

STUDY UNIT EIGHT

AVIATION WEATHER SERVICES

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This study unit contains outlines of major concepts tested, all FAA test questions and answers regarding weather, and an explanation of each answer. Each subunit within this study unit is listed above with the number of questions from the FAA pilot knowledge test pertaining to that particular subunit. For each subunit, the first number following the number of questions is the page number on which the outline begins, and the next number is the page number on which the questions begin.

CAUTION: Recall that the **sole purpose** of this book is to expedite your passing the FAA pilot knowledge test for the private pilot certificate. Accordingly, all extraneous material (i.e., topics or regulations not directly tested on the FAA pilot knowledge test) is omitted, even though much more information and knowledge are necessary to fly safely. This additional material is presented in *Pilot Handbook* and *Private Pilot Flight Maneuvers and Practical Test Prep*, available from Gleim Publications, Inc. See the order form on page 337.

8.1 WEATHER BRIEFINGS

1. When requesting a telephone weather briefing, you should identify
 - a. Yourself as a pilot
 - b. Your intended route
 - c. Your intended destination
 - d. Whether you are flying VFR or IFR
 - e. Type of aircraft
 - f. Proposed departure time and time en route
2. A standard briefing should be obtained before every flight. This briefing will provide all the necessary information for a safe flight.
3. An outlook briefing is provided when it is 6 or more hours before proposed departure time.
4. An abbreviated briefing will be provided when the user requests information to
 - a. Supplement mass disseminated data,
 - b. Update a previous briefing, or
 - c. Be limited to specific information.

8.2 AVIATION ROUTINE WEATHER REPORT (METAR)

1. Aviation routine weather reports (METARs) are actual weather observations at the time indicated on the report. There are two types of reports.
 - a. **METAR** is a routine weather report.
 - b. **SPECI** is a nonroutine weather report.
2. Following the type of report are the elements listed below:
 - a. The four-letter ICAO station identifier
 - 1) In the contiguous 48 states, the three-letter domestic identifier is prefixed with a "K."
 - b. Date and time of report. It is appended with a "Z" to denote Coordinated Universal Time (UTC).
 - c. Modifier (if required)
 - d. Wind. Wind is reported as a five-digit group (six digits if the wind speed is greater than 99 knots). It is appended with the abbreviation KT to denote the use of knots for wind speed.
 - 1) If the wind is gusty, it is reported as a "G" after the speed, followed by the highest gust reported.
 - 2) **EXAMPLE: 11012G18KT** means wind from 110° true at 12 kt. with gusts to 18 knots.
 - e. Visibility. Prevailing visibility is reported in statute miles with "SM" appended to it.
 - 1) **EXAMPLE: 1 1/2SM** means visibility 1 1/2 statute miles.
 - f. Runway visual range
 - g. Weather phenomena
 - 1) **RA** is used to indicate rain.
 - h. Sky conditions
 - 1) The ceiling is the lowest broken or overcast layer, or vertical visibility into an obscuration.
 - 2) Cloud bases are reported with three digits in hundreds of feet AGL.
 - a) **EXAMPLE: OVC007** means overcast cloud layer at 700 ft. AGL.
 - i. Temperature/dew point. They are reported in a two-digit form in whole degrees Celsius separated by a solidus, "/."
 - j. Altimeter
 - k. Remarks (RMK)
 - 1) **RAB35** means rain began at 35 min. past the hour.
3. **EXAMPLE: METAR KAUS 301651Z 12008KT 4SM -RA HZ BKN010 OVC023 21/17 A3005 RMK RAB25**
 - a. **METAR** is a routine weather observation.
 - b. **KAUS** is Austin, TX.
 - c. **301651Z** means the observation was taken on the 30th day at 1651 UTC (or Z).
 - d. **12008KT** means the wind is from 120° true at 8 knots.
 - e. **4SM** means the visibility is 4 statute miles.
 - f. **-RA HZ** means light rain and haze.
 - g. **BKN010 OVC023** means ceiling 1,000 ft. broken, 2,300 ft. overcast.
 - h. **21/17** means the temperature is 21°C and the dew point is 17°C.
 - i. **A3005** means the altimeter setting is 30.05 in. of Hg.
 - j. **RMK RAB25** means remarks, rain began at 25 min. past the hour., i.e., 1625 UTC.

