO	Cs

MAJOR STATION MODEL SYMBOLS

Figure 19: MAJOR STATION MODEL SYMBOLS



10Z MON 25 JULY 19XX

56. NMC WEATHER DEPICTION

SHADED AREAS...IFR WITH CIGS LESS THAN 1,000 FT AND/OR VSBY LESS THEN 3 MI.

CONTOURED WITHOUT SHADING...MVFR AREAS WITH CIG GREATER THAN OR EQUAL TO 1,000 TO LESS THAN OR EQUAL TO 3,000 FT AND/OR VSBY GREATER OR EQUAL TO 3 MI LESS THAN OR EQUAL TO 5 MI.

NO CONTOURS...VFR AREAS WITH CIG GREATER THAN 3,000 FT AND VSBY GREATER THAN 5 MI.

Figure 20: WEATHER DEPICTION CHART

Fig 21: *Radar Summary Chart*

3. Radar summary charts **21.1.1.3.2**

   a. Derived from radar returns from National Weather Service (NWS), terminal, and Air Route Traffic Control Center (ARTCC) weather radar stations across the U.S.

      (1) Weather radar used is primarily X-band (UHF), which is more sensitive to weather echoes

      (2) Computer-produced facsimile presentation from radar returns

   b. Identify general areas and movement of precipitation and thunderstorms for preflight planning purposes

   c. Disseminated once an hour, 35 minutes past the hour

   d. Symbology

      (1) Areas of echoes are marked with a solid outline and crosshatched

         (a) 6 different levels of intensity

         (b) Only contours for levels 1,3,5 are plotted; levels 2,4,6 are interpolated between them

         (c) Intensities

            i) Weak

            ii) Moderate (moderate to severe turbulence possible)

            iii) Strong (severe turbulence possible and lightning)

            iv) Very strong (severe turbulence probable and lightning)

            v) Intense (severe turbulence, lightning, hail likely, and organized wind gusts)

            vi) Extreme (severe turbulence, lightning, large hail, and extensive wind gusts and turbulence)

         (d) Line of echoes (such as a squall line) indicated by a solid line

      (2) Display tops and bottoms of radar echoes, if known, in hundreds of feet

      NOTE: Actual cloud tops and/or bottoms may be several thousand feet higher or lower.

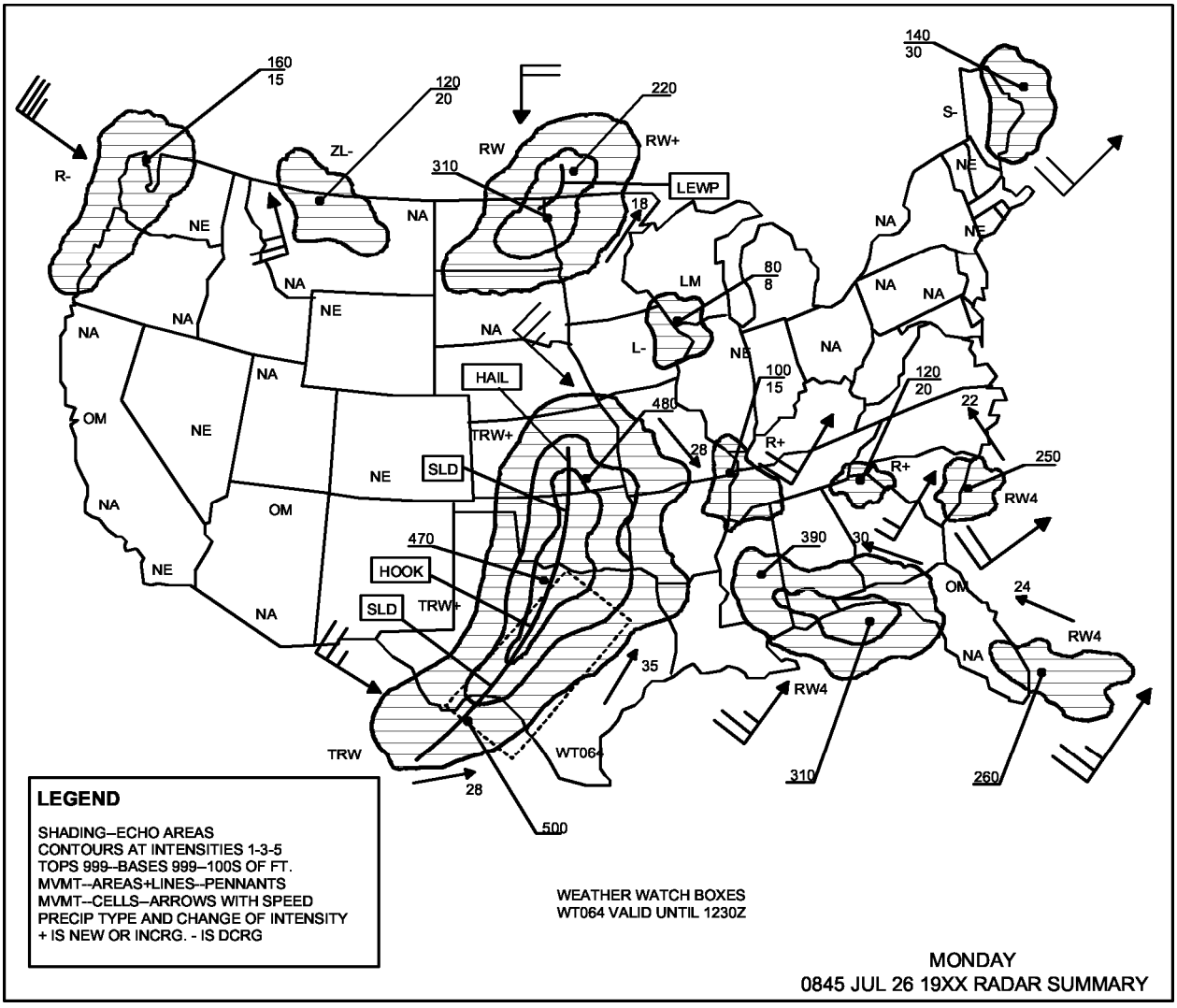


Figure 21: RADAR SUMMARY CHART

(3) Direction arrows

(a) Arrows with barbs or flags indicate area or line movement

(b) Arrows with number indicate direction and speed of individual cell within a line or area

NOTE: Arrows are oriented to eight cardinal points of compass.

(4) Contractions and letters depict the type of surface weather associated with the echoes

NOTE: A "+" (plus) symbol indicates the intensity of the echoes are increasing. A "-" (minus) symbol indicates decreasing intensity.

(5) Dashed line box indicates a forecast weather watch (WW) area

(a) Valid time and ID number of WW displayed alongside

(b) "WT" denotes tornado watch, "WS" indicates severe thunderstorms

NOTE: Only forecast information is on the RADAR Summary Chart; all other information is observed.

(6) If for any reason no echoes were observed, the following symbols are used to indicate why:

(a) "NE" - No Echo - echo information but none observed

(b) "NA" - Observation Not Available

NOTE: If plotted with station call letters, a report is available but received too late to plot.

(c) "OM" - Equipment Out for Maintenance

(d) "ROBEPS" - Radar Operating Below Performance Standards

B. Prognostic charts **21.1.1.3.4**

NOTE: Remember to correlate forecast flight conditions to scheduled flight time.

1. Low-Level Significant Weather Prognostic Chart

   a. Manually produced facsimile prognostic charts providing depictions of various surface and low-level (up to 24,000 ft MSL) significant weather features out to 48 hours

   b. The 12- and 24-hour forecasts are produced on one chart, 4 times a day

      NOTE: Separate panels depict the surface weather prognosis, and a second panel depicts the "significant weather" for each forecast time.

   c. The 36- and 48-hour forecasts are on a separate chart produced twice daily

      NOTE: A single panel depicts both surface features and significant weather. Underneath the panel, a forecast discussion about which guidance was used to prepare the chart and why it was used, is written in plain language with many abbreviations.

   d. Chart intended for general flight planning, see specific TAFs for terminal aerodrome forecasts

   e. Chart shares some symbology and coloration with the Surface Analysis (SA) chart

   f. Frontal type and position shown using standard symbols

      (1) High- and low-pressure centers indicated by Hs and Ls with the pressure value (underlined) to the nearest whole millibar

      (2) Pressure center movement is indicated by an arrow for direction, and the forecast speed of movement at the valid time of the chart is entered in knots at the head of the arrow

          NOTE: The term "STNRY" is used to indicate little movement.

      (3) Isobars will be depicted with a thin, solid line at an 8-millibar interval, labeled in tens and units of millibars

Fig 22: *Low-Level Prognostic Chart*

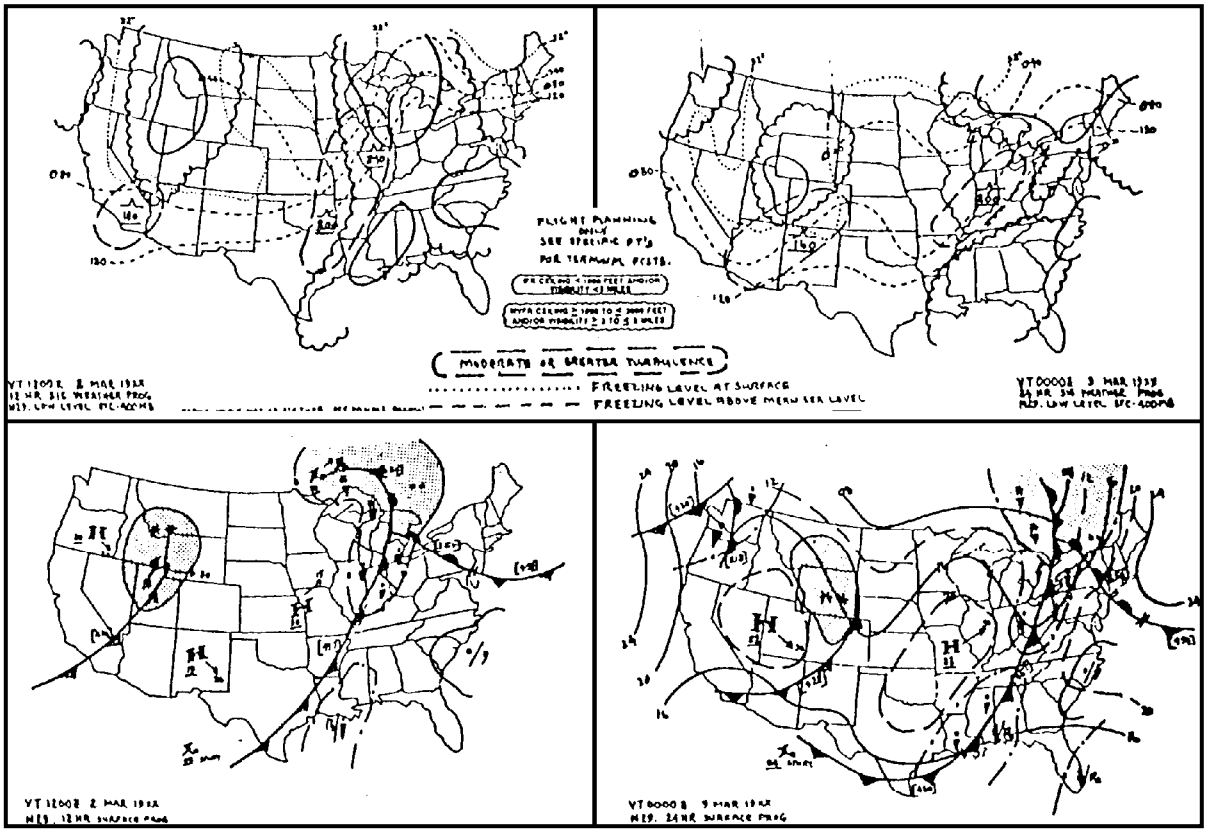


Figure 22: LOW-LEVEL PROGNOSTIC CHART

g. Chart always contains a legend in the middle of the top two panels

(1) Solid line indicates terminal areas with ceilings less than 1,000 ft and/or visibility less than 3 miles (IMC) - colored red

(2) Scalloped line indicates terminal areas with ceiling between 1,000 ft but less than 3,000 ft and/or visibility greater than 3 miles but less than 5 miles (MVFR) - colored blue

(3) Bold long-dashed lines indicate areas of moderate or greater turbulence

NOTE: The chart does not depict light turbulence. Moderate turbulence is symbolized by an inverted V, severe turbulence uses the same inverted V with a second inverted V above.

(a) No number below the V indicates turbulence from the surface up

(b) No number above the line indicates turbulence goes to above the limits of the chart (24,000 ft)

(c) The letters “SFC” will appear below the line if turbulence is expected from the surface to above 24,000 ft

NOTE: All turbulence altitudes MSL.

(4) The surface 32-degree isotherm is depicted with a dotted line and is labeled

(5) Freezing level aloft indicated with a short dashed line and labeled in hundreds of feet MSL at 4,000-ft intervals

NOTE: If an upper level freezing contour crosses the surface freezing line, multiple freezing levels aloft are indicated.

NOTE: Areas of icing are not specifically outlined on the chart; however, a pilot should know that icing is implied in clouds or areas of precipitation above the freezing level.

2. High-level significant weather prognostic—above 24,000 ft MSL

a. Manually prepared by NWS forecasters

b. Display 12- and 24-hour forecasts for significant weather conditions

c. Disseminated 4 times daily

d. Symbology

(1) Scalloped lines depict areas of widespread or embedded thunderstorms

(2) Broken lines display areas of CAT

(3) Depicts location of weather hazards, including widespread sandstorms or dust storms, squall lines, and tropical storms

(4) Arrows and wind flags show position and speed of jet stream

(5) Square boxes show height of the tropopause

NOTE: Meteorologists utilize the low-level significant Wx Prog chart more than the high-level. All of the high-level information is available from other sources, e.g., constant pressure charts. Many weather offices choose to not receive this facsimile from the National Weather Service.

Fig 23: *Winds Aloft Prognostic Chart*

3. Winds Aloft Prognostic charts

a. Computer-prepared forecasts of wind speed and direction and outside air temperature (OAT) for true altitudes of 6,000 ft, 9,000 ft, and 12,000 ft

NOTE: Charts are also available for the true altitudes of 18,000 ft (500 mbs), 24,000 ft (400 mbs), 30,000 ft (300 mbs), 34,000 ft (250 mbs), 39,000 ft (200 mbs), which approximate the constant pressure charts.

b. Flight planning applications include computation of ground speed, time en route, and other performance figures

NOTE: Although the winds aloft prognostic charts are considered accurate for a quick ready reference, the winds aloft forecast (FA) teletype report is considered to be more accurate.

c. Disseminated 2 times daily in 12-hour prognostics

(1) 8-panel chart

(2) Chart does not forecast winds and temperature for a given time but considered average winds for the period of the chart, for use until next chart received

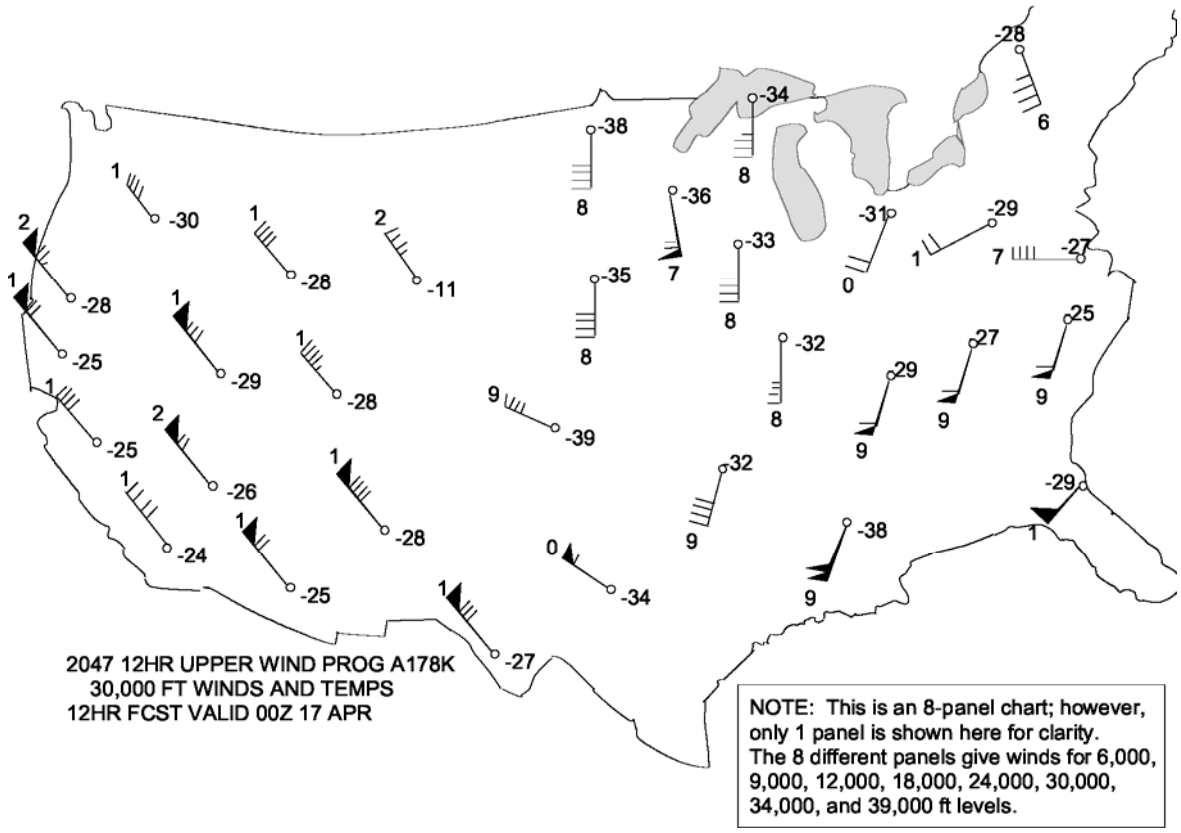


Figure 23: WINDS ALOFT PROGNOSTIC CHART

d. Symbology

(1) Wind shaft - depicts the quadrant from which the wind is blowing

(a) To 8 cardinal points of compass

(b) Number near the end of the shaft indicates direction to nearest 10 degrees

(2) Wind velocity indicated at top of shaft

(a) Flag for 50 kts

(b) Barb for 10 kts

(c) Half barb for 5 kts

(d) Accuracy to nearest 5 kts

(e) If calm or light and variable, wind will be shown as “99” to the lower left corner of station model

(3) Temperature depicted in degrees Celsius near base of wind flag

VI. Printed reports and forecasts **21.1.1.5**

A. METAR **21.1.1.5.4**

Fig 24: *METAR*

NOTE: METAR/TAF weather codes became effective July 1, 1996, at 0800 UTC. The following information is current as of April 1996. However, check the Aeronautical Information Manual and latest publications for more complete information and possible differences between the format and definitions presented here.

1. Beginning July 1, 1996, at 0800 UTC, the United States converted airport surface observations (SAs and SPs) and airport terminal weather forecasts to the International Civil Aviation Organization (ICAO) formats

a. The surface observations and terminal forecast formats and coding changed

b. Other weather products such as winds aloft (FD), area forecasts (FA), and pilot reports (PIREPs) changed little except to incorporate the new weather coding and station identifiers

METAR (or SPECI for Special Report) KPIT 201955Z (AUTO for automated observation) (COR for correction to observation) 22015G25KT 3/4 SM R28R/2600FT TSRA OVC010CB 18/16 A2992 RMK SLP013 T01760158

Figure 24: METAR

2. The hourly surface observations (SA) are referred to as METAR (Aviation Routine Weather Report), and the airport terminal forecast are referred to as TAF (Aerodrome Forecast). Pilots will notice some differences in the sequence in which information is presented, formatted (e.g., winds and cloud cover), and the abbreviations used.

3. With a little practice, pilots will find it easy to understand the new code and will find the additional information in the forecasts (TAF) very useful.

   a. Those who use DUATs (Direct User Access Terminal) or commercially provided weather services will find that all have included a plain language interpreter just as before

   b. In flight service briefings, the sequence of information may be different, and the temperature and dew point will be in degrees Celsius

      NOTE: When METAR data is missing from the body of the report (e.g., dew point), it is simply omitted; the user must know the sequence to recognize this. Some exceptions apply in remarks such as RVRNO, or SLPNO, when RVR or SLP are normally reported but not currently available.

