ASOS: Automated Surface Observing System

ASOS GUIDE FOR PILOTS

INTRODUCTION

The Automated Surface Observing System (ASOS) is a surface weather observing system being implemented by the National Weather Service (NWS), the Federal Aviation Administration (FAA), and the Department of Defense (DoD). ASOS is designed to support aviation operations and weather forecasting.

This guide is designed to provide basic ASOS information to pilots and other aviation users. Refer to the ASOS Quick Reference Handbook published by the National Weather Service for additional information.

Please refer to the FAA's Aeronautical Information Manual for operational guidance and to the FAA's Airport/Facility Directory, aeronautical charts and related publications, for ASOS broadcast frequency, dial-in telephone number, and location information.

Notices to Airmen contain ASOS system status.

Air Carrier and Commercial Operators should refer to applicable parts of the Federal Aviation Regulations and their company Operations Specifications for use of automated weather observations.

The ASOS will provide minute-by-minute observations and perform the basic observing functions necessary to generate a surface weather observation and other aviation weather information. Pilots need to understand tha t automated and manual weather observations are different and have different operational implications.

ASOS and the human observer differ in methods of data collection and interpretation. For elements such as pressure, air temperature, dew-point temperature, wind, and precipitation accumulation, both the automated system and the observer use a fixed location and time-averaging technique.

For visual elements (i.e., sky condition, visibility, and present weather), observers use a fixed time, spatial-averaging technique while the ASOS uses a fixed location, time-averaging technique. Although this is a fundamental change, the manual and automated techniques yield similar results within the limits of their respective capabilities.

SYSTEM DESCRIPTION

The ASOS at each airport consists of four main components:

- Individual Weather Sensors
- Data Collection Package(s) (DCP)
- Acquisition Control Unit (ACU)
- Peripherals and Displays

Every ASOS contains the following:

- Cloud Height Indicator
- Visibility Sensor
- Precipitation Identifier Sensor
- Pressure Sensors
- Temperature/Dew-Point Sensor

Wind direction/speed sensor:

- Rainfall Accumulation Sensor
- Freezing Rain Sensors included at most sites

ASOS data outlets include:

- On-site airport users
- National communications networks
- Computer-generated voice (through FAA radio broadcast and dial-in telephone lines)

ASOS reports available through these outlets include:

- Surface weather observations
- METAR (Scheduled Weather Report)
- SPECI (Unscheduled Weather Report)
- Non-aviation-related reports

WEATHER OBSERVATION ELEMENTS

- TYPE OF REPORT
- STATION IDENTIFIER
- DATE/TIME OF REPORT
- REPORT MODIFIER
- WIND DIRECTION AND SPEED
- VISIBILITY
- RUNWAY VISUAL RANGE
- WEATHER PHENOMENA
- SKY CONDITION
- TEMPERATURE/DEW-POINT
- ALTIMETER SETTING
- REMARKS IDENTIFIER
- REMARKS

If an element or phenomena does not occur, is missing, or cannot be observed, the corresponding group and preceding space are omitted (body and/or remarks) from that particular report. Exception: Sea-Level Pressure (SLPppp). SLPNO shall be reported in a METAR when the SLP is not available.

TYPE OF REPORT: METAR: hourly (scheduled) report; SPECI: special (unscheduled) report.

STATION IDENTIFIER: Four alphabetic characters; International Civil Aviation Organization (ICAO) location identifier.

DATE/TIME OF REPORT: All dates and times in Coordinated Universal Time (UTC) using a 24-hour clock; two-digit date and four-digit time; letter Z appended to indicate UTC.

REPORT MODIFIER: AUTO indicates a fully automated report. No human intervention. COR indicates a correction to a previously disseminated report.

WIND DIRECTION AND SPEED: Direction in tens of degrees from true north (first three digits); next two digits: speed in whole knots; as needed Gusts (character) followed by maximum observed speed; always followed by KT to indicate knots; 00000KT for calm. A Variable wind group is reported when the direction varies by 60ø or more when the average wind speed is greather than 6 knots; or if the wind speed is less than or equal to 6 knots.
Example: 21016G24KT 180V240=Winds are from 210 degrees at 16 knots with gusts to 24 knots. The wind direction varies from 180 to 240 degrees. If winds less than or equal to 6 knots; VRB05KT, etc., without the degrees of variance.

VISIBILITY: Prevailing visibility in statue miles and fractions (space between whole miles and fractions); always followed by SM to indicate statute miles; values less than 1/4 reported as M1/4SM.

RUNWAY VISUAL RANGE: Ten minute RVR value in hundreds of feet; reported if prevailing visibility is one mile or less; or RVR 6000 feet or less; always followed by FT to indicate feet; value prefixed with M or P to indicate value is lower or higher than the reportable RVR value. Example: P6000FT= greater than 6000 feet, M1000FT= less than 1000 feet.