8.3 PILOT WEATHER REPORT (PIREP)

1. No observation is more timely or needed than the one you make from the cockpit.
2. PIREPs are transmitted in a format illustrated below.

UUA/UA	Type of report: URGENT (UUA) - Any PIREP that contains any of the following weather phenomena: tornadoes, funnel clouds, or waterspouts; severe or extreme turbulence, including clear air turbulence (CAT); severe icing; hail; low-level wind shear (LLWS) (pilot reports air speed fluctuations of 10 knots or more within 2,000 feet of the surface); any other weather phenomena reported which are considered by the controller to be hazardous, or potentially hazardous, to flight operations. ROUTINE (UA) - Any PIREP that contains weather phenomena not listed above, including low-level wind shear reports with air speed fluctuations of less than 10 knots.
/OV	Location: Use VHF NAVAID(s) or an airport using the three- or four-letter location identifier. Position can be over a site, at some location relative to a site, or along a route. Ex: /OV KABC; /OV KABC090025; /OV KABC045020-DEF; /OV KABC-KDEF
/TM	Time: Four digits in UTC. Ex: /TM 0915
/FL	Altitude/Flight level: Three digits for hundreds of feet with no space between FL and altitude. If not known, use UNKN. Ex: /FL095; /FL310; /FLUNKN
/TP	Aircraft type: Four digits maximum; if not known, use UNKN. Ex: /TP L329; /TP B737; /TP UNKN
/SK	Sky cover: Describes cloud amount, height of cloud bases, and height of cloud tops. If unknown, use UNKN. Ex: /SK SCT040-TOP080; /SK BKNUNKN-TOP075; /SK BKN-OVC050-TOPUNKN; /SK OVCUNKN-TOP085
/WX	Flight visibility and weather: Flight visibility (FV) reported first and use standard METAR weather symbols. Intensity (- for light, no qualifier for moderate, and + for heavy) shall be coded for all precipitation types except ice crystals and hail. Ex: /WX FV05SM - RA; /WX FV01 SN BR; /WX RA
/TA	Temperature (Celsius): If below zero, prefix with an "M." Temperature should also be reported if icing is reported. Ex: /TA 15; /TA M06
/WV	Wind: Direction from which the wind is blowing coded in tens of degrees using three digits. Directions of less than 100 degrees shall be preceded by a zero. The wind speed shall be entered as a two- or three-digit group immediately following the direction, coded in whole knots using the hundreds, tens, and units digits. Ex: /WV 27045KT; /WV 280110KT
/TB	Turbulence: Use standard contractions for intensity and type (CAT or CHOP when appropriate). Include altitude only if different from FL. Ex: /TB EXTRM; /TB OCNL LGT-MDT BLO 090; /TB MOD-SEV CHOP 080-110
/IC	Icing: Describe using standard intensity and type contractions. Include altitude only if different from FL. Ex: /IC LGT-MDT RIME; /IC SEV CLR 028-045
/RM	Remarks: Use free form to clarify the report putting hazardous elements first Ex: /RM LLWS -15 KT SFC-030 DURGC RY 22 JFK

3. All heights are given as MSL. To determine AGL, subtract the field height from the given height.

4. Turbulence is reported as
 - a. Light = LGT
 - b. Moderate = MDT
 - c. Severe = SVR
5. Icing is reported as
 - a. Clear = CLR
 - b. Rime = RIME
6. Cloud layers are reported with heights for bases, tops, and layer type if available. "No entry" means that information was not given.
 - a. EXAMPLE: SK 024 BKN 032/042 BKN-OVC decoded means a broken layer 2,400 ft. MSL to 3,200 ft. MSL. A second layer is broken to overcast starting at 4,200 ft. MSL.
7. Wind direction and velocity are given as a five- or six-digit code (e.g., /WV 27045 means 270° at 45 knots).
8. Air temperature is expressed in degrees Celsius (°C).