4. To help remember the sequence, think of 3 W's at the beginning – Where, When, and Wind. This works for both METAR and TAF

   a. Where

      (1) KPIT is the ICAO station identifier

         (a) 3-letter identifiers are preceded by a "K" for the contiguous United States

         (b) Alaska and Hawaii use 4-letter identifiers, beginning with "PA" and "PH," respectively

         (c) Changes are planned to incorporate alphabetic identifiers for those weather reporting stations where numbers and letters are now used (e.g., W10 to KHEF)

   b. When

      (1) **20**1955Z is the **20th** day of the month

      (2) 20**1955Z** at **1955Z** time

c. Wind

(1) **220**15G25KT—reported as the 3-digit *true* direction to the nearest 10 degrees

NOTE: ATC towers, ATIS and airport advisory service report wind as *magnetic.*

(2) 220**15**G25KT—the 2- or 3-digit speed

(3) 22015**G**25KT—if the wind is gusting

(4) 22015G**25KT**-2- or 3-digit maximum speed and units

NOTE: 00000KT—calm winds.

(5) 22015KT **180V260**—wind direction varies 60 degrees or more, and wind is greater than 6 kts

(6) **VRB**—wind direction is variable, and speed is less than or equal to 6 kts

(7) **RMK**—peak wind is one element reported in the remarks section whenever the maximum instantaneous speed is greater than 25 kts. **22030/15** means a maximum *instantaneous* wind of **30** kts occurred **15** minutes past the hour from **220** degrees. **PK WND 22030/15**

d. Visibility

(1) 3/4SM—3/4 statute mile visibility. Miles and fractions are also reported (e.g., **2 3/4SM** for 2 and 3/4 sm visibility)

(2) R28R/2600FT—Runway Visual Range (RVR). Signifies that the runway visual range for runway **28 Right is 2,600** ft. The format is **R**(XXX) Runway Designator including (**L**)eft (**C**)enter or (**R**)ight/(**XXXX**) 4-digit visibility in ft

(3) Some coding pilots may also see for RVR include:

(a) **M**—indicates that RVR is less than lowest reportable sensor value (e.g., **M0600FT)**

(b) **P**—indicates RVR greater than highest reportable sensor value (e.g., **P6000FT)**

(c) V—variable. If the RVR is variable between 2,000 and 4,000 ft for runway 6L: (**R06L/2000V4000FT**). May contain up to four RVR reports

e. Significant Present Weather

(1) TSRA (Thunderstorm/Moderate Rain) Format is a 2-character descriptor (e.g., TS, SH, DR) sometimes followed by a 2-character weather phenomenon (e.g., RA, SN, FG)

(2) Intensity or proximity of weather phenomenon:

(a) "-"—Light

(b) "+"—Heavy

(c) "no sign"—Moderate

(d) "VC"—in the vicinity

f. Clouds

(1) OVC010CB—specifies cloud amount, height, and type. Overcast clouds are present at 1,000 ft consisting of cumulonimbus clouds

(2) Cloud height is reported in hundreds of feet. When clouds are composed of towering cumulus or cumulonimbus, TCU or CB will follow cloud height

(3) Clouds are categorized based on eighths (octas) of the sky

(a) SKC—Sky clear

(b) FEW—>0-2 octas

(c) SCT—3-4 octas

(d) BKN—5-7 octas

(e) OVC—8 octas

(4) Vertical Visibility (VV)—may be listed here for indefinite ceiling such as "VV004" for Vertical Visibility 400 ft

(5) Temperature/Dew Point—listed in degrees Celsius

NOTE: When temperatures are below 0 degrees C, they are preceded by “M” for minus (e.g., 10/M06 for temperature 10 degrees C, dew point -6 degrees C).

(6) Altimeter Setting—(ex. A2992) “A” indicates setting in inches of mercury for United States. Consists of 4 digits: inches and hundredths

(7) Remarks (RMK) come last

(a) **RMK SLP013** T01760158—Selected stations will contain SLP for sea level pressure reported as the last 3 digits in hectoPascals (millibars) to the nearest tenth (e.g., 1001.3 is reported as SLP013)

(b) RMK SLP013 **T01760158–**9-character code breaks down the temperature and dew point to the nearest 1/10th of a degree Celsius (selected stations)

(i) The “T” stands for temperature

(ii) The “0” means positive temperature

(iii) A “1” in place of the “0” stands for negative temperature

(iv) Other temperature codes, such as 10142, 20012, or 401120084, may appear to document temperatures not related to aviation (selected stations)

B. METAR on ASOS/AWOS **1.1.1.5.4**

1. ASOS/AWOS reports will also use METAR/SPECI code formats. An ASOS/AWOS report can be identified by the term A01 or A02 in the remarks (RMK) section. Example:

METAR KOFP 251955Z AUTO 30008KT 10SM CLR 22/10 A3010 RMK A02 SLP138 T02180096

2. Some ASOS/AWOS sites are attended

a. The term AUTO is not included in the report (A01 or A02 remain)

b. An attended site may contain information that has been manually provided by the observer

3. Only a fully automated site without human intervention will contain the word AUTO

4. When ASOS/AWOS reported sky condition is clear (CLR), it means no clouds at or below 12,000 ft

Fig 25: *Terminal Aerodrome Forecast*

C. TAF **1.1.1.5.1**

1. TAF contains a definitive forecast for specific time periods and will replace the terminal forecast

   TAF (TAF AMD – Amended Forecast, when included)

   KPIT 091730Z 091818 22020KT 3SM -SHRA BKN020

   FM2030 30015G25KT 3SM SHRA OVC015 TEMPO 2022 1/2SM TSRA OVC008CB

   FM0100 27008KT 5SM -SHRA BKN020 OVC040 PROB40 0407 00000KT 1SM -RA BR

   FM1000 22010KT 5SM -SHRA OVC020 BECMG 1315 20010KT P6SM NSW SKC

2. Once you know how to pick out the TAF forecast time periods, the same logical sequence that we saw in METAR will follow. Below, a TAF is broken down to highlight its individual segments. Key words (and their definitions) indicating a new time period has started are in boldface

   TAF

   KPIT 091730Z 091818 22020KT 3SM -SHRA BKN020

   FM2030 30015G25KT 3SM SHRA OVC015 WS015/30045KT **TEMPO 2022** 1/2SM TSRA OVC008CB

   FM2300 27008KT 5SM -SHRA BKN020 OVC040 **PROB40 0407** 00000KT 1SM -RA BR

   FM1000 22010KT 5SM -SHRA OVC020 **BECMG 1315** 20010KT P6SM NSW SKC

3. The **Where**, **When**, and **Wind** trick works with TAF; however, here's a little twist with the “when”

   TAF
   KPIT 091730Z 091818 22020KT

   a. Where

      (1) KPIT is the ICAO station identifier.

KNQI TAF 191515 16018G28KT 8000 FEW015SCT025CB BKN040 BKN250
52005 QNH2990INS VCTSSHRA
TEMPO 1900 VRB20G35KT 3200 TSSHRA BKN 015CB OVC025
BECMG 0102 17013G22KT 9999 SCT020 SCT250 QNH2995INS
BECMG 0910 14005KT 4800BR SCT010 SCT250 QNH3000INS
TEMPO 1013 0800FG VV002
BECMG 1415 16010KT 9000 HZ SCT020 SCT100 BKN250 QNH2992INS

Figure 25: TERMINAL AERODROME FORECAST (TAF)

(2) The usual 3-letter identifiers are preceded by a “K” for the contiguous United States.

(3) Alaska and Hawaii will use 4-letter identifiers beginning with “PA” and “PH” respectively.

(4) Changes are planned to incorporate 3-letter identifiers for those weather reporting stations where numbers and letters are now used (e.g., W10 to KHEF)

b. When

(1) 091730Z—the forecast for the 9th day of the month with an issuance time of 1730Z or UTC (2-digit date and 4-digit time)

(2) **09**1818—the valid period with the first 2 digits containing the day of the month (09)

(3) 09**18**18—the second 2 digits specify the hour beginning the forecast period (1800Z)

(4) 0918**18**—the last 2 digits are the hour ending the forecast period (1800Z on the next day, the 10th)

c. Wind

(1) WS015/30045KT means at 1,500 ft, we expect wind to be 300 degrees at 45 kts. This indicates low-level wind shear not associated with convective activity

d. Time Periods, Etc.

(1) FM2030—From 2030Z or UTC time (indicates hours and minutes)

(2) TEMPO 2022—Temporary changes expected between 2000Z and 2200Z

(3) FM2300—From 2300Z

(4) PROB40 0407—There is a 40% probability of this condition occurring between 0400Z and 0700Z

(5) FM1000—From 1000Z

(6) BECMG 1315—Conditions becoming as described between 1300Z and 1500Z

7. Once the specific time periods can be discerned, the sequence of wind, visibility, significant weather, cloud cover and cloud height follows and is repeated for each time block

   a. The only exception is after qualifiers such as PROB40, TEMPO, and BECMG, some of the components may be omitted if these are not expected to change

   b. Notice that after TEMPO 2022, there is no wind given, and after PROB40 0407, there is no cloud cover listed

      NOTE: When no significant weather (NSW) appears, it only indicates obstruction to visibility or precipitation previously noted has ended.

D. METAR/TAF **1.1.1.5.4, 1.1.1.5.1**

1. International Differences

   a. Pilots and operators who fly to international destinations are cautioned to be alert to differences between U.S. METAR/TAF and international METAR/TAF. The following are some key differences:

      (1) Altimeter Setting

         (a) The United States reports the altimeter setting in inches of mercury (e.g., A2992)

         (b) Internationally, it will reported in hectoPascals (millibars) (e.g., Q1016)

      (2) Wind

         (a) Internationally, wind may be reported in kts (KT), kilometers per hour (KMH), or meters per second (MPS). Appropriate units are indicated on both METAR and TAF

      (3) Wind Shear

         (a) Low-level wind shear, not associated with convective activity (e.g., WS015/30045KT, see TAF) will appear in TAFs in the United States, Canada, and Mexico only

(4) Visibility

(a) Internationally, visibility is reported in 4 digits, using meters, with the direction of the lowest visibility sector (e.g., 6000SW—meaning visibility is lowest at 6,000 meters to the southwest)

(b) In the United States, we use prevailing visibility in statute miles, not the lowest visibility, so the same conditions would be reported differently

(c) International visibility reports also contain a trend, such as:

i) D—Down

ii) U—Up

iii) N—No change

iv) V—Variable

2. Other

a. Remarks (RMK) included in U.S. METAR are transmitted to only Canada and Mexico and no other international stations

b. Pilots may also see the following notation on International METAR/TAF: CAVOK (Ceiling and Visibility OK)

(1) CAVOK is used to replace weather and clouds if visibility is 10 km or more, and there are no clouds below 1,500 meters (5,000 ft) or below the highest minimum air traffic control sector altitude, whichever is greater

(2) Also, there must be no other significant weather. NSC means no significant clouds

c. International TAFs may include temperature, turbulence, and icing forecasts

Fig 26: *METAR Abbreviations*

Fig 27*: METAR (SPECI or Special Report)*

Fig 28: *Area Forecase Coverage*

E. Area Forecast (FA) **21.1.1.5.3**

1. General - provides overview of aviation weather conditions over the United States and adjacent coastal waters

a. Used for flight planning and a weather briefing aid

AO1	Automated Observation without precipitation discriminator (rain/snow)
AO2	Automated Observation with precipitation discriminator (rain/snow)
AMD	Amended Forecast (TAF)
BECMG	Becoming (expected between 2-digit beginning hour and 2-digit ending hour
BKN	Broken 5-7 octas (eighths) cloud coverage
CLR	Clear at or below 12,000 ft (ASOS/ AWOS report)
COR	Correction to the observation
FEW	>0-2 octas (eighths) cloud coverage
FM	From (4-digit beginning time in hours and minutes)
LDG	Landing
M	In temperature field, means “minus” or below zero
M	In RVR listing, indicates visibility less than lowest reportable sensor value (e.g., M0600)
NO	Not available (e.g., SLPNO, RVRNO)
NSW	No Significant Weather
NOTE: NSW only indicates obstruction to visibility or precipitation previously noted has ended. Low ceilings, wind shear, and other weather conditions may still exist.	
OVC	Overcast 8 octas (eighths) cloud coverage
P	In RVR, indicates visibility greater than highest reportable sensor value (e.g., P6000FT)
P6SM	Visibility greater than 6 SM (TAF only)
PK WND	Peak wind
PROB40	Probability 40 percent
R	Runway (used in RVR measurement)
RMK	Remark
RY/RWY	Runway
SCT	Scattered 3-4 octas (eighths) cloud coverage
SKC	Sky Clear
SLIP	Sea Level Pressure (e.g., 1001.3 reported as 013)
SM	Statute mile(s)
SPECI	Special Report
TEMPO	Temporary changes expected (between 2-digit beginning hour and 2-digit ending hour)
TKOF	Takeoff
T01760158, 10142, 20012 and 401120084 In Remarks -- examples of temperature information	
V	Varies (wind direction and RVR)
VC	Vicinity
VRB	Variable wind direction when speed is less than or equal to 6 kts
W	Vertical Visibility (Indefinite Ceiling)
WS	Wind shear (In TAFs, low-level and not associated with convective activity)

DESCRIPTORS	
BC	Patches
BL	Blowing
DR	Low Drifting
FZ	Supercooled/freezing
MI	Shallow
PR	Partial
SH	Showers
TS	Thunderstorm

WEATHER PHENOMENA	
BR	Mist
DS	Dust Storm
DU	Widespread Dust
DZ	Drizzle
FC	Funnel Cloud
+FC	Tornado/Water Spout
FG	Fog
FU	Smoke
GR	Hail
GS	Small Hail/Snow Pellets
HZ	Haze
IC	Ice Crystals
PE	Ice Pellets
PO	Dust/Sand Whirls
PY	Spray
RA	Rain
SA	Sand
SG	Snow Grains
SN	Snow
SQ	Squall
SS	Sandstorm
UP	Unknown Precipitation (Automated Observations)
VA	Volcanic Ash

CLOUD TYPES	
CB	Cumulonimbus
TCU	Towering Cumulus

INTENSITY VALUES	
-	Light
no sign	Moderate
+	Heavy

Figure 26: METAR ABBREVIATIONS

NOTE: When METAR data is missing (e.g., dew point), it is simply omitted, and the user must know the sequence to recognize this. Some exceptions apply in remarks such as RVRNO or SLPNO, when RVR or SLP are normally reported but not currently available.

METAR KPIT 201955Z 22015G25KT 3/4SM R28R/2600FT TSRA OVC010CB 18/16 A2992 RMK SLP013 T01760158

Where:	**KPIT**
When:	**201955Z** 20th day of month at 1955Z
Wind:	**22015G25KT 220** degrees at 15 gusting to 25 kts
V:	Variable direction, e.g., 20015KT 220V280
VRB:	Variable direction, when speed is less than or equal to 6 kts
Visibility:	**3/4SM** 3/4 statute miles; typical: 2 3/4 SM, 1 SM

RVR **R28R/2600FT** Runway 28 Right visibility 2,600 ft

M:	Used for RVR less than lowest reportable sensor value (e.g., **M0600FT**)
P:	Used for RVR greater than highest reportable sensor value (e.g., **P6000FT**)
V:	Variable

Significant Weather:	**TSRA** -- thunderstorm/moderate rain
Sky Condition:	**OVC010CB** – overcast clouds at 1,000 ft consisting of cumulonimbus
Typical:	**SCK, FEW, SCT, BKN, VV004** indefinite ceiling (Vertical Visibility) 400 ft
Temperature/Dew Point:	**18/16** -- 18 degrees Celsius/dew point 16 degrees Celsius (M=Minus or below zero)
Altimeter:	**A2992** inches of mercury and preceded by an “A”

RMK SLP013 T01760158 10142 20012 401120084 -- At selected stations, sea level pressure is reported as the last 3 digits in hectoPascals (millibars) (e.g., 1001.3 is reported as **SLP013**). Codes such as T01760158 10142 20012 and 401120084 are climate temperature information.

TAF (TAF AMD is Amended Forecast when included)

KPIT 091730Z 091818 22020KT 3SM -SHRA BKN020 WS015/30045KT

FM2030 30015G25KT 3SM SHRA OVC015 TEMPO 2022 1/2 TSRA OVC008CB

FM2300 27008KT 5SM -SHRA BKN020 OVC040 PROB40 0407 00000KT 1SM -RA BR

FM1000 22010KT 5SM -SHRA OVC020 BECMG 1315 20010KT P6SM NSW SKC

Where:	**KPIT**
When:	**091730Z** – issuance day and time (9th day at 1730Z)
	091818 valid period (9th day at 1800Z to next day, 10th at 1800Z
Wind:	**22020KT**– 220 degrees at 20 kts
Visibility:	**3SM** – 3 statute miles, typical - **2 3/4SM, ISM**
P6SM:	Greater than 6 statute miles
Significant Wx:	**-SHRA** light rain showers
Sky Condition:	**BKN020** -- broken clouds at 2,000 ft
Typical:	**FEW, SCT, BKN, OVC**
	VV004 indefinite ceiling (Vertical Visibility) 400 ft. **CB** and **TCU** clouds noted when present.
Wind Shear:	**WS015/30045KT** --Low-level wind shear at 1,500 ft forecast to be 300 degrees at 45 kts (only nonconvective, low-level, wind shear is forecast)

Sequence of Wind, Visibility, Significant Weather and Sky Condition repeats preceded by:

FM2030:	From 2030Z
TEMPO 2022:	Temporarily between 2000Z and 2200Z
FM2300:	From 230OZ
PROB40 0407:	There is a 40% probability between 0400Z and 0700Z
FM1000:	From 1000Z
BECMG 1315:	Becoming between 1300Z and 1500Z

NOTE: Weather conditions such as wind and sky condition may be omitted after **PROB40**, **TEMPO**, and **BECMG**, if no change is expected from those same conditions given in the previous time block.

Figure 27: METAR (SPECI OR SPECIAL REPORT)

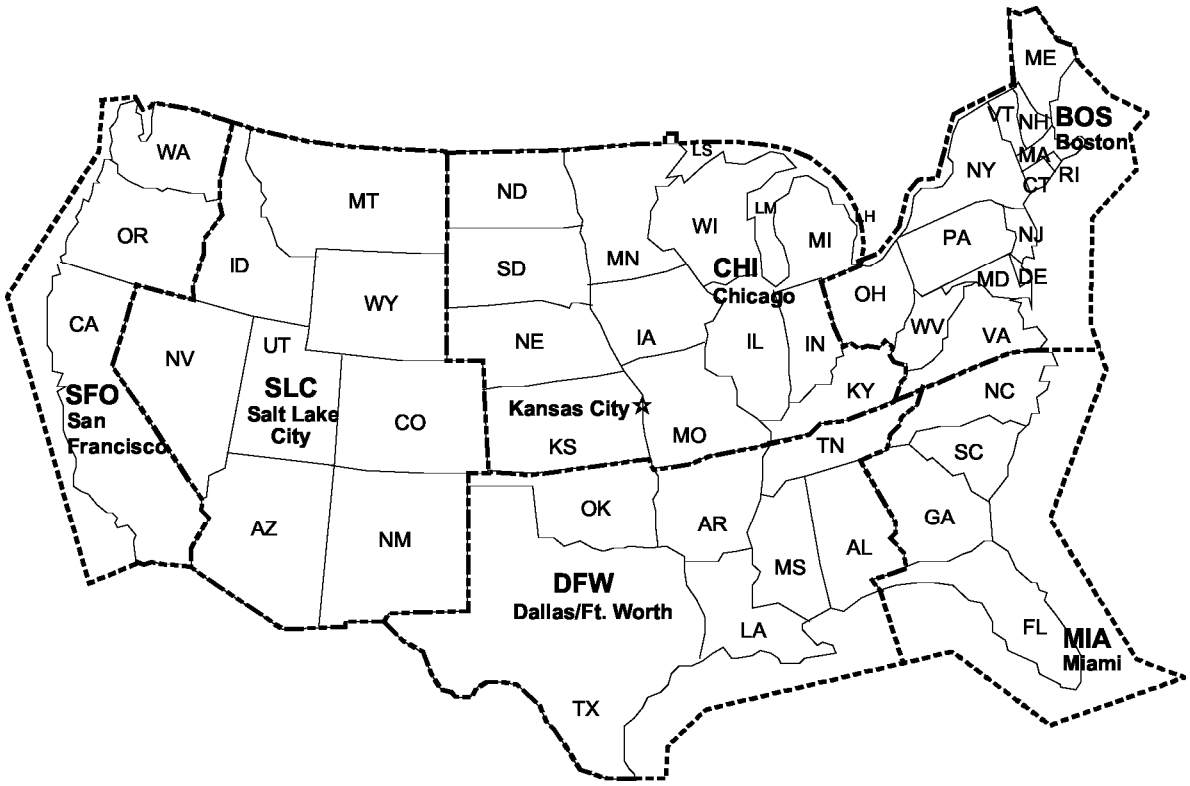


Figure 28: AREA FORECAST COVERAGE

b. Intended for use by General Aviation pilots, Civil and Military operations, National Weather Service (NWS), and Federal Aviation Administration (FAA) briefers

c. Consists of two sections:

(1) HAZARDS/FLIGHT PRECAUTIONS

(2) SYNOPSIS AND VFR CLOUDS/WEATHER

d. Communications headers contain unique information for routing purposes, as well as allowing individual sections to be replaced, rather than appended

e. In-flight advisories (AIRMETs, SIGMETs, Convective SIGMETs) amend or update the FA; however, the appropriate section of the FA should be amended or corrected as soon as practical

2. Responsibility - Issued by the National Aviation Weather Advisory Unit (NAWAU) in Kansas City, Missouri, for the conterminous United States and coastal waters

a. Pacific Coast (SFO)

b. Rocky Mountain (SLC)

c. North-Central (CHI)

d. Northeast (BOS)

e. South-Central (DFW)

f. Southeast (MIA)

g. Four additional FAs issued by the Weather Service Forecast Offices (WSFO) in Anchorage, Fairbanks, and Juneau for Alaska and in Honolulu for Hawaii

h. A specialized FA for the Gulf of Mexico shall be issued by the National Hurricane Center in Miami

(1) Combines aviation and marine information in support of offshore helicopter operations

(2) Addresses an area including the coastal plains and coastal waters from Appalachicola, Florida, to Brownsville, Texas, and the Gulf west of 85W and north of 27N

3. Issuance and Valid Times

   a. Prepared 3 times a day in the contiguous states and Alaska (4 times a day in Hawaii)

   b. Valid beginning the hour after the scheduled issue time

   c. The Gulf FA is prepared twice daily

4. Preparation of the Area Forecast

   a. Only authorized contractions (see FAA Handbook 7340.1) should be used

      NOTE: Observed weather abbreviations (R, S, F, etc.), 2-letter state and great lake designators and location identifiers should be used.

   b. All times stated in whole hours (2 digits), using UCT and qualifiers such as BY, UNTIL, AFT, THRU, BYD

   c. Visibilities in statute miles, all other distances in nautical miles, speeds in knots

   d. Commas or colons in a sentence indicated by three dots (...)

5. Hazards/Flight Precautions section

   a. Covers 12-hour period beginning with one valid time

   b. Section depicts weather impacting the area or a negative report

   c. Section serves only as a flag alerting user that conditions are meeting, or are expected to meet, AIRMET, SIGMET, or convective SIGMET criteria

      NOTE: Detail needed for preflight or flight resides in the appropriate In-Flight Advisory.

   d. Hazards section always has a Flight Precautions entry; if none expected, “NONE EXPT” shall be stated

   e. Every HAZARDS section will conclude with the statement “TSTMS IMPLY PSBL SVR OR GTR TURBC ICG LLWS AND IFR CONDS”

   f. The reference plane within the FA sections is mean sea level (MSL) unless otherwise noted

      NOTE: The statement “NON MSL HGTS DENOTED BY AGL OR CIG” shall be included in the hazards section.

Fig 29: *Area Forecast (FA)*

som (start of message indicator)
SFOH FA 191045
HAZARDS VALID UNTIL 192300
WA OR CA AND CSTL WTRS
*****
FLT PRCTNS...MTN OBSCN...WA OR CA
*****
TSTMS IMPLY PSBL SVR OR GRT TURBC SVR ICG LLWS AND IFR CONDS.
NON MSL HGTS ARE DENOTED BY AGL OR CIG.
eom (end of message indicator)

SFOC FA 191045
SYNOPSIS AND VFR CLOUDS/WX
SYNOPSIS VALID UNTIL 200500
CLDS/WX VALID UNTIL 192300...OTLK VALID 192300-200500
*****
SYNOPSIS...WEAK CDFNT ALG CSTL SXNS MOVG TO CASCDS AND BCMG STNRY. WK HI PRES BLDG INTO CSTL SXNS BY 02Z. ALF...MOIST WLY FLOW WL CONT OVER WA OR AND GENLY WK SWLY FLOW OVER CA.
*****
WA OR CASCDS WWD
SEE AIRMET SIERRA FOR MTN OBSCN.
WA NRN OR...15-25 SCT-BKN 35-45 BKN-OVC 100-120. WDLY SCT RW-.
17Z-20Z BCMG 20 SCT-BKN 50 BKN 80-100. WDLY SCT RW-, TOPS 180.
OTLK...VFR.

SRN OR...CLR. OTLK...VFR.
*****
WA OR E OF CASCDS
WA...50-70 SCT 120 SCT. WRN SXNS WDLY SCT RW-. TOPS 180.
OTLK ... VFR.

OR...CLR. OTLK...VFR.
*****
CA
SEE AIRMET SIERRA FOR MTN OBSCN.
CSTL SXNS OF NRN CA...10-15 BKN 25. AFT 21Z...CLR. OTLK... VFR.
LAX BASIN...15 BKN 25. VSBYS 3-5FH. AFT 16Z...CLR. VSBYS LAX BASIN 3-5FH.
OTLK...MVFT CIG F.
RMNDR AREA...CLR. OTLK...VFR.
*****
WA OR CA CSTL WTRS
ALG CST 10-25 SCT-BKN 30 OTHERWISE CLR. OTLK...MVFR CIG F.
eom

Figure 29: AREA FORECAST (FA)

6. Synopsis and VFR Clouds/Weather section

    a. Section contains an 18-hour synopsis, consisting of a 12-hour specific forecast, followed by a 6-hour categorical outlook giving a total forecast period of 18 hours

    b. All or parts of the SYNOPSIS AND VFR CLOUDS/WEATHER section may be delayed if the forecaster determines that available information is inadequate to support a quality FA product

    c. The following specific items, if applicable, should be included for each 12-hour specific forecast in the SYNOPSIS AND VFR CLOUDS/WEATHER section

        (1) Sky condition (cloud height, amount, and tops) if bases are at or below 18,000 ft MSL

        (2) Surface visibilities and associated obstructions when visibility is between 3 and 6 miles (if coverage is 3,000 square miles or greater)

        (3) Weather (precipitation, including thunderstorms, fog, haze, blowing dust, etc.), if it results in surface visibilities of 3 to 6 miles

        (4) Thunderstorms, if expected to be more than isolated

        (5) Surface wind if sustained winds of 20 kts or more

            (a) Wind directions use an 8-point compass

            (b) Gusts are reported if expected to be 10 kts over sustained speed

7. OUTLOOK - 6-hour categorical forecast to follow 12-hour specific clouds and weather forecasts

    a. As a minimum “IFR,” “MVFR,” or “VFR”

    b. If IFR or MVFR due to ceiling, use “CIG”

    c. If due to visibility, use standard weather and obstruction to visibility symbols

    d. VFR should stand alone except for wind (WND), thunderstorms (TRW), and precipitation (without intensities)

Fig 30: *Winds Aloft Forecast (FD)*

F. Winds Aloft Forecast (FD) **21.1.1.5.2**

1. Teletype report, based on observed (balloon) information transmitted twice a day

   a. Teletype identifier is “FD”

   b. The total forecast is usable for 15 hours

   c. Broken into two segments with the forecast periods given at the beginning of each segment

      (1) Valid time indicates that these conditions should exist specifically at this time

      (2) “For use” times mean that these conditions should exist through this period as the average conditions

2. Wind and Temperature coding/decoding rules

   a. Wind normally given with a series of 4 digits

      (1) First 2 digits indicate direction wind is from (true)

      (2) Second 2 digits depict the wind speed in knots

   b. Temperature follows wind information in degrees Celsius

      (1) Above or below 0 degrees indicated with a + or -

      (2) All temperatures above 24,000 ft MSL are below zero so the minus sign is dropped

   c. Exceptions

      (1) Variable winds indicated by “99” for direction

      (2) Forecast winds less than 5 kts indicated by “9900” and read as “light and variable”

      (3) If wind speeds exceed 100 kts, 100 is subtracted from the wind speed and 50 is added to the direction, e.g., a wind from 230 at 145 kts would be encoded as 7345

      (4) Wind speeds in excess of 200 kts would be encoded at 199 kts, e.g., 7399 would be 230 degrees at 199 kts

3. Temperature decoding/encoding rules

   a. Temperature and wind are sometimes omitted from the forecast

FD WBC 250550
BASED ON 25000Z DATA
VALID 251200Z FOR USE 0600Z-1500Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
XQP									
CAE	3410	3320 - 07	3133 - 08	3147-09	3067-18	3076-30	308544	298853	298961
ATL	9900	3110 - 05	3023 - 06	3036-07	3056-16	3063-28	307143	307453	297863
BHM	0805	2907 - 03	3018 - 04	3029-06	3046-16	3054-28	306443	296752	297363
JAN	1109	2708+ 01	2814 - 01	2819-04	2931-15	2939-27	294742	295251	295762
ZQP									
SHV	1714	2417+ 04	2620+ 01	2621-03	2827-14	2835-27	284442	284751	285061
DAL	1912	2325+ 07	2425+ 03	2524-01	7201-14	7702-26	771242	782450	782061
ABI		2320+ 09	2422+ 06	2522-00	2724-14	2732-26	264141	274650	275260
ZPZ									
INK		2512+ 10	2714+ 07	2717+01	2825-14	2733-26	274241	274750	265560
ELP		2609	2833+ 07	2717+01	2866-13	2886-20	780641	770451	268761
TUS		1822+ 12	2329+ 07	2536+01	2758-13	2879-26	780341	780151	288361
BLH	1311	1708+ 11	2219+ 06	2433+00	2743-13	2960-25	800041	309551	308561

Figure 30: WINDS ALOFT FORECAST (FD)

(1) Wind information is never forecast for altitudes within 1,500 ft of the surface

(2) Temperature information is never forecast at any altitude within 2,500 ft of the surface

(3) Temperature information is never forecast for the 3,000 ft level

4. Interpolation—Often the wind information will not be forecast for the altitude which the pilot wishes to file. In this case, they must interpolate for the desired information

G. National Weather Service (NWS) Severe Weather Reports and Forecasts **21.1.1.4.6**

NOTE: Flight is not specifically prohibited in the areas where convective outlooks, AIRMETs, SIGMETs, and convective SIGMETs are active, but common sense and experience should help determine your flight decision making. However, Severe Weather Watch bulletins (WW) and CNATRA Weather Warnings (CAWW) do prohibit flight in the areas covered.

1. Convective Outlooks (AC)

a. Issued by the National Severe Storm Forecast Center (NSSFC) in Kansas City

b. Outlines potential general thunderstorm activity and areas where thunderstorm intensity may approach severe limits

c. Disseminated 3 times daily (2 times daily between September 1 and January 31) - 24-hour forecast period

d. Format - Narrative presents affected region and rationale of the forecast

NOTE: ACs can alert a pilot several hours in advance of possible severe or widespread convective activity.

2. Severe Weather Watch bulletin (WW)

a. Issued by the NSSFC in Kansas City

b. Defines areas of possible severe thunderstorms and tornadoes; describes level of intensity, hail size, wind speeds, CB tops, estimated cell movement, cause of severe weather, and updates convective outlooks (AC)

c. Disseminated as needed

d. Format - Report contains the type and location of severe weather expected

e. Hazards

(1) Thunderstorms with surface winds of 50 kts or more

(2) Thunderstorms containing hail 3/4-inch diameter or greater at surface

(3) Tornadoes

f. Flight restrictions as stated in OPNAVINST 3710.7

(1) Navy pilots will not file into or fly through WW areas

(2) Exceptions to OPNAVINST severe weather restrictions **21.1.1.4.7**

(a) Operational necessity

(b) Research/weather reconnaissance

(c) Emergencies

(d) Storm development has not progressed as forecast and when flight

i) Remains in VFR conditions, or

ii) If in IFR conditions, aircraft has operable weather radar

(e) Aircraft capable of flying above existing or developing severe storms

3. CNATRA Weather Warning (CAWW) **21.1.1.4.8**

a. Issued by forecasters at the Chief of Naval Air Training (CNATRA)

b. Defines areas of hazardous weather pertinent to all Naval Air Training Command activities

c. Disseminated as needed

d. Format - Report lists hazards and affected areas

e. Hazards

(1) Severe thunderstorms (wind gusts 50 kts or more or hail 3/4" diameter or larger)

(2) Embedded thunderstorms

(3) Line of thunderstorms

(4) Severe or extreme turbulence

(5) Severe icing

(6) Widespread sandstorms or dust storms limiting visibility to 2 sm or less

f. Flight restrictions

(1) Training activities suspended in CAWW area

(2) Exceptions to CNATRA severe weather restrictions (same as OPNAVINST 3710.7)

(a) Operational necessity

(b) Research/weather reconnaissance

(c) Emergencies

(d) Storm development has not progressed as forecast and when flight

i) Remains in VFR conditions, or

ii) If in IFR conditions, aircraft has operable weather radar

(e) Aircraft capable of flying above existing or developing severe storms

H. National Weather Service (NWS) Aviation In-flight Weather Advisories **21.1.1.11, 21.1.1.11.1, 21.1.1.11.2**

1. Provides information for en route aircraft

2. Designed to serve both civilian and military pilots

3. Types

a. Significant Meteorological (SIGMET) Advisories

(1) Convective SIGMETs (WST)

(2) Nonconvective SIGMETs (WS)

b. Airman's Meteorological (AIRMET) Advisories (WA)

4. Latest revisions to program designed to meet overlapping requirements of large versus small aircraft, aircraft operating under visual flight rules (VFR) and instrument flight rules (IFR), small aircraft operating higher, and larger aircraft sometimes operating lower

5. Responsibility for Issuance - The National Aviation Weather Advisory Unit (NAWAU) in Kansas City, Missouri, has the responsibility for issuing WAs, WSTs, and WSs for the conterminous United States

    a. Designated forecaster(s) maintain watch on weather developments using weather radar, surface observations, PIREPs, and satellite image information

    b. Additional information used consists of information from the National Meteorological Center (NMC), products from the NMC National Severe Storms Forecast Center, Hurricane advisories, and forecasts from Weather Service Field Offices (WSFO)

6. Standardizations - The following standardizations shall apply to all In-Flight Advisories

    a. All heights or altitudes shall be stated with reference to mean sea level (MSL), except in the case of low ceilings which shall be referenced to “above ground level” and indicated by “CIGS,” e.g., CIGS BLO 10

    b. Domestic In-Flight Advisories shall describe designated weather conditions up to and including 45,000 ft (150 millibars)

    c. Any abbreviations or contractions used in the advisories shall conform with FAA Contractions Handbook 7340.1

    d. Weather and obstructions to visibility shall be indicated by using the weather abbreviations used for METAR (see FLIP GP Chapter 8)

7. CONVECTIVE SIGMETs (WST) at 55 minutes past the hour (H+55) **21.1.1.11.2**

    a. Issued hourly

        (1) As thunderstorms are likely to be accompanied by severe or greater turbulence, severe icing, and low-level wind shear, these conditions shall not be specified in the advisory

        (2) “NONE” shall be used as the text if appropriate

        (3) Valid for up to 2 hours or until superseded by the next hourly issuance

        (4) Special WSTs as required

Fig 31: *Convective SIGMET (WST)*

MKCC WST 221855
CONVECTIVE SIGMET 20C
VALID UNTIL 2055Z
ND SD FROM 90W MOT-GFK-ABR-90W MOT
INTSFYG AREA SVR TSTMS MOVG FROM 2445. TOPS ABV 450.
WIND GUSTS TO 60 KTS RPRTD. TORNADOES...HAIL TO 2 IN...WIND GUSTS TO 65 KTS PSBL ND PTN.

CONVECTIVE SIGMET 21C
VALID UNTIL 2055Z
TX 50SE CDS ISOLD SVR TSTM D30 MOVG FROM 2420. TOP ABV 450.
HAIL TO 2 IN…WIND GUSTS TO 65 KTS PSBL.

OUTLOOK VALID 222055-230055
AREA 1...FROM INL-MSP-ABR-MOT-INL
SVR TSTMS CONT TO DVLP IN AREA OVR ND. AREA IS XPCD TO RMN SVR AND SPRD INTO MN AS STG PVA MOVS OVR VERY UNSTBL AMS CHARACTERIZED BY-12 LIFTED INDEX.

AREA 2...FROM CDS-DFW-LRD-ELP-CDS
ISOLD STG TSTMS WILL DVLP OVR SWRN AND WRN TX THRUT FCST PD AS UPR LVL TROF MOVS NEWD OVR VERY UNSTBL AMS. LIFTED INDEX RMNS IN THE -8 TO -10 RANGE. DRY LINE WILL BE THE FOCUS OF TSTM DVLPMT.

Figure 31: CONVECTIVE SIGMET (WST)

(5) Three bulletins issued for eastern (E), central (C), and western (W) regions

(a) Boundaries at 87 and 107 degrees west

b. WSTs shall be issued when either of the following occurs and/or is forecast to occur for more than 30 minutes of the valid period, regardless of the size of the area affected (i.e., including isolated)

(1) Severe thunderstorms

(a) May include specific information on tornadoes and/or hail 3/4-inch or greater and/or wind gusts of 50 kts or greater

(2) Embedded thunderstorms

(a) Occurring within and obscured by haze, stratiform clouds, or precipitation from stratiform clouds

(b) Intended to alert pilots that avoidance by visual or radar detection could be difficult or impossible

(3) A line of thunderstorms

(a) At least 60 miles long with thunderstorms affecting at least 40% of the length

(4) An area of active thunderstorms affecting at least 3,000 square miles

(a) Thunderstorms having a reflectivity intensity (VIP LVL) of 4 or greater and/or having significant satellite signature affecting at least 40% of the area outlined

8. Special Convective SIGMETs - A WST special shall be issued anytime when either of the following criteria are met and/or forecast to be met for more than 30 minutes of the scheduled WST's valid period

a. Tornado, hail 3/4-inch or greater, or wind gusts to 50 kts or greater reported to the NAWAU forecaster or indicated when previous WST did not mention severe thunderstorms

b. Indications of rapidly changing conditions if in the forecaster's judgment, not sufficiently described in existing SIGMET

9. Nonconvective SIGMETs (WS)

a. Not issued on a regular scheduled basis

Fig 32:
SIGMET (WS)

DFWP UWS 051700
SIGMET PAPA 1 VALID UNTIL 052100
AR LA MS
FROM MEM TO 30N MEI TO BTR TO MLU TO MEM
MDT TO OCNL SVR ICG ABV FRZLVL XPCD. FRZLVL 80 E TO 120 W. CONDS CONTG BYD 2100Z.

SFOX WS 030130
SIGMET XRAY 2 VALID UNTIL 030530
OR WA
FROM SEA TO PDX TO EUG TO ONP TO HQM TO SEA
MDT TO OCNL SVR TURBC BTWN 280 AND 350 XPCD DUE TO WINDSHEAR ASSOCD WITH JTSTR.
CONDS BGNG AFT 0200Z CONTG BYD 0530Z AND SPRDG OVR CNTRL ID BY 0400Z.

Example of a multi-area issuance SIGMET:

CHIO WS 051700
SIGMET OSCAR 2 VALID UNTIL 052100
KS
FROM PWE TO OSW TO 40W LBL TO PWE
OCNL SVR TURBC BLO 60. CONDS DUE TO STG NWLY FLOW BHD CDFNT AND XPCD TO CONT BYD 2100Z.

DFWO WS 051700
SIGMET OSCAR 2 VALID UNTIL 052100
OK
FROM OSW TO ADM TO 40W LBL TO OSW
OCNL SVR TURBC BLO 60. CONDS DUE TO STG NWLY FLOW BHD CDFNT AND XPCD TO CONT BYD 2100Z.

Example of a multi-area issuance SIGMET cancelled in one area and continued in another:

CHIO WS 052100
CANCEL SIGMET OSCAR 2. CONDS HAVE DMSHD.