8.4 AVIATION AREA FORECAST

1. Aviation area forecasts (FA) are forecasts of visual meteorological conditions (VMC), clouds, and general weather conditions for several states and/or portions of states. They can be used to interpolate conditions at airports which have no terminal forecasts. FAs are issued three times a day and consist of
 - a. A 12-hr. forecast
 - b. An additional 6-hr. categorical outlook
2. FA weather format. An example is presented on page 224 for questions 26 through 29. It is presented in abbreviations. You will see this same FA utilizing abbreviations on your pilot knowledge test.
3. There are four sections in an FA:
 - a. Communication and product header section
 - b. Precautionary statements section
 - c. Synopsis section (for the purposes of the test, this section is not considered a forecast)
 - d. VFR clouds/weather section (VFR CLDS/WX); this section is referred to as the forecast section
 - 1) Included in the VFR CLDS/WX section is a categorical outlook that is valid for an additional 6 hours. For the purposes of the test, the categorical outlook is not considered a forecast.
4. In order to get a complete weather picture, including icing, turbulence, and IFR conditions, an FA must be supplemented by In-Flight Aviation Weather Advisories (AIRMETs Zulu, Tango, and Sierra).
 - a. A pilot should refer to the In-Flight Aviation Weather Advisories to determine the freezing level and areas of probable icing aloft.

8.5 TERMINAL AERODROME FORECAST (TAF)

1. Terminal aerodrome forecasts (TAFs) are weather forecasts for selected airports throughout the country.
2. The elements of a TAF are listed below:
 - a. Type of report
 - 1) **TAF** is a routine forecast.
 - 2) **TAF AMD** is an amended forecast.
 - b. ICAO station identifier
 - c. Date and time the forecast is actually prepared
 - d. Valid period of the forecast
 - e. Forecast meteorological conditions. This is the body of the forecast and includes the following:
 - 1) Wind
 - 2) Visibility
 - 3) Weather
 - 4) Sky condition
 - a) Cumulonimbus clouds (CB) are the only cloud type forecast in TAFs.

3. EXAMPLE:

TAF

KBRO 300545Z 300606 VRB04KT 3SM SCT040 OVC150 TEMPO 2124 SHRA
FM0200 10010KT P6SM OVC020 BECMG0306 NSW BKN020=

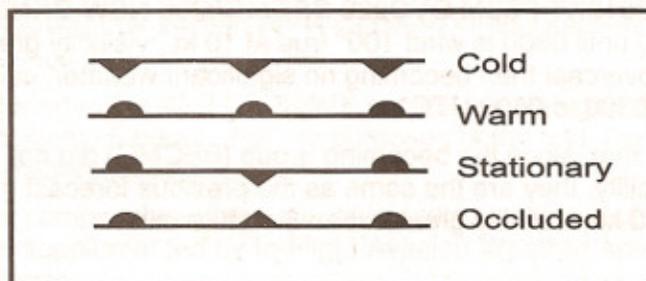
- a. **TAF** is a routine forecast.
- b. **KBRO** is Brownsville, TX.
- c. **300545Z** means the forecast was prepared on the 30th day at 0545 UTC.
- d. **300606** means the forecast is valid from the 30th day at 0600 UTC until 0600 UTC the following day.
- e. **VRB04KT 3SM SCT040 OVC150 TEMPO 2124 SHRA** means the forecast from 0600 until 0200 UTC is wind variable in direction at 4 kt., visibility 3 SM, scattered cloud layer at 4,000 ft., ceiling 15,000 ft. overcast, with occasional rain showers between 2100 and 2400 UTC.
- f. **FM0200 10010KT P6SM OVC020 BECMG0306 NSW BKN020=** means the forecast from 0200 until 0300 is wind 100° true at 10 kt., visibility greater than 6 SM, ceiling 2,000 ft. overcast then becoming no significant weather, ceiling 2,000 ft. broken between 0300 to 0600 UTC.
 - 1) Note that, since the becoming group (BECMG) did not forecast wind and visibility, they are the same as the previous forecast group, i.e., wind 100° true at 10 kt., visibility greater than 6 statute miles.