DFWO WS 052100
SIGMET OSCAR 3 VALID UNTIL 060100
FROM OSW TO TXK TO SPS TO GAG TO OSW
OCNL SVR TURBC BLO 60. CONDS XPCD TO GRDLY DMSH AFT 00Z

Figure 32: SIGMET (WS)

b. Issued whenever any of the following weather phenomena occur or are forecast to occur and affect an area of at least 3,000 square miles

(1) Severe or extreme turbulence or clear air turbulence (CAT) not associated with thunderstorms (see Turbulence Reporting Tables in FLIP Flight Information Handbook (FIH) Section C)

(2) Severe icing not associated with thunderstorms (see Icing Tables in FLIP FIH Section C)

(3) Widespread dust storms, sandstorms, or volcanic ash lowering surface and/or in-flight visibilities to less than 3 miles

(4) Volcanic Eruption

10. AIRMETs (WA) **21.1.1.11.1**

Fig 33:
AIRMET (WA)

a. Issued on a scheduled basis every 6 hours (beginning at 0200 UTC)

NOTE: Scheduled issuance times are 15 minutes prior to valid time.

b. Unscheduled amendments and corrections issued as necessary and are valid beginning at the time of issuance

c. Issued by NAWAU using the Area Forecast (FA) designators (SFO, SLC, CHI, DFW, BOS, MIA) to denote the area covered, not the issuing office

d. AIRMET bulletins shall contain details of conditions within their designated geographical areas when one or more of the following conditions occur or are expected to occur, and affect an area of at least 3,000 square miles:

(1) Moderate icing

(2) Moderate turbulence

(3) Sustained surface wind of 30 kts or more

(4) Ceilings less than 1,000 ft and/or visibility less than 3 miles affecting over 50% of an area at any one time

(5) Extensive mountain obscuration precluding VFR flight

ZCZC MKCWA4Z ALL 190200
WAUS1 KDFW 190200
DFWZ WA 190200
AIRMET ZULU FOR ICG AND FRZLVL VALID UNTIL 190800
*****
NO SGFNT ICG XPCD.
*****
FRZLVL...90-120 E OF DYR-MSL-ATL LN SLPG TO 120-140 OVR RMNDR.
****
NNNN

ZCZC MKCWA4T ALL 191400
WAUS1 KDFW 191400
DFWT WA 191400
AIRMET TANGO FOR TURBC...STG SFC WNDS AND LLWS VALID UNTIL 192000

AIRMET TURBC...OK TX
FROM OSW TO LRD TO PEQ TO 40W LBL TO OSW
OCNL MDT TURBC BLO 60 DUE TO STG AND GUSTY LOW LVL WINDS.
CONDS CONTG BYD 2000Z.
*****
AIRMET STG SFC WINDS...TX
FROM CDS TO DFW TO SAT TO MAF TO CDS
AFT 18Z...SUSTAINED SFC WINDS GTR THAN 30 KTS XPCD. CONDS CONTG BYD 20000Z.
*****
LLWS BLO 20 AGL DUE TO STG WINDS DMSHG BY 16-18Z.
*****
OTLK VALID 2000-0200Z...OK TX AR
MDT TURBC BLO 60 CONTG OVER OK/TX AND SPRDG INTO AR BY 2200-0200Z CONTG ENTR AREA BYD 0200Z.
****
NNNN

ZCZC MKCWA5S ALL 191400
WAUS1 KSLC 191400
SLCS WA 191400
AIRMET SIERRA FOR IFR AND MTN OBSCN VALID UNTIL 192000
*****
AIRMET IFR...WY CO
FROM 70ENE GCC TO GLD TO FMN TO 60N JAC TO 70ENE GCC
OCNL CIGS BLO 10 AND OR FSBYS BLO 3 IN PCPN AND F. CONDS CONTG BYD 2000Z AND GRDLY DMSHG.
*****
AIRMET MTN OBSCN...MT WY CO
FROM YXC TO YXH TO AKO TO TBE TO FMN TO LKT TO YXC
MTNS OCNL OBSCD IN CLDS/PCPN. CONDS CONTG BYD 2000Z.
*****
OTLK VALID 2000-0200Z...MTN OBSCN MT WY CO
CONDS CONTG BYD 0200Z IN WY/CO BUT ENDING IN MT BTWN 2200-0200Z.
****
NNNN

Figure 33: AIRMET (WA)

e. AIRMET message texts

(1) Text portion of each AIRMET message within a bulletin shall contain the available details about the phenomenon conditions which have met or are expected to meet AIRMET or significance criteria

(2) Details shall include whether conditions are occurring or forecast to occur, their causes, their vertical extent, any changes expected during the AIRMET valid period, and remarks concerning the time of onset and/or cessation of conditions

11. Military Weather Advisory (MWA)

Fig 34: Military Weather Advisory (MWA)

a. Prepared and issued by the Air Force Global Weather Center (AFGWC)

b. Transmitted twice a day with a 12-hour Military Weather Advisory, which is a forecast of possible severe weather

c. Two versions produced

(1) Teletype

(2) Facsimile

d. The forecast is coded as follows:

(1) Red - tornadoes, waterspouts, or funnel clouds

(2) Blue - severe thunderstorms (maximum wind gusts of 50 kts or greater and/or hail, if any, 3/4-inch or greater in diameter) and locally damaging windstorms

(3) Green - moderate thunderstorms (maximum wind gusts of 35 kts or greater, but less than 50 kts; and/or hail, if any, 1/2-inch or greater in diameter, but less than 3/4-inch in diameter)

(4) Orange - thunderstorms (maximum wind gusts less than 35 kts and/or hail, if any, less than 1/2-inch in diameter)

(5) Black - strong surface winds (35 kts or more and not associated with thunderstorms)

(6) Purple - heavy rain (2 inches or more in 12 hours or less)

(7) Hatched purple - heavy snow (2 or more inches in 12 hours or less)

(8) Brown - freezing precipitation

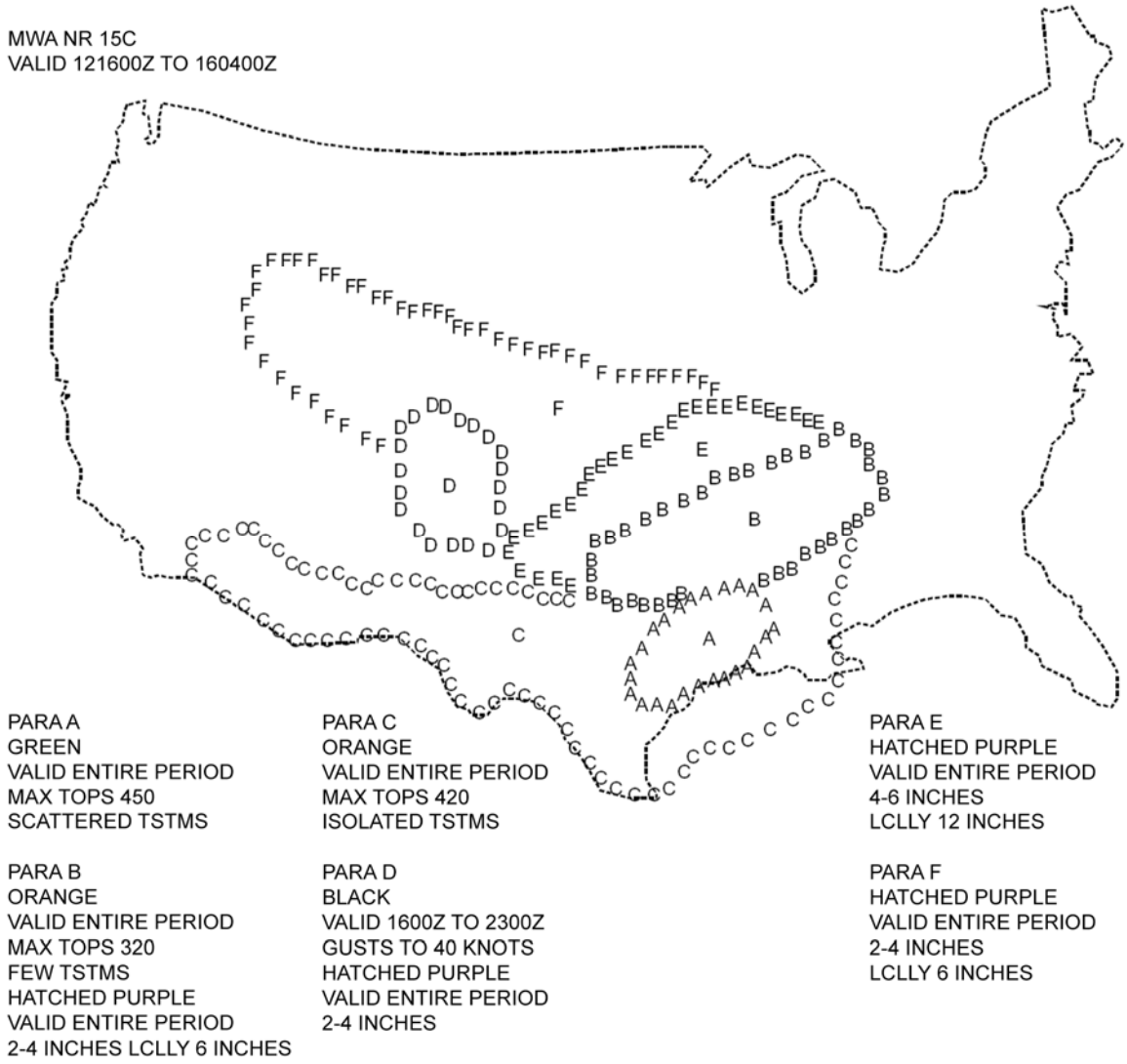


Figure 34: MILITARY WEATHER ADVISORY (MWA)

e. Other abbreviations

(1) MIC (maximum instantaneous coverage) - the percent of the area which will be covered by thunderstorm cells at time of maximum activity

(2) TAA (total area affected) - the percent of the area which will experience one or more thunderstorms during the applicable valid period

(3) EP (entire period) - used if the phenomena are expected for the entire period instead of a particular time period

f. Maximum thunderstorm tops

(1) The percentages of MIC and TAA will be entered in the thunderstorm areas as MIC/TAA (such as 3/25)

(2) The advisory areas will be enclosed by solid lines with a letter designator within the area

(3) Forecast areas depict the worst conditions expected during period noted

g. Teletype bulletin -This bulletin contains information identical to the facsimile product

NOTE: It also serves to amend and correct both the facsimile and teletype product.

h. Using the chart

(1) Use the contents of this advisory strictly as a preflight aid to help plan your route of flight to avoid possible severe weather

(2) Compare the MWA forecast with the existing or latest weather in the available weather charts and teletype reports

VII. En route procedures 21.1.1.9.1

A. Sources of in-flight weather information

NOTE: The sources below are listed in the order in which they should be used.

1. Pilot-to-Metro Service (PMSV)

a. Operated out of NASs, MCASs, and USAF bases—call name example: “Kingsville Metro” or “Metro”

b. Normally, pilots can directly access weather forecasters

(1) In some cases, USN or USMC forecasting has been centralized to support outlying satellite detachments during off-peak hours when a forecaster is not on duty

(2) Most USN and USMC stations are manned 24 hours with observers maintaining a basic weather watch

NOTE: Observers can provide basic services, e.g., read latest field conditions or read a TAF (terminal) report.

(3) For forecaster services, e.g., DD-175-1 updates or extensions, the observer can act as an intermediary with the Sub-Regional Forecast Center (SRFC) forecaster or advise the pilot who to call

(4) Advise forecaster/observer of ETA when terminal weather is requested

(5) A listing of the Subregional Forecast Centers (SRFC) can be found in FLIP FIH

c. Operates on UHF frequencies

d. Listed in the FLIP Flight Information Handbook and the Enroute Supplement under “Metro”

2. Enroute Flight Advisory Service (EFAS)

a. Operated by FAA—call name example: “San Antonio Flight Watch” or “Flight Watch”

b. Provides updated en route weather information

(1) Not intended for preflight weather brief or random weather reports and forecast, contact nearest FSS for this information

(2) Specifically designed to provide en route aircraft with timely and meaningful weather advisories pertinent to the type of flight intended, route of flight, and altitude

c. Usually accessible anywhere over continental U.S. above 5,000 ft AGL, generally 6:00 am to 10:00 pm; however, hours of operation are expanding at some facilities

d. Operates on VHF frequencies—122.0

e. Also available on specific frequencies reserved for high altitude traffic (for aircraft flying above 18,000 ft)

3. Flight Service Station (FSS)

   NOTE: The FSS system has recently been consolidated into approximately one facility per state. Regional FSS denoted on FLIP High Altitude Charts with a shadow box.

   a. Operated by FAA—call name example: "San Angelo Radio"

   b. Provides en route weather information as part of its service

      NOTE: FSS operators can read METARs, Area and Terminal Aerodrome Forecasts, PIREPs, AIRMETs and SIGMETs, but they are not trained forecasters.

   c. FSS available frequencies are 255.4, 122.2, selected discrete frequencies and emergency 243.0 and 121.5

      NOTE: When calling Metro, Flight Watch, or FSS, advise the service of your approximate location to receive transmissions from the proper remote transmitter. At the completion of the dialogue, the service often appreciates a PIREP including aircraft type, altitude/flight level, and conditions of flight.

4. Air Route Traffic Control Center (ARTCC)

   a. Can provide weather information and updating as requested, but weather dissemination is not a primary service

   b. Can provide real-time weather avoidance assistance through use of current ATC radar and weather radar

      NOTE: ARTCC will not routinely provide updated weather briefings for route, as provided by Metro and Flight Watch.

5. Transcribed Weather Broadcasts (TWEB)

   a. Recorded weather information transmitted over selected NDB and VOR stations

   b. Amount and type of weather information vary from station to station, but can include local weather, route weather, winds aloft, and terminal aerodrome forecasts

6. Hazardous In-flight Weather Advisory Service (HIWAS)

   a. Broadcasts continuously over selected VOR stations

   b. Contains summary of any AIRMETs, SIGMETs, convective SIGMETs, CWAs and PIREPs

7. Automated Weather Observation System (AWOS)

   a. AWOS is a real-time system consisting of various sensors, a processor, a computer-generated voice subsystem, and transmitter to broadcast local minute-by-minute weather directly to the aircraft

      (1) AWOS observations derived from an automated system will include the prefix “AWOS”

      (2) Some AWOS locations will be augmented by certified observers who will provide weather and obstruction to visibility information in the remarks of the report when the reported visibility is less than 3 miles. Augmentation is identified as “OBSERVER WEATHER”

      (3) The reported visibility is derived from a sensor near the touchdown of the primary instrument runway

      NOTE: The AWOS visibility is reported as a runway visibility range and may differ from the prevailing visibility.

      (4) The reported sky condition/ceiling is derived from the ceilometer located next to the visibility sensor and may differ from the observed sky condition, because the AWOS is totally dependent on clouds over the sensor site

   b. There are four operational levels of AWOS

      (1) AWOS-A - reports only altimeter setting

      (2) AWOS-1 - reports altimeter setting, wind data, temperature, dew point, and density altitude

      (3) AWOS-2 - reports information in AWOS-1 plus visibility

      (4) AWOS-3 - reports information in AWOS-2 plus cloud and ceiling data

      (5) AWOS information is transmitted over a discrete frequency or the voice portion of a local NAVAID

      NOTE: The system transmits a 20- to 30-second weather message each minute. The messages are updated each minute and are receivable within 25 nm of the AWOS site, at or above 3,000 ft AGL.

   c. AWOS broadcasts phraseology generally follows that used in other weather broadcasts. The following are explanations of exceptions:

      (1) The word “TEST” is added when the system is not in commissioned status

(2) The phrase “TEMPORARILY INOPERATIVE” is added when the system is inoperative

(3) Ceiling is announced as either “CEILING” or “INDEFINITE CEILING”

NOTE: All automated ceiling heights are measured ceilings except indefinite ceilings.

(4) The word “CLEAR” is not used in AWOS due to limitations in height ranges of the sensors

NOTE: No clouds detected is announced as “NO CLOUDS BELOW” or “CLEAR BELOW.”

(5) “SKY CONDITION MISSING” is announced only if the system level is able to report ceiling/sky condition, and the data is not available

NOTE: Ceiling/sky conditions are not announced if the system level is not able to report them.

(6) “VISIBILITY LESS THAN ONE QUARTER” is the lowest visibility reported

NOTE: “VISIBILITY MISSING” is announced only if the system level is able to report visibility, and the data is not available. Visibility is not announced if the system level is not able to report it.

(7) If remarks are included, the word “REMARKS” is announced after the altimeter setting in the following priority:

(a) Automated remarks

i) Density altitude

ii) Variable visibility

iii) Variable wind direction

(b) Manual remarks (prefaced with “OBSERVER WEATHER”)

i) Type and intensity of precipitation

ii) Direction and intensity of thunderstorms

iii) Obstructions to visibility when 3 miles or less

8. Automatic Terminal Information Service (ATIS)

   NOTE: ATIS frequencies are incorporated on individual FLIP Terminal Instrument Approach Procedures and aerodrome listings in the Enroute Supplement. Where this service is available, listing will be found on the COMMUNICATIONS line, e.g., (ATIS 276.2). Pilots will be expected to listen to ATIS broadcasts, when in operation, to obtain essential, but routine, terminal information.

   a. ATIS broadcasts are recorded, and the pilot should notify controllers that he has received the broadcast by repeating the alphabetical code word appended to the broadcast. Example: "INFORMATION ECHO RECEIVED"

   b. When the pilot acknowledges that he has received the ATIS broadcast, controllers may omit those items contained on the broadcast if they are current

      NOTE: Rapidly changing conditions will be issued by Air Traffic Control, and the ATIS will contain words as follows: "LATEST CEILING/VISIBILITY/ALTIMETER/(OTHER CONDITIONS) WILL BE ISSUED BY APPROACH CONTROL/TOWER."

   c. The absence of a sky condition/ceiling and/or visibility on ATIS indicates a sky condition/ceiling of 5,000 ft or above and visibility of 5 miles or more

      NOTE: A remark may be made in the broadcast, "THE WEATHER IS BETTER THAN 5,000 AND 5," or the existing weather may be broadcast.

   d. Controllers will automatically issue pertinent information to pilots who do not acknowledge receipt of the ATIS broadcast or who acknowledge receipt of a broadcast which is not current

B. Pilotweather reports (PIREPs) **21.1.1.11.3, 21.1.1.11.3.1**

   1. Issued by pilot to ATC or weather disseminating agencies (PMSV, EFAS, FSS, etc.)

   2. Reports filed when

      a. Requested

      b. Unusual and unforecast weather is encountered (mandatory voice report)

      c. Weather conditions on IFR approach differ from latest observation (mandatory voice report after landing)

      d. Missed approach is executed due to weather

e. Hazardous or potentially hazardous weather is encountered (wind shear, microburst, icing, severe turbulence, etc.) particularly on arrival or departure

3. Relay time-critical information directly to ATC

4. All PIREPs can be given to Metro, Flight Watch, or other weather dissemination agencies on the frequency of the outlet closest to the aircraft position. See your Flight Information Handbook.

5. Format (also available in FLIP Flight Information Handbook)

a. Aircraft location or area of occurrence

b. Time (UTC)

c. Altitude (MSL)

d. Type aircraft

e. Sky cover (bases, tops, amount)

f. Temperature

g. Wind

h. Turbulence (see turbulence tables in FIH)

i. Icing (see icing tables in FIH)

j. Remarks

NOTE: Pilots should use standardized terminology as indicated in the FLIP Flight Information Handbook when making a pilot report (e.g.,"trace," "light," "moderate," or "heavy icing"). Also, use "frequency" table as appropriate.

VIII. Flight Weather Packet **21.1.1.11.4**

NOTE: OPNAV 3710.7 encourages the use of flight weather packets for extended flights.

A. Should be requested at least 2 hours prior to the weather brief, preferably 24 to 48 hours prior

1. Can be prepared in less than 2 hours, but probably will not be as complete

B. Contents

1. Folder

2. Horizontal Weather Depiction Chart

   a. Prepared for your proposed flight time and path

   b. Depicts atmospheric conditions from surface to 5,000 ft above the proposed flight level for the entire route and includes:

      (1) Areas of 5/8 or more of cloud coverage

      (2) All areas of cumulonimbus (CB), towering cumulus (TCU), in eighths coverage, along with tops and bottoms

      (3) Heights of freezing level

      (4) Fronts and pressure centers with movements

      (5) Significant weather and obstructions to visibility

      (6) Hazards to flight

      (7) Proposed route of flight

      (8) Any miscellaneous entries deemed operationally significant

3. Completed DD-175-1

   a. Pilot shall receive a verbal briefing as well as the weather briefing form

4. Upper wind charts for proposed flight level(s) or OPARS customized flight plan

C. Use

1. Folder contents serve as reminders of weather expected to encounter en route and stopover terminals

2. Pilot should note any deviations from weather

3. Pilots should turn in folder at final destination and if possible debrief with the forecaster actual conditions encountered in flight

IX. Optimum Path Aircraft Routing System (OPARS) **21.1.1.11.5**

A. General

Fig 35: *OPARS Kneeboard Output*

1. Primary purpose of OPARS is to provide computer-prepared flight planning service to the Naval Aviation community

2. Service provides customized flight plan which can be used in many different ways

```
OPTION:  2KB  -  KNEEBOARD 2

FLIGHT PLAN FOR JOHNSON                          COMPUTED 1849Z

BASED   UPON  9607191200  WEATHER  DATA

LEG01 STANDARD KNQI        TO KMAF                    20 JUL 96

ACFT TYPE T45FNF           DRAG:       0       EFF:   100

PLANNED FOR ETD 1900Z                  INITIAL CRUISE FLIGHT LEVEL 190
         FUEL   TIME      DIST    ARRIVE     RAMP       LAND       CARGO      OPNLWT
POA   001235   1/06       0380    2006Z      013512     012277     000000     010500

ALT   ...
RES   001777      0/24
TOT   003012      2/30

FUEL BIAS        200      DBIAS         0      ABIAS:      0        IBIAS:    0

ROUTING USED FOR THIS LEG
KNQI.. CRIMP  J25 SAT J2 JCT J15 LOWGO .. KMAF

CPT         F/L  TMP   WIND     T/C T/H  M/H    TAS   G/S    ZD   CD   ETE   ETR   EFU   EFR
KNQI         11    00   00000    000 000  *****  ***   ***    001  0001 00/01 01/05  002   0028
KNQI       N27304W097486
CRIMP       320   P11   12514    342 342  337.7  ***   ***    059  0060 00/11 00/54  004   0024
CRIMP      N28265W098089
*TOC*       390   P02   13021    347 347  343.1  ***   ***    018  0078 00/04 00/50  000   0023
*TOC*      N28444W098135
SAT         390   P02   14518    347 347  340.6   410   426    056  0134 00/43 00/50  001   0022
SAT        N29386W098277
JCT         390   P02   16516    309 309  300.1   410   426    091  0225 00/13 00/30  002   0020
JCT        N30359W099491
*SDP*       390   P02   17015    294 294  283.1   411   420    035  0260 00/05 00/25  000   0019
*SDP*      N30498W100260
LOWGO       145   P16   34003    294 294  285.6  ***   ***    089  0349 00/17 00/08  001   0018
LOWGO      N31260W102014
KMAF         29   P17   04503    343 343  335.3  ***   ***    032  0381 00/08 00/00  000   0017
KMAF       N31565W102121

*TOC*   =   TOP OF CLIMB
*SDP*   =   START DESCENT POINT

TOTAL WIND FACTOR      11KTS
```

Figure 35: OPARS KNEEBOARD OUTPUT

a. Amount of fuel required to arrive with a specific reserve

b. Maximum cargo/stores that can be carried for a particular flight/mission

c. Amount of fuel required to “top off” for in-flight refueling

d. Maximum time on station

e. Mandatory overwater reporting positions for overseas flights

f. Fuel usage for a specific route and/or altitude

g. Other options available due to crew requirements and/or recommendations

B. Program Description

1. Data bases

a. Aircraft performance data from appropriate NATOPS manual for over 80 different Navy and Marine aircraft

NOTE: Several sets of data for one aircraft may be entered for different drag conditions, e.g., TA4 with drop tanks and without drop tanks.

(1) Climb (usually normal rate of climb)

(2) Cruise (usually maximum range)

(3) Descent (usually flight idle)

b. Forecast winds and temperatures derived by computer at the Fleet Numerical Oceanography Center (FNOC) located at Monterey, CA

(1) Input includes land and shipboard surface and upperwind data

(2) Computer analyzes on the basis of historical data and current information which produces wind and temperature forecasts for the next 48 hours

(3) Forecast model is run and OPARS data is updated every 12 hours

c. High altitude airways, NAVAIDs, and waypoints, along with all airfields with 5,000 ft or longer, are entered for the entire Northern Hemisphere and updated every 4 weeks

d. ADIZ zones, international boundaries, and prohibited airspace are entered

C. Request Procedures

1. Computer terminals located at Naval Oceanography Command Detachments and facilities (NOCD or NOCF) and some squadron/ wing operations spaces (mostly VP squadronstwings)

   NOTE: Found in NOCD/NOCF and Marine weather offices from Japan to Spain.

   a. Lead time of 2-3 hours normally required; actual process, however, only takes ten minutes or less

   b. Best service provided if requested a day in advance of flight

2. Secondary method is through DoD message system (AUTODIN)

   a. This method allows access at any military base or aircraft carrier

   b. Message process takes 8-10 hours (minimum) from the time the request is sent

D. For a single leg flight plan (no intermediate stops), the following input data is required

NOTE: Examples for a flight from NAS Kingsville to Hill AFB are included in the following.

Fig 36 & 37: *OPARS Request Form*

1. Pilot/unit - (optional entry)

2. Leg -1 (no intermediate stops)

3. POD - KNQI (ICAO for Point Of Departure)

   NOTE: In CONUS, “NQI” would be sufficient.

4. POA - CUS (Point Of Arrival, Hill AFB)

5. Routing

   a. $J (computer select best jet route)

   b. $R (fly jet routes or direct legs)

   c. $C (canned tracks, i.e., IR routes)

   d. ..., OLM, J126, RBL, J1, OAK, ... (route desired by pilot)

   e. Several other options

6. TOD/TOA - 2000 (Time Of Departure. Time Of Arrival could be entered if desirous of arriving at a specified time)

OPARS FLIGHT PLANNING

ALL ENTRIES ARE LIMITED TO ONE LINE AND MUST BEGIN IMMEDIATELY FOLLOWING THE PROMPT. REFER TO SECTION 2 OF THE OPARS USER'S MANUAL FOR A DETAILED DESCRIPTION OF EACH DATA ITEM.

NOTES

* 17 DC REQUIRED ONLY ON CERTAIN AIRCRAFT TYPES.
* 19 SPERF REQUIRES 5 PARAMETERS.
* 21 SPERF ALT CAN ACCEPT UP TO 3 PARAMETERS.

REQUIRED INPUT

LEG - 1

02 PILOT/UNIT	>	
11 LEG	>	
12 POD	>	
44 POA	>	
24 ROUTING	>	
13 TOD/TOA	>	
51 TOG	>	
08 OMODE	>	
05 ACTYPE	>	
14 OPWT	>	
18 CARGOCH	>	
15 FUEL/RES	>	
49 REFUEL	>	
*17 DC	>	

SPECIAL PERFORMANCE (SPERF)

*19 SPERF	>	
20 SPERF BIAS	>	
*21 SPERF ALT	>	

LEG - 2			LEG - 3		
44 POA	>		44 POA	>	
24 ROUTING	>		24 ROUTING	>	
13 TOD/TOA	>		13 TOD/TOA	>	
51 TOG	>		18 CARGOCH	>	
18 CARGOCH	>		15 FUEL/RES	>	
15 FUEL/RES	>		*17 DC	>	
49 REFUEL	>				
*17 DC	>				

REQUEST TAKEN BY

REQUEST TRANSMITTED BY | RECEIVED (DTG (Z))

JOB NAME

NASKINGS 3140/18 (Rev 3-89) (Over)

Figure 36: O PARS REQUEST FORM

OPTIONAL INPUT

	LEG - 1	LEG - 2	LEG - 3
03 DATE >			
06 EFF >			
09 WARNPT >			
10 FLTDATE >			
16 BIAS >			
*17 DC >			
25 RTARND >			
26 UPPRALT >			
27 LOWRALT >			
28 INCRUALT >			
29 INFLTRF1 >			
30 INFLTRF2 >			
31 INFLTRF3 >			
32 DBIAS >			
33 ABIAS >			
34 OVERA >			
35 OVERB >			
36 OVERC >			
37 OVERD >			
38 OVERE >			
43 IBIAS >			
6 MBF >			
47 ATALT >			
48 ALTRNAT >			

REQUIRED INPUT - MISSION LEG

53 EOM > _____ 55 INALT > _____ 56 OUTALT > _____

OPTIONAL INPUT - MISSION LEG

52 BOM > _____ 57 LOM > _____ 59 TIMEOUT > _____
54 FUELCH > _____ 58 TIMEIN > _____ 60 MINENG > _____

ADDITIONAL REMARKS

NASKINGS 3140/18 (Rev 3-89) (Back)

Figure 37: OPARS REQUEST FORM

7. OMOD - 1 KB (1 Kneeboard output format)

   NOTE: Ten formats available, kneeboard is the most common request.

8. AC Type - T45A (aircraft type and model)

9. OPWT - 10493 (no fuel, no cargo weight in Ibs)

10. CARGOCH - 0 (cargo weight in Ibs)

11. Fuel/Reserve - 600 (desire 600 Ibs fuel reserve at POA)

    NOTE: OPARS will calculate amount of fuel to load at POD.

X. Satellite imagery **21.1.1.11.6**

Fig 38: *GOES Satellite*

A. Background and introduction

1. U.S. Congress established system in 1961

   a. Operated by National Oceanic and Atmospheric Administration (NOAA)

   b. Utilizes “Geostationary Operational Environmental Satellites” (GOES) and others that operate in a similar manner

      (1) GOES-1 was launched 16 Oct 1975; by 2004, fourteen had been launched.

      (2) GOES satellites now provide virtual worldwide coverage

      (3) CONUS covered by GOES-East located at 75 degrees west and GOES-West at 135 degrees west

      NOTE: A third satellite, GOES-Central, is located at 107 degrees west and is used for weather facsimile broadcasts.

      (4) Scanners provide information on reflected visible light and thermal infrared portions of the spectrum

Fig 39: *GOES Coverage*

B. Visual pictures

1. Resemble standard black and white photographs

   a. Reconstructed on Earth by line processing similar to television, from digital data collected by the satellite sensors

Fig 40: *Visual Picture*

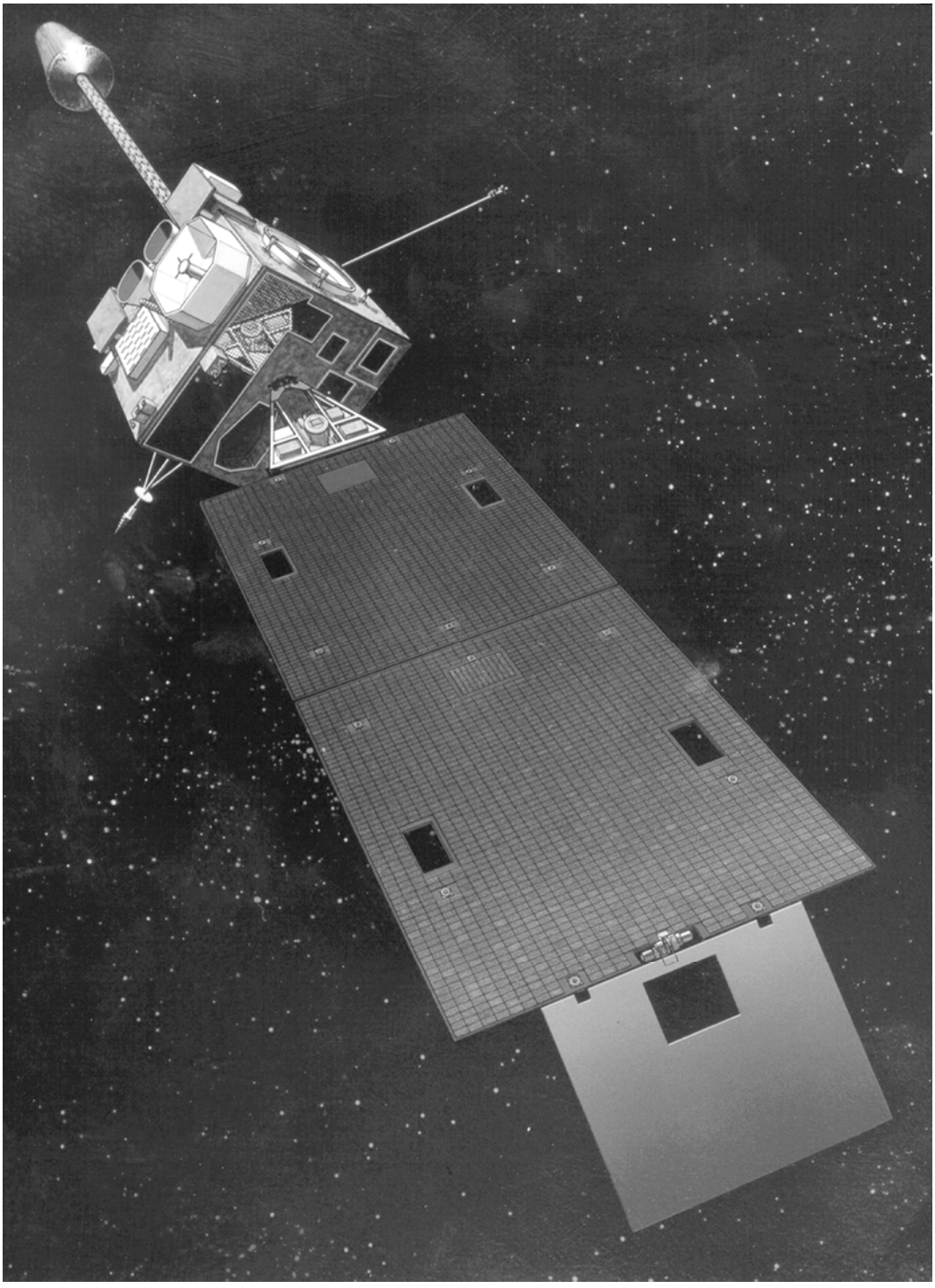


Figure 38: GOES SATELLITE

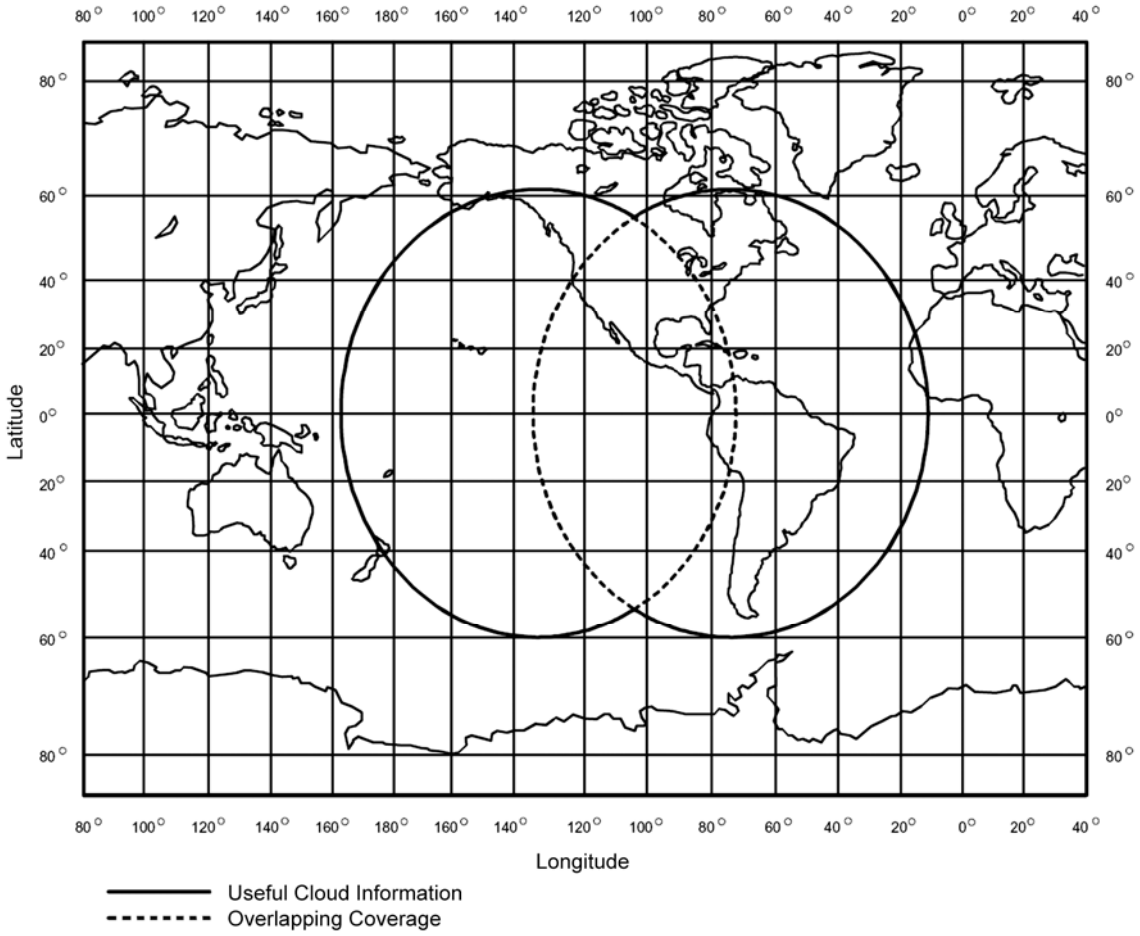


Figure 39: GOES COVERAGE

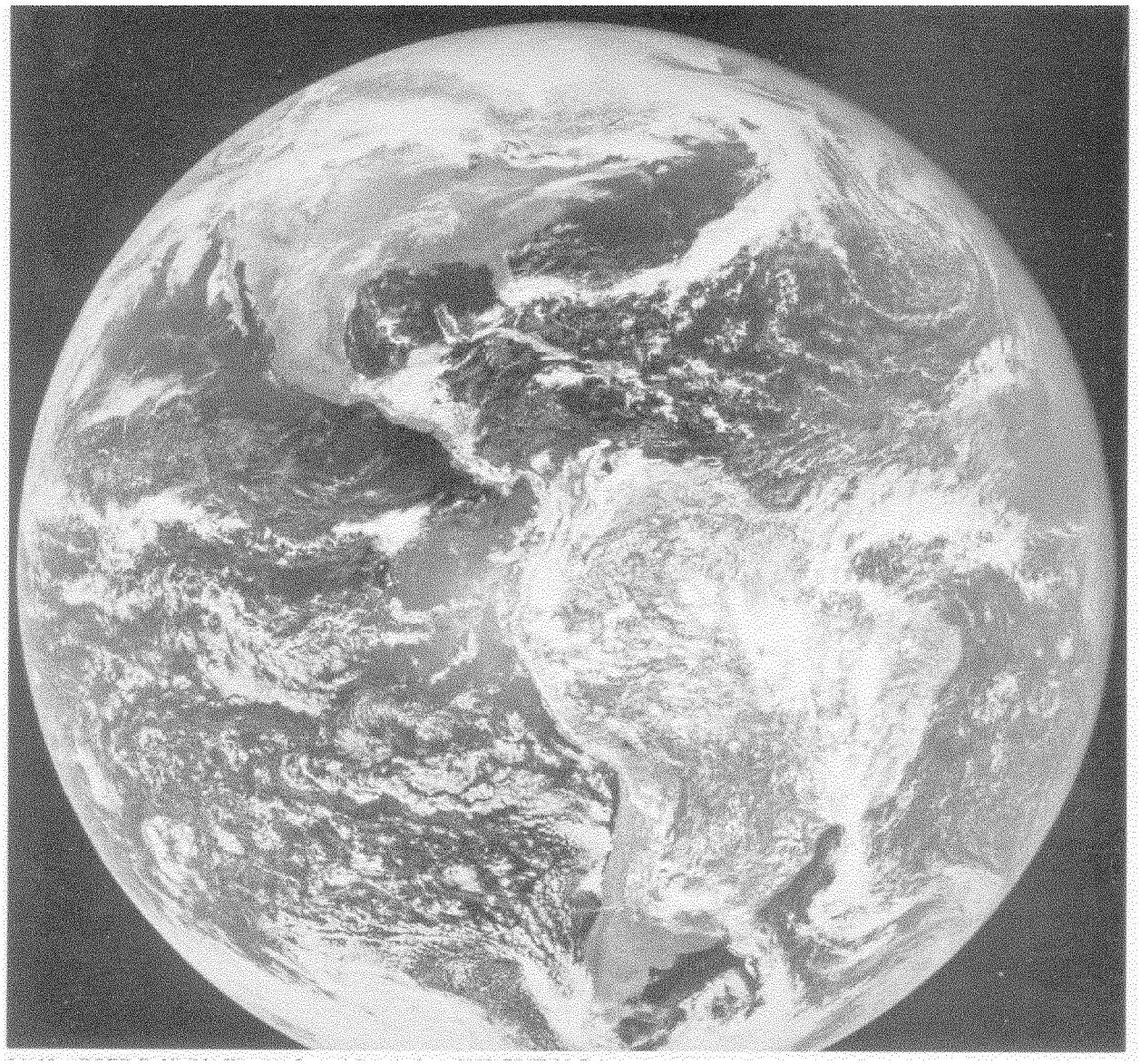


Figure 40: VISUAL PICTURE

b. Picture is the result of reflected sunlight

(1) Clouds are an excellent reflector of sunlight

(2) Neither the Earth's atmosphere nor empty space reflects sunlight; therefore, the background will always be black

(3) Reflectivity table: (thick clouds appear white, thin clouds appear darker)

(a) Cumulonimbus - 92%

(b) Thick Cirrostratus - 74%

(c) Thick Stratocumulus - 68%

(d) Thin Stratus - 42%

(e) Sand, No Foliage - 27%

(f) Sand and Brushwood -17%

(g) Water Surfaces - 9%

NOTE: Terrain has intermediate to low reflectivity and will appear as some shade of grey. Water appears almost black. Land/water contrast will normally be good.