8.6 WEATHER DEPICTION CHARTS

1. A weather depiction chart is an outline of the United States depicting sky conditions at the time stated on the chart based on METAR reports.
 - a. Reporting stations are marked with a little circle.
 - 1) If the sky is clear, the circle is open; if overcast, the circle is solid; if scattered, the circle is 1/4 solid; if broken, the circle is 3/4 solid. If the sky is obscured, there is an "X" in the circle.
 - 2) The height of clouds is expressed in hundreds of feet above ground level, e.g., 120 means 12,000 ft. AGL.
2. Areas with ceilings below 1,000 ft. and/or visibility less than 3 SM, i.e., below VFR, are bracketed with solid black contour lines and are shaded.
 - a. Visibility is indicated next to the circle; e.g., 2 stands for 2 SM visibility.
 - 1) If the visibility is greater than 6 SM, it is not reported.
 - b. Areas of marginal VFR with ceilings of 1,000 to 3,000 ft. and/or visibility at 3 to 5 SM are bracketed by solid black contour lines and are unshaded.
 - c. Ceilings greater than 3,000 ft. and visibility greater than 5 SM are not indicated by contour lines on weather depiction charts.
3. Significant weather is indicated by the following symbols:

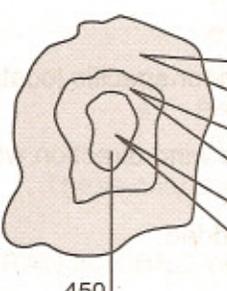
	FOG OR GROUNDS FOG		FREEZING DRIZZLE		SHOWER
	HAZE		FREEZING RAIN		THUNDERSTORM
	SMOKE		ICE PELLETS		CLOUDS TOPPING RIDGES
	DRIZZLE		SNOW		
	RAIN				

4. The weather depiction chart quickly shows pilots where weather conditions reported are above or below VFR minimums.
5. The weather depiction chart displays recent positions of frontal systems and indicates the type of front by symbols.



8.7 RADAR SUMMARY CHARTS AND RADAR WEATHER REPORTS

1. Radar summary charts graphically display a collection of radar reports concerning the type, intensity, and movement of precipitation, e.g., squall lines, specific thunderstorm cells, and other areas of hazardous precipitation.
 - a. Lines and cells of hazardous thunderstorms can be seen on radar summary charts and are not shown on other weather charts.
2. The symbols below are used on radar summary charts.



Digit	PRECIPITATION INTENSITY	RAINFALL RATE in/hr STRATIFORM	RAINFALL RATE in/hr CONVECTIVE
1	LIGHT	LESS THAN 0.1	LESS THAN 0.2
2	MODERATE	0.1 - 0.5	0.2 - 1.1
3	HEAVY	0.5 - 1.0	1.1 - 2.2
4	VERY HEAVY	1.0 - 2.0	2.2 - 4.5
5	INTENSE	2.0 - 5.0	4.5 - 7.1
6	EXTREME	MORE THAN 5.0	MORE THAN 7.1

Highest precipitation top in area in hundreds of feet MSL (45,000 feet MSL).

————— SYMBOLS USED ON CHART —————

SYMBOL	SYMBOL MEANING	SYMBOL	SYMBOL MEANING
R	RAIN	↗ 35	CELL MOVEMENT TO THE NORTHEAST AT 35 KNOTS
RW	RAIN SHOWER	LM	LITTLE MOVEMENT
S	SNOW	WS999	SEVERE THUNDERSTORM WATCH NUMBER 999
SW	SNOW SHOWER	WT210	TORNADO WATCH NUMBER 210
T	THUNDERSTORM	SLD	8/10 OR GREATER COVERAGE IN A LINE
NA	NOT AVAILABLE	/	LINE OF ECHOES
NE	NO ECHOES		
OM	OUT FOR MAINTENANCE		

3. Severe weather watch areas are enclosed by a heavy, dashed line, usually in the form of a rectangular box.
4. Radar weather reports are textual reports of weather radar observations.
 - a. They include the type, intensity, location, and cell movement of precipitation.
5. Finally, it is important to remember that the intensity trend (increasing or weakening) is no longer coded on either the radar summary chart or radar weather report (SD).

8.8 EN ROUTE FLIGHT ADVISORY SERVICE (EFAS)

1. En Route Flight Advisory Service (EFAS) provides weather advisories on 122.0 MHz below FL 180. It is called Flight Watch.
 - a. Generally, service is available from 6 a.m. to 10 p.m. local time.
 - b. EFAS provides information regarding actual weather and thunderstorm activity along a proposed route.
2. It is designed to be a continual exchange of information on winds, turbulence, visibility, icing, etc., between pilots and weather briefers.