C. Infrared pictures

Fig 41: *Infrared Picture*

1. Everything with a temperature above absolute zero radiates energy

2. Wave length of energy varies with temperature

3. GOES measures energy level at specific wave lengths

4. Earth receivers convert energy measurements to temperatures

a. IR imagery portrays different temperatures as black (very warm), white (very cold), or some shade of grey

b. High clouds are very cold so they appear white; mid-level clouds are warmer, so they appear as some shade of grey; low clouds and/or fog often are the same temperature as the surrounding terrain and cannot be distinguished at all

5. Enhanced IR pictures

a. Meteorologist has the option of assigning shades of grey to specific temperatures which allows specific items, i.e., thunderstorms, to be highlighted

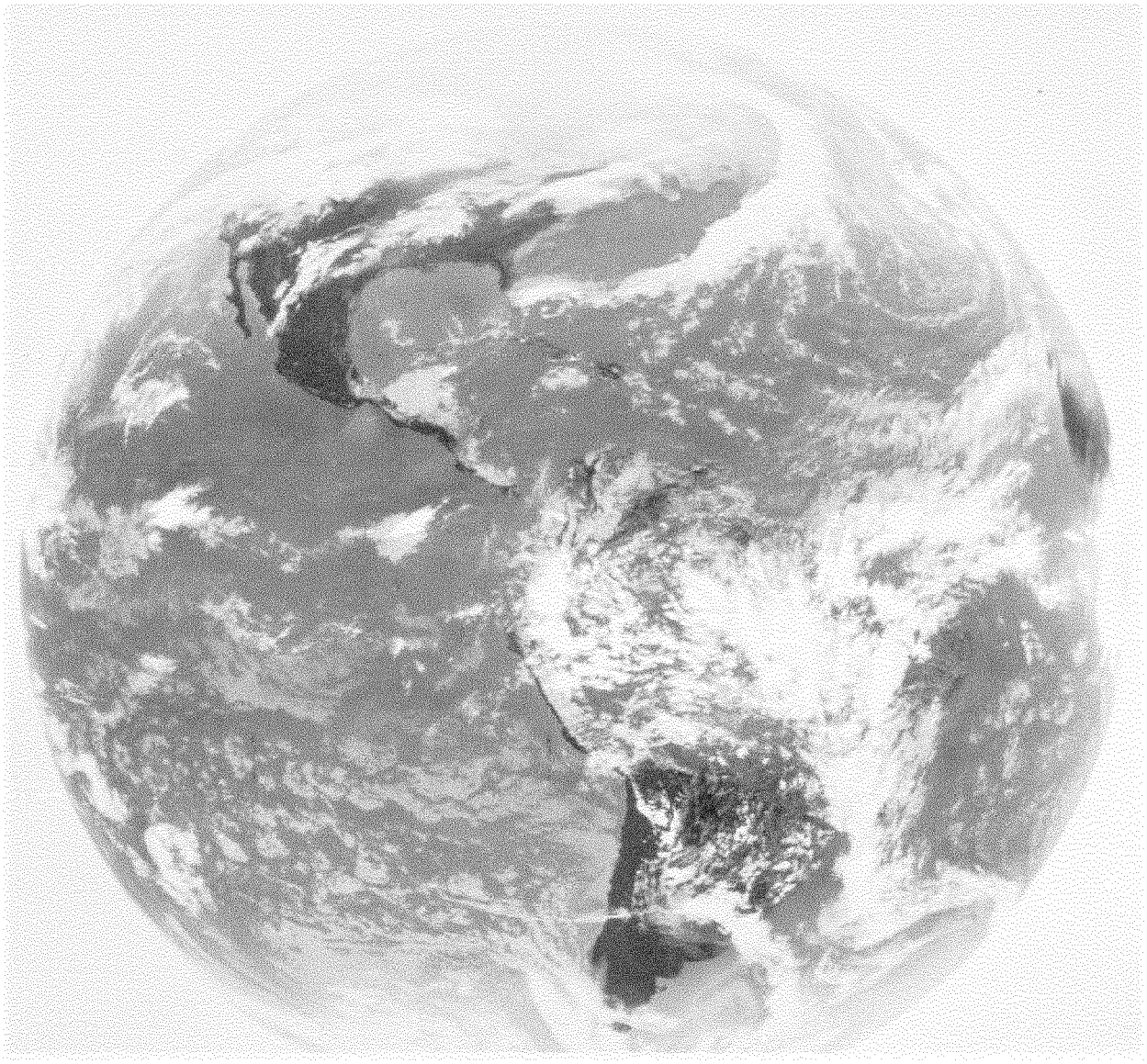


Figure 41: INFRARED PICTURE

b. Operationally enhanced IR used quite often

D. Date/Time data

Fig 42: *Picture with Date/Time Data*

1. As with all weather products, checking the currency of the product can be important

2. Some weather briefing facilities can provide real-time CRT imagery, direct from the appropriate satellite

3. Printed product will display DTG legend

   a. First 4 numbers UCT (Z) time - indicates time of picture transmission start

   b. Second group calender day, month, year

   c. Last group indicates sector

E. Use of the pictures

1. Low-pressure areas and fronts

   a. Primary characteristic is “question mark” or “comma” shaped cloud pattern

   b. Center of low-pressure located near center of vortex

   c. Tail of the “comma” denotes the location of the cold front

   d. Warm fronts often hard to define without the use of surface data

   e. Enhanced IR very helpful in determining locations of thunderstorms in the cloud pattern

2. Mountain Wave Turbulence

   a. Caused by winds in excess of 25 kts blowing perpendicular to rough or mountainous terrain causing moderate to severe turbulence

   b. Satellite imagery of wavy cloud pattern

      NOTE: The tighter the waves, the more severe the turbulence.

3. Jet Streams

Fig 41: *Satellite Picture of Jet Stream*

   a. Indicated by narrow bands of cirrus clouds

   b. Almost always marked by very sharp northern and southern boundaries

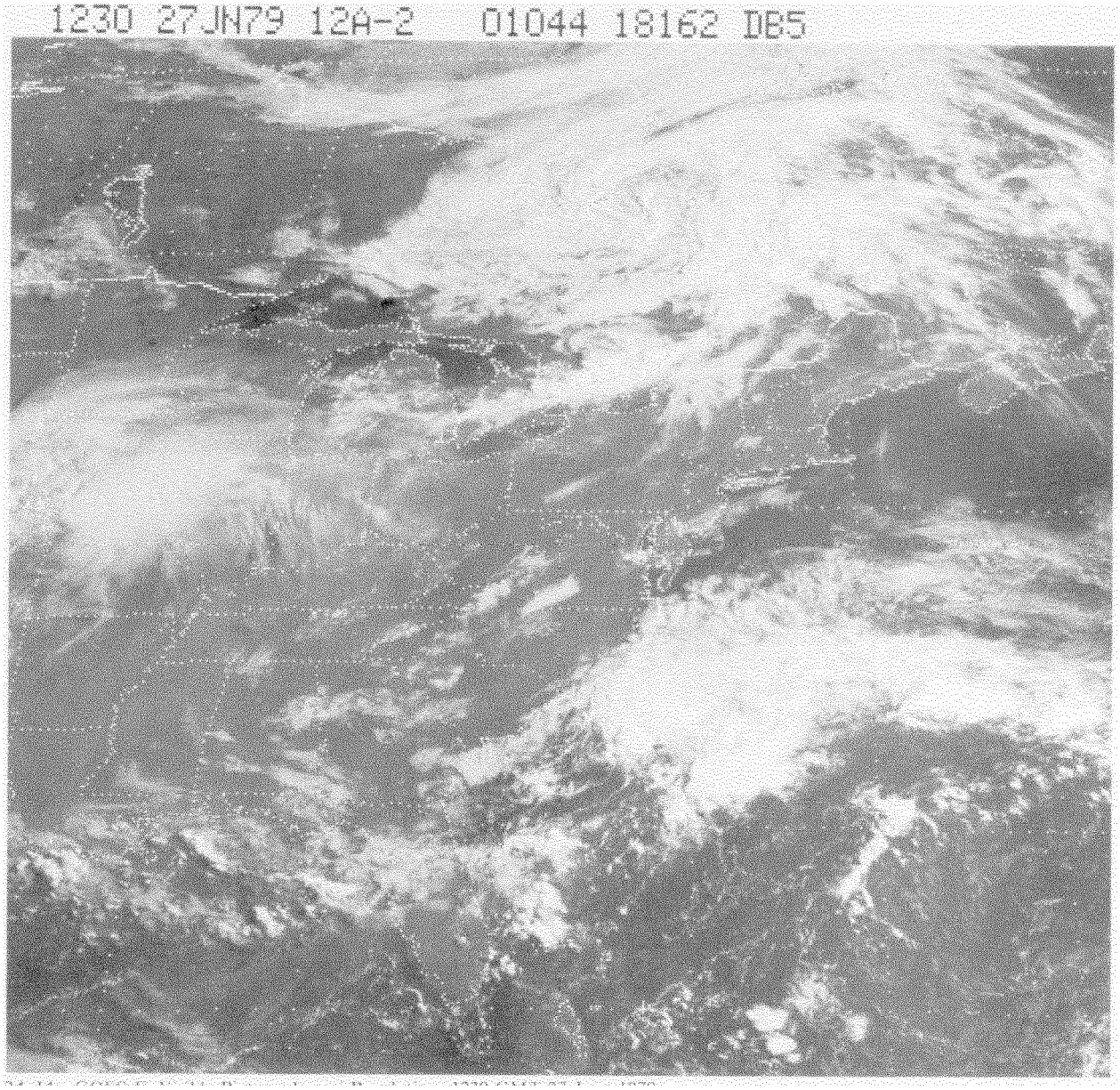


Figure 42: PICTURE WITH DATE/TIME DATA

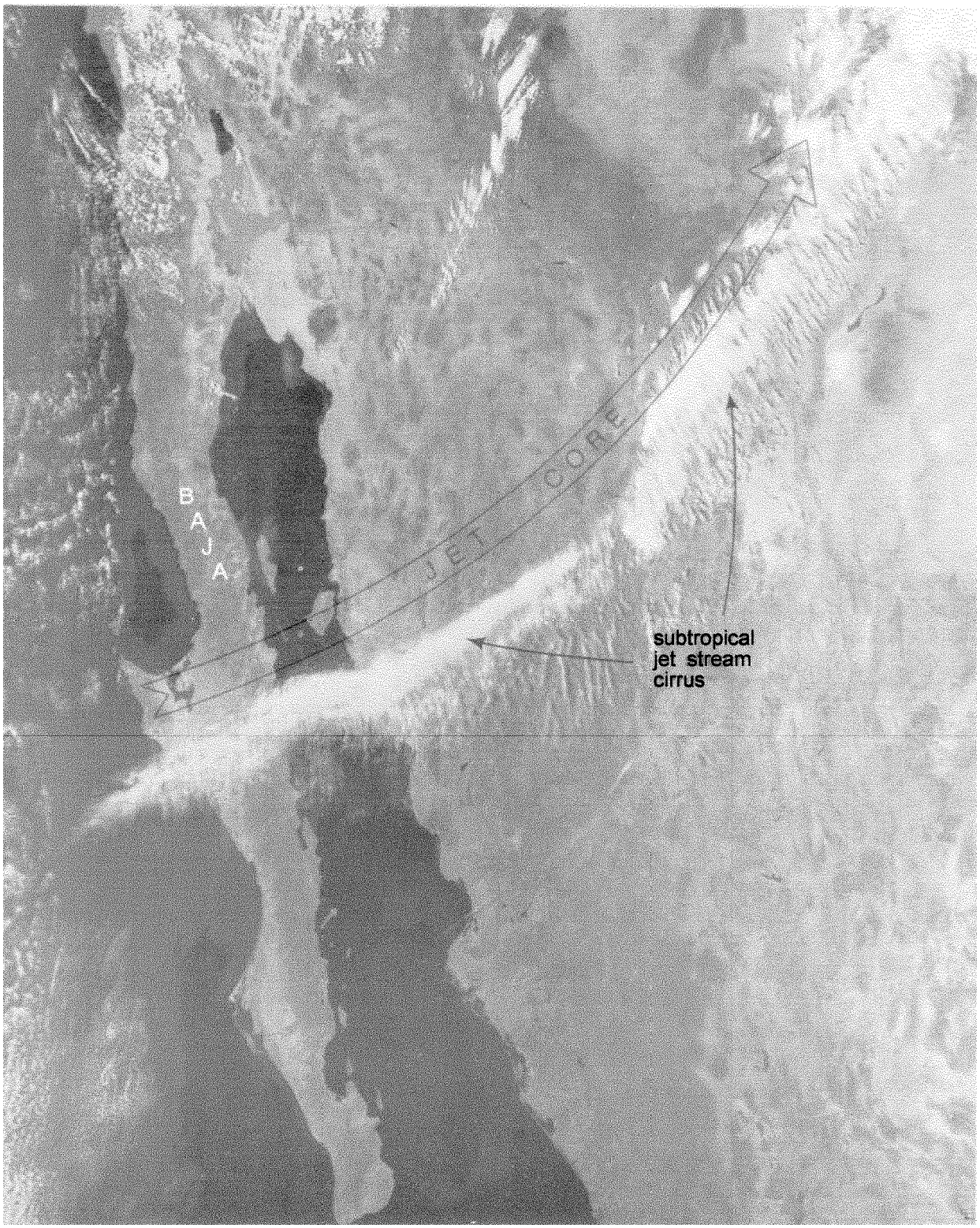


Figure 43: SATELLITE PICTURE OF JET STREAM

4. Fog and Low Clouds

   a. Show up on visual pictures only (reflective sunlight)

   b. Not enough contrast to show on IR

F. Other uses of the GOES

1. IR radiation in any of several bands

2. Atmospheric temperature sounding capability

3. Solar X-ray emissions and the near earth space environment

4. Provides selected data for research-oriented environmental scientists

Fig 44: *The GOES Mission*

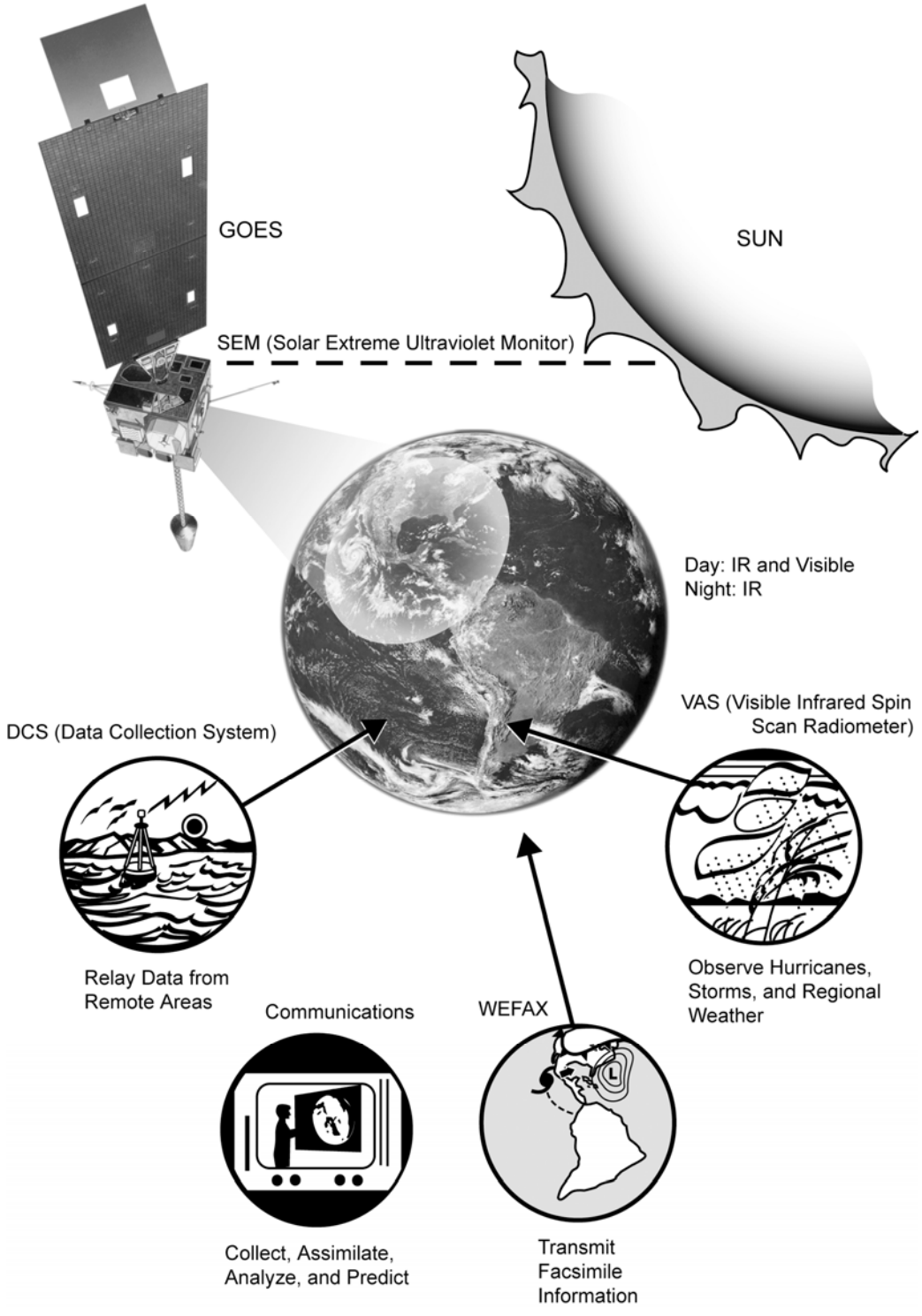


Figure 44: THE GOES MISSION

XI. Spatial Disorientation **9.7.1.1.5.2**

Spatial disorientation is the mistaken perception of one's position relative to the earth. Three sensory systems give us the information we use to maintain our equilibrium and determine where we are and how we are oriented.

A. Sensory Systems

1. Visual System

a. 90% of the information we use for point reference comes from our eyes

b. When we fly in visual meteorological conditions (VMC), our vision enables us to keep the aircraft properly oriented to Earth by reference to the ground, sky, and horizon

c. It is the most reliable of our senses but is prone to illusion, mistakes in processing or interpreting what we see, that can result in spatial disorientation

2. Vestibular System

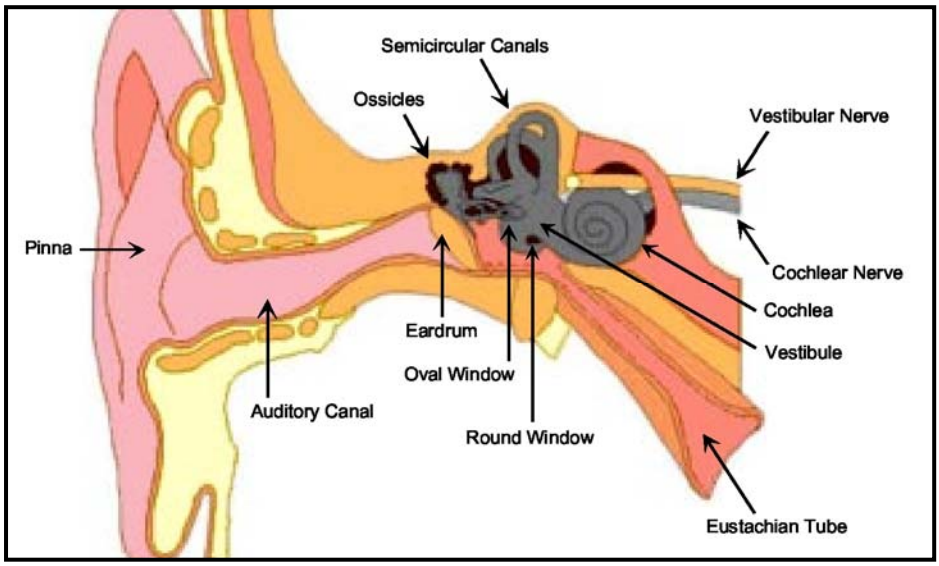


Fig 45: *Vestibular System*

Figure 45: VESTIBULAR SYSTEM

a. Secondary positioning system consists of motion- and gravity-sensing organs

b. The system is redundant; there is one in each inner ear

c. Each vestibular apparatus has two structures: semicircular canals and otolith organs

(1) Semicircular Canals

Fig 46: Semicircular Canals

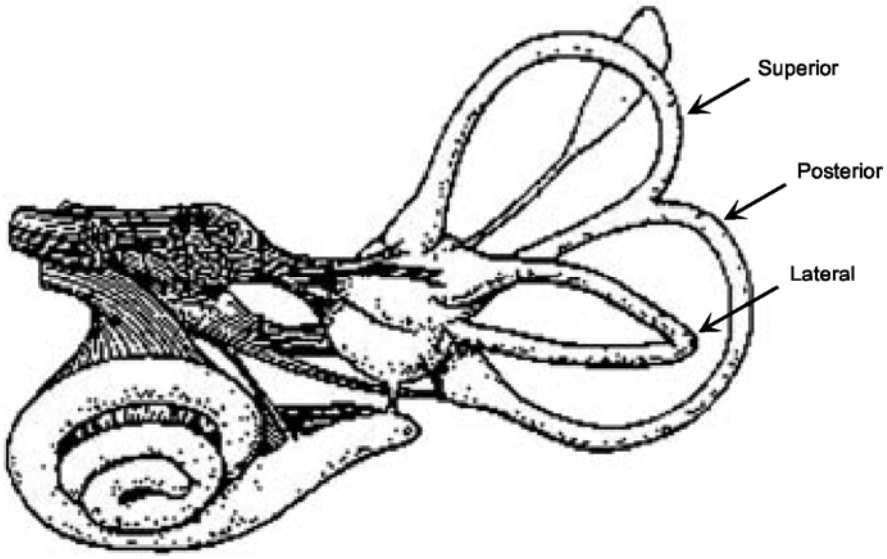


Figure 46: SEMICIRCULAR CANALS

(a) Each semicircular canal has three perpendicular tubes containing fluid and sensory hairs

(b) As the body moves, the motion of fluid in the canals provides the brain with roll, pitch, and yaw information

(c) When a turn commences, the inertia of the fluid moves in the opposite direction relative to the sensory hairs and we correctly interpret the turn and its direction

d) A limiting factor is that if a turn continues, the fluid catches up, creating the sensation that the turn has ceased

(e) Therefore, a prolonged turn results in the false sensation of not turning at all and, when the turn stops, a sensation of a turn in the opposite direction

(f) Additionally, any bank rate of less than 2 degrees per second is insufficient to stimulate the fluid in the canals, and will not be felt

(2) Otolith Organs

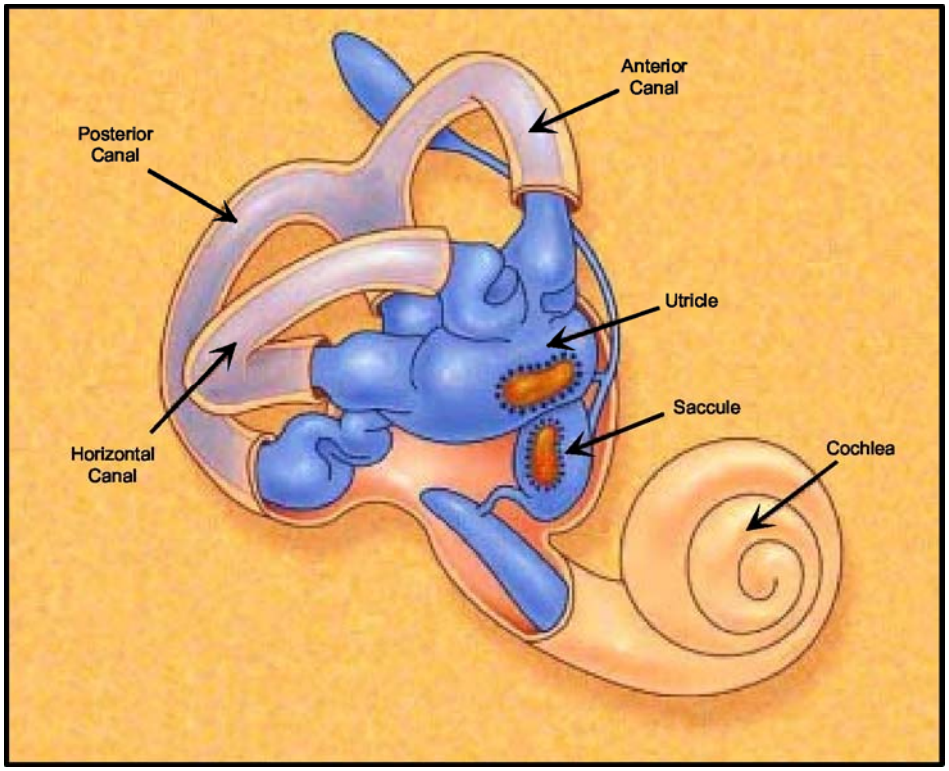


Fig 47: *Otolith Organs*

Figure 47: OTOLITH ORGANS

(a) The otolith organs (utricle and saccule) are small sacs at the base of the semicircular canals

(b) They are embedded with sensory hairs and contain a membrane with chalk-like crystals – called otoliths

(c) As the head moves or body moves, the movement of the membrane against the sensory hairs register gravity

(d) When the forces of acceleration and deceleration stimulate the otoliths, without visual reference, the body can't tell the difference between the inertial forces resulting from acceleration/ deceleration and the forces of gravity

(e) Acceleration may give the sensation of tilting backwards

(f) Deceleration may give the perception of pitching forward

3. Somatosensory System

a. Comprised of nerves in the skin, muscles, joints, and internal organs, along with hearing

b. The nerves sense pressure differentials

c. While in flight, these sensations are most acutely felt where the body and the aircraft meet, namely on the seat. This originated the term “seat-of-the-pants” flying

d. Hearing can determine our position relative to a sound source

B. Sensory Illusions

1. All three sensory systems are prone to errors

2. In some cases, we may have the illusion of straight-and-level when we're almost inverted

3. We may be convinced we're tumbling when we're straight and level

4. Visual Illusions:

   a. False Horizon:

      (1) While flying over sloping cloud decks or land that slopes gradually, pilots are often compelled to fly with their wings parallel to the slope rather than straight and level

   b. Confusion of Ground Lights with Stars

      (1) Sparse, isolated ground lights can be mistaken for stars

      (2) A line of ground lights may be assumed to represent the horizon

      (3) This can lead pilots to maneuver so as to put the ground “above” them or fly into the ground because the perceived horizon is below the actual one

   c. Autokinesis

      (1) A stationary light stared at for several seconds in the dark will appear to move

      (2) This can lead to mistaking the light for another aircraft, and to attempt to maneuver the aircraft to compensate for the perceived movement of the light

5. Vestibular Illusions

   a. The Leans

      (1) Most common form of spatial disorientation

      (2) In a prolonged turn, the fluid in the semicircular canals will stabilize and may perceive a roll to wings level as a turn in the opposite direction

      (3) This causes the pilot to lean in an attempt to assume what they think is a true vertical posture

(4) The pilot will also have the tendency to bank the aircraft into an attitude erroneously perceived to be straight and level

b. The Graveyard Spiral

(1) When entering a spin, the fluid in the semicircular canals begins to accelerate and the pilot's first impression is accurate, a spin is perceived

(2) After about 10 to 20 seconds, the fluid reaches a constant speed and the sensation of spinning is replaced by one of no rotary motion

(3) If the spin is then terminated the fluid cause a sensation of spinning in the opposite direction

(4) The pilot may then try to correct for this false impression by putting the aircraft back into the original spin

c. Vertigo/Coriolis Illusion

(1) An abrupt head movement in a prolonged constant-rate turn can create the illusion of rotation or movement in an entirely different axis

(2) Looking down, as you might when searching for a chart in the cockpit, and then looking up can cause vertigo

d. Inversion Illusion

(1) An abrupt change from climb to straight-and-level can excessively stimulate the sensory organs for gravity and linear acceleration creating the illusion of tumbling backwards

(2) The pilot may correct for this illusion by pushing the nose of the aircraft abruptly downward, thus intensifying the illusion

C. Spatial disorientation in flight will be experienced at one time or another by all pilots

1. Spatial disorientation is ranked among the most cited contributing factors to fatal aircraft accidents

a. Spatial disorientation accounts for 20% of all military fatal mishaps

D. Spatial Disorientation Prevention

1. When flying wing on another aircraft, remember your perceived aircraft attitude often differs substantially from your true attitude because you are concentrating on the other aircraft

2. Do not base control of the aircraft on “seat-of-the-pant'' sensations

3. Do not unnecessarily mix flying by instruments with flying by external visual cues

4. Make an early transition to instruments when flying in poor visibility

5. Maintain flight proficiency under IFR conditions

6. Be thoroughly familiar with your aircraft's instrumentation

7. Do not fly with an upper respiratory tract infection, when under the influence of drugs or alcohol, or when mentally or physically debilitated

REMEMBER, experience does not make you immune!

SUMMARY

* Meteorological definitions
* Weather patterns associated with frontal systems
* Meteorological hazards and their effects on flight and flight planning
* Weather minimum requirements outlined in OPNAVINST 3710.7
* Analytic and prognostic weather charts
* Printed reports and forecasts
  - Terminal aerodrome forecasts
  - Area forecast
  - Winds and temperatures aloft forecast
  - Severe weather reports, advisories, and forecasts
* En route procedures including weather information sources and PIREP
* Flight weather packets
* Optimum Path Aircraft Routing System (OPARS)
* Satellite imagery
* Spatial Disorientation

CONCLUSION

As an aviator, you experience the meteorological environment in a unique and potentially hazardous way. You cope with this environment as a matter of course. As an instructor, you must help students develop these same skills to operate effectively and safely within that environment. Understanding weather phenomena and the hazards to flight they may represent will help keep your students from becoming “weather statistics!”

Lesson Guide

COURSE/STAGE: Instrument Rating

LESSON TITLE: IR Review

LESSON IDENTIFIER: IRFP-02

LEARNING ENVIRONMENT: Classroom

ALLOTTED LESSON TIME: 2.0 hr

TRAINING AIDS

* Figures
  Fig 1: Destination Weather Requirements
  Fig 2: Airspace Classes

STUDY RESOURCES

* Federal Aviation Regulations (FAR) Part 91
* NATOPS General Flight and Operating Instructions Manual.
* 0PNAVINST 3710.7
* DoD FLIP high altitude charts
* DoD FLIP IFR flight supplement
* DoD FLIP Flight Information Handbook
* DoD FLIP high altitude approach plates
* Aeronautical Information Manual
* INav and BI materials

LESSON PREPARATION:

Review:
* Materials from the INAV block
* Notes and MILs from UJPT BIFP-05 through -09, E2-C2 or ADV BIFP-02 through -05, or IUT BIFP-02 through -04

REINFORCEMENT: N/A

EXAMINATION:

Testing will take palce in IRFP-03X Open Book Exam (UJPT, E2-C2, ADV, and IUT) and IRFP-04X (UJPT, E2-C2, and ADV) following this review.

PRESENTATION CONTENTS

LESSON OBJECTIVES

2.1.8.3
Recall FLIPs required for flight planning

1.1.1.8.6.3
Recall the meaning of special use airspace

2.9.4.2.1
Interpret TACAN/VOR DME approach plates

2.9.4.3.1
Interpret VOR approach plates

2.9.4.6.1
Interpret ILS approach plates

2.1.8.8
Recall items to be checked during route/altitude selection

2.6.6.1
Recall procedures for performing an instrument departure

1.1.1.8
Recall the applicability of the OPNAVINST 3710 series to naval aviators

1.1.1.2.1
Recall requirements IAW OPNAVINST 3710.7 for obtaining DD-175-1

2.1.8.6
Recall information provided by NOTAM system

1.1.1.4.8
Recall CNATRA severe weather restrictions

2.1.8.1
Determine fuel requirements for route of flight

1.1.1.1
Determine weather minimums

2.1.8.2
Determine alternate routes/airfields

2.9.4.9.1
Recall procedures for performing missed approach

2.7.6.1.1
Recall elements normally contained in an ATC clearance

1.1.1.8.1
Recall requirements for filing DD-175

1.1.1.9
Recall locations, types, uses, functions of air traffic control facilities

2.7.5.2.4.1
Recall procedures/IAS for flying VOR holding

2.7.5.1.6.1
Recall procedures/IAS for flying TACAN/VOR DME holding

2.7.5.3.1
Recall voice procedures associated with instrument navigation

2.9.4.1.2
Recall procedures for performing an en route descent

2.9.4.1.2.2
Recall penetration procedures

2.9.4.1.1
Recall criteria which influence type of instrument approach

2.9.4.3.3
Interpret approach plates

1.9.1.3.1.1
Recall procedures/reasons for performing flight under IFR to a visual approach

1.9.1.3.1.2
Recall procedures/reasons for performing IFR approach to a contact approach

2.9.4.5.2.1
Recall procedures for a PAR approach

2.9.4.5.1.1
Recall procedures for flying an ASR approach

2.9.5.4.1
Recall procedures for performing a circling approach

1.1.1.7.1.1
Recall IFR minimums

1.8.1.10.2.2
Recall procedures for lost communications situations

1.1.1.7.1.2
Recall airspace requirements for IFR

MOTIVATION

OPNAVINST 3710.7 states in part: "All naval pilots in DIFOPS flying status except DIFOPS Code 2 aviators are required to maintain a valid instrument qualification." Additionally, it states that each naval aviator annually shall satisfactorily complete a written examination covering the following areas: 1) federal aviation regulations, 2) navigational systems and procedures, 3) meteorology, and 4) instrument procedures contained in pertinent military directives. This review lesson will cover the pertinent information that you will need to successfully pass the instrument written examination.

OVERVIEW

This lesson prepares you for the examination for the instrument rating as required by OPNAVINST 3710.7.

The following information will be covered in this review:

* Flight Publications
* OPNAV 3710.7 series
* En route and arrival procedures
* Lost communications
* Airspace review

PRESENTATION

I. Flight Publications

A. Aeronautical Information Manual

1. "Official Guide To Basic Flight Information and ATC Procedures," i.e., regulatory in nature

a. Contains basic flight information and ATC procedures

b. Excellent publication for up-to-date instrument procedures

c. FLIPs contain much of the same information, but scattered. These are a single source, primarily civilian in orientation. They are highly detailed and include:

(1) NAVAID info

(2) Radar services

(3) Airport lighting (VASI)

(4) Airspace

(5) Operations and communications

(6) Procedures

(7) METRO

(8) Wake turbulence

(9) Glossary

(10) Medical

(11) Mountainous terrain

Sg1, fr 2
Lesson Organization-Flight Publications

Sg1, fr 3
Aeronautical Information Manual (AIM)

Sg1, fr 4
Flight Information Publications (FLIP)

B. Flight Information Publications (FLIP) **2.1.8.3**

1. General Planning (GP)

   a. Index in CH-1

   b. Terms CH-2

   c. Flight Plans CH-4: DD-175 preparation

   d. Pilot Procedures CH-5: Preflight, Departure, En Route and Arrival

   e. Definitions

2. Area Planning (AP/1)

   a. Division of U.S. Airspace Explanations, Entry Requirements

   b. Flight hazards

   c. Route/area restrictions

   d. Preferred IFR routes

   e. Supplementary aerodrome remarks

3. Special Use Airspace (AP/1A) **1.1.1.8.6.3**

   a. Lists user, restrictions, times, altitudes, contact numbers for:

      (1) Warning area—airspace over international waters which may contain hazards to nonparticipating aircraft

         (a) Restricted joint use—white on charts, controlled airspace. Center cannot issue clearance into/through danger. Same as warning over land.

         (b) MOAs

(c) Parachute jumping areas

4. Military Training Routes (AP/1B)

   a. Gives info on MTR and refueling tracks, plus lost comm procedures for IR routes and scheduling activity for all routes

5. IFR Enroute Supplement

   a. Alphabetical listing of U.S. aerodromes which includes:

      (1) DoD high and/or low instrument approach procedures

      (2) Radar capabilities

      (3) NAVAID info

      (4) IFR facilities (centers)

      (5) Special notices (inside front cover)

      (6) Canadian/Mexican section

      (7) Section A has legends, explanations and examples

      (8) Voice procedures (inside back cover)

      (9) Hours of no NOTAM maintenance

6. Flight Information Handbook

   a. Emergency procedures

      (1) Lost comm

      (2) Hijacking

      (3) Intercept

      (4) Distress signals

b. FAA traffic control procedures

c. Position reporting procedures

d. ATIS

e. RCR

f. Aerodrome lighting systems

g. METRO information

h. NOTAM

i. National Weather Service

j. PIREPs

7. Approach Plates **2.9.4.2.1, 2.9.4.3.1, 2.9.4.6.1**

a. Legend

b. Radar approach minimums

c. Field diagram spot elevation, A-gear, runway lengths

d. Latitude/longitude (may not be oriented north/ south)

e. Profile altitudes

(1) DME

(2) VDP

Sg1, fr 5
Approach Plate
(2 Overlays)

Sg1, fr 6
Procedure Turn
(4 Overlays)

Sg1, fr 8
VDP - Visual Descent Point
(2 Overlays)

(a) VDP is a point on the final approach course from which normal descent to touchdown point may be commenced, provided visual reference IAW FARs are established: approach light system, runway threshold, threshold markings, threshold lights, REIL, VASI touchdown zone, markings for lights, runway lights. If you descend prior to VDP, you may be below a safe glideslope. If you are not visual at the VDP and continue to the MAP (perfectly legal), you may be above a safe glideslope (high descent rate/land long).

(b) Terps box lists minimums for approaches, including:

(i) Decision height (DH): MSL altitude at which a decision must be made, during a precision approach, to continue or execute a missed approach

(ii) Minimum descent altitude (MDA): MSL altitude on nonprecision approach that you cannot descend below until criteria of part 91.175 is met and a safe landing can be made (3710)

(iii) Height above touchdown (HAT): AGL height of DH or MDA above highest point on first 3,000 ft of runway

(iv) Height above airport (HAA): AGL height of MDA above published field elevation. Associate with nonprecision circling approaches

(v) Weather minimums: NAS Kingsville uses CAT C 120 to 141 KIAS for approach speed.
Note: RVRs are not linear 24 = 1/2, 50 = 1 sm.

Sg1, fr 9
High Altitude Chart

8. High Altitude Charts **2.1.8.8**

   a. Use above 18,000 ft in Class A airspace

   b. All aerodromes have at least 5,000 ft hard surface

   c. Only those in dark blue have DoD FLIP high approaches

   d. Green has approaches (low, may be non-FLIP)

   e. Brown no approach procedure high or low

   f. MEA 18,000 ft unless otherwise indicated

   g. MAA 45,000 ft unless otherwise indicated

   h. Jet routes are point-to-point, no airway width

   i. Shows underlying low altitude charts

Sg1, fr 9
Low Altitude Chart

9. Low Altitude Charts

   a. 1,200 ft AGL to 17,999 ft MSL

   b. Airways are 8 nm wide with defined center line

   c. No minimum runway length

   d. Blue has instrument approach. Dark blue is published in FLIP Low Altitude Approach

   e. Low Altitude Approach in FLIP

   f. MOCA guarantes obstruction clearance between radio fixes on VOR airways and reception within 22 nm of NAVAID

g. MEA guarantees both signal cover and obstruction clearance along route

h. MEA changes take place at NAVAID

i. MCA climb prior to NAVAID so as to cross at that altitude or above

j. Shows MTRs, special use airspace, Class B and Class C airspace.

10. Civil SIDs and STARs **2.6.6.1**

a. SIDs alphabetical by aerodrome

b. STARs alphabetical by procedure

(1) If you do not want a STAR

(a) Indicate on DD-175 in remarks section or

(b) On initial radio contact request no STAR

(2) Will see more of in future

II. OPNAV 3710.7 Series **1.1.1.8**

A. Pilot-in-command responsible for the safe orderly conduct of the flight

B. Nonessential flights of convenience or prestige

1. Repeated flight to hometown area

2. Major sports events

3. Civic celebrations

Sg1, fr 11
SID (Vector)

Sg1, fr 12
SID (Vector)
Departure Route Description

Sg1, fr 13
SID (Pilot NAV)

Sg1, fr 14
SID (Pilot NAV)
Departure Route Description

Sg1, fr 15-16
STAR

Sg1, fr 17
STAR (Review)

Sg2, fr 2
Lesson Organization-OPNAV 3710.7

C. Single-piloted aircraft, one set of flight controls, operated by one NATOPS qualified pilot

NOTE: FAA considers all tandem seat military turbojets to be single-piloted.