8.9 WINDS AND TEMPERATURES ALOFT FORECASTS (FD)

1. Forecast winds and temperatures are provided at specified altitudes for specific locations in the United States.
2. A four-digit group (used when temperatures are not forecast) shows wind direction with reference to **true** north and the wind speed in **knots**.
 - a. The first two digits indicate the wind direction after a zero is added.
 - b. The next two digits indicate the wind speed.
 - c. No temperature is forecast for the 3,000-ft. level or for a level within 2,500 ft. AGL of the station.
3. A six-digit group includes the forecast temperature aloft.
 - a. The last two digits indicate the temperature in degrees Celsius.
 - b. Plus or minus is indicated before the temperature, except at higher altitudes (above 24,000 ft. MSL) where it is always below freezing.
4. When the wind speed is less than 5 kt., the forecast is coded 9900, which means that the wind is light and variable.
5. When the wind speed is over 100 kt., the forecaster adds 50 to the direction and subtracts 100 from the speed. To decode, you must reverse the process. For example, 730649 = 230° (73-50) at 106 kt. (100 + 06) and -49° (above 24,000 feet).
6. An example forecast is provided for questions 56 through 60 on page 232.

8.10 SIGNIFICANT WEATHER PROGNOSTIC CHARTS

1. Significant Weather Prognostic Charts contain four charts (panels).
 - a. The two upper panels forecast significant weather from the surface up to 24,000 ft.: one for 12 hr. and the other for 24 hr. from the time of issuance.
 - b. The two lower panels forecast surface conditions: one for 12 hr. and the other for 24 hr. from time of issuance.
2. The top panels show
 - a. Ceilings less than 1,000 ft. and/or visibility less than 3 SM (IFR) by a solid line around the area;
 - b. Ceilings 1,000 to 3,000 ft. and/or visibility 3 to 5 SM (MVFR) by a scalloped line around the area;
 - c. Moderate or greater turbulence by a broken line around the area;
 - 1) A peaked hat  indicates moderate turbulence.
 - 2) Altitudes are indicated on the chart; e.g., 180 means from surface to 18,000 feet.
 - d. Freezing levels, given by a dashed line corresponding to the height of the freezing level.

3. The bottom panels show the location of
 - a. Highs, lows, fronts
 - b. Other areas of significant weather
 - 1) Unshaded outlined areas indicate precipitation covering half or less of the area.
 - 2) Shaded outlined areas indicate precipitation covering more than half of the area.
 - 3) Precipitation type and intensity is reported with standard symbols. Some examples include:
 - a)  thunderstorms embedded in a larger area of continuous moderate rain
 - b)  thunderstorms embedded in a larger area of intermittent moderate rain
 - c)  continuous light to moderate snow
 - d)  intermittent light to moderate snow
 - 4) Precipitation symbols may be connected to an area of precipitation by an arrow if there is not sufficient room to place them in that area.
4. These charts are used to determine areas to avoid (freezing levels and turbulence).

8.11 TRANSCRIBED WEATHER BROADCASTS

1. TWEBs are continuous recordings of meteorological and aeronautical information broadcast on certain NDB and VOR facilities.
 - a. Generally, they are based on specific routes of flight.

8.12 AIRMETS AND SIGMETs

1. SIGMETs and AIRMETS are issued to notify pilots en route of the possibility of encountering hazardous flying conditions.
2. SIGMET advisories include weather phenomena which are potentially hazardous to all aircraft.
 - a. Convective SIGMETs include
 - 1) Tornadoes
 - 2) Lines of thunderstorms
 - 3) Embedded thunderstorms
 - 4) Thunderstorm areas greater than or equal to thunderstorm intensity level 4 with an area coverage of 40% or more
 - 5) Hail greater than or equal to 3/4 in. diameter
 - b. SIGMETs include
 - 1) Severe or extreme turbulence or clear air turbulence (CAT) not associated with thunderstorms
 - 2) Severe icing not associated with thunderstorms
 - 3) Duststorms, sandstorms, or volcanic ash lowering visibility to less than 3 SM
 - 4) Volcanic eruption
3. AIRMETS apply to light (e.g., small single-engine) aircraft to notify of
 - a. Moderate icing
 - b. Moderate turbulence
 - c. Visibility less than 3 SM or ceilings less than 1,000 ft.
 - d. Sustained winds of 30 kt. or more at the surface
 - e. Extensive mountain obscurement