D. Flight Planning Chapter **4 1.1.1.2.1**

1. DD-175-1 Weather Brief

   a. Valid for max of 2+30 from briefing time

   b. Void time is never more than 30 minutes after ETD

   c. Earliest brief time with a void time of 30 minutes is then 2+00 prior to ETD

   d. Extension past void time may be granted by calling a forecaster (phone or radio). A face-to-face brief may be required if significant changes have occurred

   e. Must use NAVOCEANCOMDET brief, if available

2. NOTAMs Base OPS, Class I and Class 2 (printed) **2.1.8.6**

   a. Changes to airways and approach procedures

   b. Flight restrictions

   c. Special notices

      (1) Temporary MOAs

      (2) RPV flights

      (3) Hazards

      (4) Restrictions

      (5) Special traffic management

d. APs

3. Other requirements

a. Fuel requirements

b. Alternate and destination information (runway, A-gear, RCR, etc.)

c. Alternate filing requirements ETA ± 1 hour

(1) Cannot use PAR for alternate; can use for destination

(2) Must use approach which does not require comm radios

d. Must file using minimums for expected runway/approach in use and not to lowest available

e. Aviation severe weather warnings (WWs)

(1) If severe weather develops as forecasted, you can fly around or over

(2) If severe weather does not develop

(a) File VFR and maintain VMC

(b) File IFR and maintain VMC

NOTE: See weather section for AIRMETs, SIGMETs.

E. CNATRA Aviation Weather Warning (CNATRAINST 3710.8) **1.1.1.4.8**

1. Aircraft under operational control of CNATRA shall be restricted in the same manner as stated in OPNAV 3710.7 whenever a CAWW/SIGMET has been issued

Sg2, fr 3
IFR Filing Criteria

Sg2, fr 4
Frame Intentionally Left Blank

Figure 1:
Destination Weather Requirements

<table>
<tr><td>DESTINATION WEATHER
ETA plus and minus one (1) hour</td><td colspan="3">ALTERNATE WEATHER
ETA plus and minus one (1) hour</td></tr>
<tr><td>0-0 up to but not including
published minimums</td><td colspan="3">3,000 - 3 or better</td></tr>
<tr><td rowspan="3">Published minimums up to but
not including 3,000 - 3 (single-piloted
absolute minimums 200 - 1/2)</td><td rowspan="2">NON-
PRECISION</td><td colspan="2">PRECISION</td></tr>
<tr><td>ILS</td><td>PAR</td></tr>
<tr><td>* Published
minimums
plus 300-1</td><td>Published
minimums
plus
200-1/2</td><td>*Published
minimums
plus
200-1/2</td></tr>
<tr><td>3,000 - 3 or better</td><td colspan="3">No alternate required</td></tr>
<tr><td colspan="4">*In the case of single-piloted or other aircraft with only one operable UHF/VHF transceiver,
radar approach minimums may not be used as the basis for selection of an alternate airfield.</td></tr>
</table>

Figure 1: DESTINATION WEATHER REQUIREMENTS

2. Issued when one or more of the following have been reported, detected by radar or imminently expected within 100 miles of NPA, NGU, NMM or NQI and no WW/SIGMET has been issued.

   a. Tornadoes

   b. Line(s) of thunderstorms > 45% coverage

   c. Severe thunderstorms

   d. Embedded thunderstorms

   e. Severe or extreme turbulence

   f. Severe icing

   g. Widespread dust/sand storms that lower visibility to < 2 miles

F. Fuel **2.1.8.1**

1. Fuel is not authorized to be purchased from other than military/contract except when

   a. Official business

   b. Flight terminated by bonafide emergency

   c. Flight is made by aircraft with limited range and purchase is necessary to complete mission

2. Minimum required (reference OPNAV 3710.7)

   a. No alternate required: takeoff to destination IAF plus reserve; includes approach for landing

   b. Alternate required: fuel to fly from takeoff to the approach fix serving destination and thence to an alternate airfield, plus a reserve of 10% of planned fuel requirements

   c. Reserve—the greater of 10% of planned fuel usage or 20 minutes at max endurance at 10,000 ft

d. Minimum fuel advisory only, no special handling. Give fuel remaining in minutes, not pounds

e. Emergency fuel actual emergency, priority handling

G. Takeoff minimums (actual) **1.1.1.1**

1. Standard Instrument Rating

a. Nonprecision mins for the landing runway in use or 300-1; whichever is greater, but never less than 300-1

b. Precision mins for the landing runway in use or 200-1/2; whichever is greater, but never less than 200-1/2

2. Special no mins; only good judgment and operational necessity prevail

3. Formation circling (nonprecision) or 1,000/3

4. High performance takeoff—pilots shall not perform or request clearance to perform unusual maneuvers within class B, C, or D airspace, if such maneuvers are not essential to the performance of the flight. These include unnecessary low passes, unscheduled fly-bys, climbs at very steep angles, practice approaches to altitudes below specific minimums (unless a landing is to be made), or any so-called “flat hatting” wherein a flight is conducted at a low altitude and/or a high rate of speed for thrill purposes.

H. Approach criteria **2.1.8.2**

1. Need published mins to commence at destination and alternate

2. Once commenced may continue, even if weather goes below mins on en route descent, and commences when passing through highest published IAF

3. Must use RVR when available for straight-in approaches

4. Formation to commence circling mins or 1,000/3; once commenced cleared to published mins for approach being flown

    a. Avoid dissimilar aircraft, except in an emergency

    b. Two aircraft max

    c. May bring more than two through layer to VFR below deck

I. Missed approaches **2.9.4.9.1**

1. Mandatory waveoff

    a. Tower

    b. Wheels watch

    c. Outside observer

    d. GCA controller (runway not in sight)

2. Non-mandatory missed approach

    a. GCA controller (runway in sight, safe landing can be made and cleared to land)

J. Practice approaches at destination, or alternate if field is below mins, are <u>not</u> allowed

1. Allowed at en route fields regardless of weather with no intent to land

2. Must meet 3710.7 fuel requirements

K. Operation near civilian aircraft 500 ft vertically, 1 mile horizontally

L. Acrobatic flight

1. Any intentional abrupt change in attitude pitch > 45, AOB > 60, with 2 + g's

2. A break as defined in NATOPS is not considered acrobatic flight

3. Do not perform over congested, populated areas, within federal airways, or Class D or E airfields

M. When flying less than 3,000 ft AGL, avoid noise-sensitive and wildlife areas

Sg 2, fr 5
Lesson Organization-En Route and Arrival Procedures

III. En Route and Arrival Procedures

A. Clearance **2.7.6.1.1, 1.1.1.8.1**

1. An authorization by ATC for the purpose of preventing collisions between **KNOWN** aircraft. Aircraft are to proceed under specified traffic conditions within controlled airspace. It is not an authorization to deviate from any rule, regulation, or minimum to conduct unsafe operation of aircraft

2. Elements

a. Clearance limit

b. Departure procedure

c. Route and altitude data

3. Readback: required only if clearance differs from filed or pilot is requested to readback.

4. "Via flight plan" or "No delay expected" routes: require altitude/flight level to be issued

B. Departure/SIDs **2.6.6.1**

1. Conformation to routing/altitudes depicted is required unless:

a. Altitude restrictions are removed

b. Pilot is cleared to an altitude above restriction by departure control.

c. Pilot is vectored off SID. SID is cancelled unless told by control “expect to resume SID.” If any restrictions still apply, ATC must state “comply with instructions”

C. ARTCC **1.1.1.9**

1. Separation of **KNOWN** IFR traffic

   a. Within 40 nm, radar 3 nm

   b. Outside 5 nm

   c. Non-radar 10 nm

2. Control of joint-use restricted areas

3. Issue of airborne clearances

D. Holding **2.7.5.2.4.1, 2.7.5.1.6.1**

1. Holding clearance for fix where pattern not depicted

   a. Radial

   b. Fix

   c. Location of holding pattern in relation to fix

   d. Leg lengths

   e. EAC/EFC

   f. Turns—if left, i.e., nonstandard

   g. If no turn direction given, assume standard turns. Hold SE of the CRP 120 radial 35 DME fix, 10 nm legs EFC 1935 or hold SE as depicted.

   h. Always hold inbound to fix

   i. Make all maneuvers to the holding side of the radial

j. Further clearance should be received 5 minutes prior to reaching a clearance limit or holding instructions issued. If clearance is not issued, slow to holding speed no sooner than 3 minutes prior to clearance/holding fix.

E. Voice reports **2.7.5.3.1**

1. Reference Flight Information Handbook (FIH), Sections B and C

2. Reference AIM—Distills FARs

3. Reference T-45A courseware

a. Instrument FTI

b. Instrument Navigation Lesson Guide

F. En route descent **2.9.4.1.2**

1. Begins when leaving cruising altitude

2. Final approach type to be flown should be understood by both pilot/controller prior to commencing

3. ATC may not terminate descent unless

a. Radar outage

b. Emergency

c. With pilots permission/request

d. Controllers cannot authorize speeds in excess of 250 KIAS below 10,000 ft

e. If IMC is to be encountered, ATC must issue lost Comm

G. Penetration considerations **2.9.4.1.2.2**

1. Weather at destination/alternate
2. Altimeter
3. Runway in use/RCR
4. Penetration checklist

H. Approaches **2.9.4.1.1, 2.9.4.3.3**

1. Clearance

a. An aircraft which has been cleared to a holding fix and subsequently “cleared for approach” has not received new routing. Routing via the holding fix is still required

b. Clearance for the approach does not clear an aircraft to descend from assigned altitude to IAF altitude, if being radar vectored or on an unpublished route

c. Aircraft using the high altitude can file for a low altitude approach

d. Commencing approach/leaving altitude aircraft must be established on a segment of approach

e. Approach is considered to have commenced when passing the highest IAF altitude for any approach at that field on an en route descent

f. ATIS ceiling/visibility omitted if greater than 5,000/5

g. SFA required for single-piloted night or IMC

h. Altimeter reset errors 1” = 1,000 ft

i. Place clearance to alternate on request

(1) Destination

(2) Route

(3) Altitude

(4) Fuel on board in minutes

(5) Time en route

j. Types **1.9.1.3.1.1**

(1) Visual

(a) Operate VMC on IFR flight plan, under control of ATC

(b) Must have field in sight, be #1 to land, or have preceding traffic in sight

(c) Not an instrument approach procedure

(d) Requested by either ATC or pilot

(2) Contact **1.9.1.3.1.2**

(a) Requested by pilot

(b) Ground reported visibility at least 1 sm (standard or special instrument approach has been published and is available)

(c) On IFR flight plan, clear of clouds. Takes place of instrument approach procedure

(d) Proceed to field by visual reference to surface

(3) GCA **2.9.4.5.2.1, 2.9.4.5.1.1**

(a) Field mins may be lower or higher than single pilot mins

(b) Lost Comm—assume “lost comm conditions” if transmission is not received while in:

(i) Pattern for 1 minute

(ii) Final for 5 seconds

(iii) ASR final for 15 seconds

(4) Circling **2.9.5.4.1**

(a) Mins listed in the radar mins section of the approach plate are mins from radar approaches

(5) ILS

(a) Must fly the aircraft on or above the glideslope from the point of glideslope intercept or outer marker to the middle marker (MAP)

(b) Must stay on or above VASI glideslope until a lower altitude is required for landing

k. Cleared for the option, you can

(1) Low approach

(2) Touch and go

(3) Full stop

(4) Stop and go

l. Cleared for approach

(1) May execute any published approach

2. Criteria for continuing an approach to landing (FAR 91.175) **1.1.1.7.1.1**

   a. Operation below the DH or MDA

      (1) Restricted unless:

         (a) The aircraft is CONTINUOUSLY in a position from which a safe landing can be made at normal descent rates using normal maneuvers

         (b) Visibility is not less than that prescribed for approach being conducted

         (c) At least ONE of the following visual references for the INTENDED runway is distinctly visible and identifiable to the pilot:

            (i) The approach light system (must have red terminating lights or red side row lights to go below 100 ft above TDZ elevation

            (ii) The threshold

            (iii) Threshold lights

            (iv) REIL

            (v) VASI

            (vi) Touchdown zone (TDZ) or TDZ markings

            (vii) TDZ lights

            (viii) Runway or runway markings

            (ix) Runway lights

IV. Lost Communications **1.8.1.10.2.2**

Sg 2, fr 6
Lessson Organization-Lost Communications

It is impossible to develop procedures for all possible situations associated with two-way communications failure. Pilots are expected to exercise good judgment and if the situation dictates, take emergency action.

A. Guidelines

1. Pilots should be predictable
2. Controllers base their actions on expected pilot actions
3. Intent to preclude extended IFR flight in controlled airspace
4. Squawk 7600
5. VMC
   a. Descend out of Class A airspace, maintain VMC and land as soon as practicable. Not intended to land minutes short of destination or at unsuitable field.
   b. Make sure you can maintain VMC to landing
6. IMC
   a. Route
      (1) Last assigned
      (2) If on vector, direct to fix or airway
      (3) Expected
      (4) Filed

b. Altitude (highest for the route segment being flown)

(1) Last assigned

(2) Minimum (MEA, MSA, ESA)

(3) Expected

7. Leaving clearance limit

a. EAC time received—If fix is from beginning of approach, commence descent/approach as close as possible to EAC time

b. EFC time not received—If fix is from beginning of approach, commence descent/approach as close as possible to ETA

c. EFC received—if not an IAF, leave clearance limit at EFC

d. Should hold at limit and depart to approach fix at a time which will place the aircraft at the fix as close as possible to ETA

V. Airspace Review **1.1.1.7.1.2**

Sg 2, fr 7
Lessson Organization-Airspace Reveiw

A. Class A

1. 18,000 ft MSL to FL600

2. Operating rules

a. IFR ATC clearance

b. Positive control

c. Transponder two-way comm

d. Pilot requires instrument rating

Sg 2, fr 8
Figure 2: *Airspace Classes*

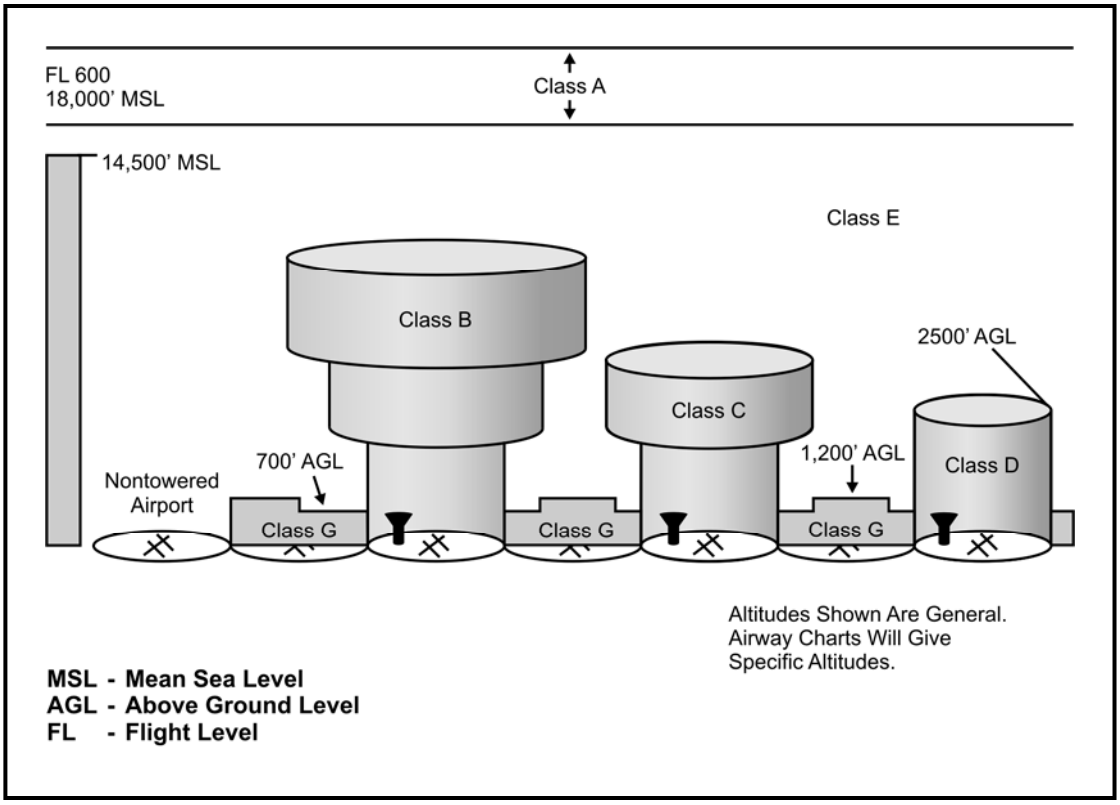


Figure 2: AIRSPACE CLASSES

B. Class B

1. IFR and VFR 3 miles and clear of clouds
2. ATC clearance
3. Private certificate
4. Transponder two-way comm
5. 250 KIAS max within 200 KIAS beneath

Sg 2, fr 9
Class C Airspace

Sg 2, fr 10
Airspace Classes Review

C. Class C

1. IFR and VFR
2. ATC clearance IFR radio contact VFR
3. Transponder and two-way comm
4. VFR 3 miles 500 ft below, 1,000 ft above, 2,000 ft horizontally
5. 200 KIAS below 2,500 ft, AGL within 4 nm of primary airfield

D. Class D

1. Surrounds tower-controlled fields (generally 4.4 nm radius, with extensions as necessary)
2. From surface to 2,500 ft AGL, rounded to nearest 100 ft
3. Two-way comm with tower event at satellite field
4. 200 KIAS below 2,500 ft AGL within 4 nm of primary airfield

E. Class E

1. Surface-based
   a. Surrounds non-tower airport

b. 100 ft and 3 miles, or IFR clearance; exists only when approved weather observations available on field

2. Aloft

a. Victor airways, transition areas, and other airspace used for navigation that are not part of airway system

b. Mandates higher weather mins for VFR

c. Begins at 1,200 ft AGL (some begin at 700 ft AGL)

F. Class G

1. What's left, uncontrolled

G. Special Use Airspace: activities, because of their nature, must be confined within this airspace, or limitations are imposed upon aircraft operations that are not a part of those activities, or both

Sg 2, fr 11
Special Use Airspace

NOTE: The status, shape, and vertical limits of special use airspace vary from area to area. Many of these areas become active only during certain days and hours, or can be over-or under-flown outside their defined limits.

1. Alert area **1.1.1.8.6.3**

Caution: Users and transients are equally responsible for avoiding collisions in alert areas.

a. Location: within U.S. airspace system, usually near air training bases

b. Identifier (on aeronautical charts): “A” prefix

c. Activities: high volume of pilot training exercises and other high intensity VFR aerial activity

d. Flight restrictions: none, but exercise extreme caution

e. Found on low altitude and tactical charts

2. Military operations area (MOA)

Caution: Pilots should exercise caution when transiting active or "hot" MOAs.

a. Location: distributed widely within U.S. airspace system

b. Identifier: named zone--e.g., "Kings III," "Martin C," "Reserve A"

c. Activities: military training

d. Flight restrictions

(1) VFR: none

(2) IFR: not generally cleared through an active MOA, unless aircraft separation can be assured by ATC

e. Found on low altitude and tactical charts

3. Warning area

WARNING: Penetrating warning areas without authorization can be extremely hazardous to both civilian and military flights.

a. Location: in international airspace beyond the 3-sm limit of the U.S. border

b. Identifier: "W" prefix

c. Activities: invisible hazards to flight such as artillery firing, aerial gunnery, or flight of guided missiles

d. Flight restrictions

(1) VFR: none, but extremely hazardous

(2) IFR: will not be cleared through active warning areas

(3) Navy aircraft: no OPNAVINST restriction—however, penetration of an active warning area could be in violation of squadron or wing SOP

e. Found on high and low altitude charts, plus tactical charts

4. Restricted airspace

WARNING: Penetrating restricted areas without authorization is in violation of FARs and can be extremely hazardous.

a. Location: within U.S. airspace system or over U.S. territorial waters

b. Identifier: “R” prefix

c. Activities: hazards similar to warning areas, including artillery firing, aerial gunnery, or flight of guided missiles

d. Flight restrictions

(1) Joint use: may use with permission from military or civilian controlling agency

(2) Non joint use: may use with permission from controlling agency prior to flying

(3) IFR flights may be cleared through non-active restricted airspace, if ATC has received permission from (or is) the controlling authority

e. Found on high and low altitude charts, plus tactical charts

5. Prohibited airspace

   a. Location: within U.S. airspace system

   b. Identifier: “P” prefix on area identifier

   c. Activities: continuously active to protect areas concerning national security or national welfare—White House and other presidential residences, nuclear manufacturing/storage facilities, etc.

SUMMARY

Sg 3, fr 3
Review Menu

This lesson has focused on the following topics:

* Flight publications
* OPNAV 3710.7 series
* En route and arrival procedures
* Lost communications
* Airspace review

CONCLUSION

Having reviewed the material in this lesson, you are now prepared to take the IR open- and closed-book exams.

NOTES