WEATHER PHENOMENA: ASOS reports rain (RA): liquid precipitation that does not freeze; snow (SN): frozen precipitation precipitation other than hail; Precipitation of unknown type (UP); intensity prefixed to precipitation: light (-), moderate (no sign), heavy (+); fog (FG); freezing fog (FRFG- temperature below 0øC); Mist (BR); Haze (HZ); Squall (SQ); augmented by observer: Funnel Cloud/Tornado/Waterspout (FC); Thunderstorm (TS); Hail (GR); Small hail (GS;<1/4 inch); Freezing Rain (FZRA); VA (volcanic ash).

SKY CONDITION: ASOS will not report clouds higher than 12,000 feet above ground level (AGL). Cloud amount and height: CLR (no clouds detected below 12,000 feet); FEW (few: <1/8 - 2/8 sky coverage); SCT (scattered: 3/8 - 4/8); BKN (broken: 5/8 - 7/8); OVC (overcast: 8/8); followed by 3-digit height in hundreds of feet. Indefinite sky condition expressed as vertical visibility: (VV), followed by 3 digit height in hundreds of feet.

TEMPERATURE/DEW-POINT: Each is reported in whole degrees Celsius using two digits; values are separated by a solidus(/); sub-zero values are prefixed with an M (minus). Example: 04/M02 = Temperature = +4øC Dew-Point = -2øC

ALTIMETER SETTING: Altimeter always prefixed with an A indicating inches of mercury - reported in hundredths of an inch and reported using four digits. Example: A2992=29.92 inches, A3044=30.44 inches.

REMARKS IDENTIFIER: RMK

REMARKS: Additional information may be added to the weather observation in the form of remarks.
Automated remarks are generated by the system when appropriate conditions exist.
Augmented remarks are added when conditions are observed by an observer attending the system.

TORNADIC ACTIVITY: At augmented stations, tornadoes, funnel clouds, or waterspouts are coded as Tornadic activity_B/E(hh)mm_LOC/DIR_(MOV). The report should include TORNADO, FUNNEL CLOUD, or WATERSPOUT, time begin/end, location, and movement. Example: TORNADO B25 MOV E=a tornado which began at 25 minutes past the hour is moving east.

TYPE OF AUTOMATED STATION: AO1 is an automated station without a precipitation sensor. AO2 is an automated station with a precipitation sensor.

PEAK WIND: The peak wind is coded as PK WND dddff(f)/(hh)mm. This is the maximum wind, greater than 25 knots, observed since the last METARwith direction in tens of degrees, speed in whole knots, and minutes past the hour. Example: PK WND 20032/25=the peak wind was from 200 degrees at 32 knots and occurred 25 minutes past the hour.

WIND SHIFT: A wind shift is coded in the format WSHFT_(hh)mm. It is defined as a change in wind direction of 45 degrees or more which takes place in less than 15 minutes and has sustained winds of 10 knots or more throughout the wind shift. The contraction FROPA may be entered after the time if the wind shift is a result of a frontal passage. Example: WSHFT 1715 FROPA=a wind shift occurred at 1715Z as a result of a frontal passage.

TOWER OR SURFACE VISIBILITY: Tower visibility is coded as TWR_VIS_ vvvv and is the visibility reported by tower personnel. For example, TWR VIS 2. Surface visibility is coded as SFC_VIS_vvvv and is the visibility reported by ASOS. For example, SFC VIS 2. Visibility is reported in statute miles.

VARIABLE PREVAILING VISIBILITY: Variable prevailing visibility is coded as VIS_vnvnvnvnvnVvxvxvxvxvx , where vnvnvnvnvn is the lowest visibility evaluated and vxvxvxvxvx is the highest. This is only reported if the visibility is less than 3 miles and rapidly increases or decreases by « mile or more during the observation period. Example: VIS 1V2 = visibility varying from 1 to 2 miles.

VISIBILITY AT SECOND LOCATION: Visibility at a second location is coded as VIS_vvvv [LOC] and is reported if lower than the reported prevailing visibility in the body of the report. Example: VIS 2RWY 11 = visibility 2 miles at runway 11.

LIGHTNING: Lightning is coded as Frequency_LTG(type)_ [LOC]; When detected the frequency, type, and location of lightning is reported. Example: FRQ LTGCC NE = frequent cloud to cloud lightning to the northeast.

BEGINNING AND ENDING OF PRECIPITATION AND THUNDERSTORMS: The beginning and ending of precipitation is coded as w w B (hh)mmE(hh)mm; the beginning and ending of thunderstorms is coded as TSB(hh)mmE(hh)mm. Example: RAB07E15 means that rain began at 7 minutes past the hour and ended at 15 minutes past the hour.

VIRGA: Virga is an augmented remark describing precipitation not reaching the ground.

VARIABLE CEILING HEIGHT: Variable ceiling height is coded as CIG_hn hnhnVhxhxhx. It is reported if the ceiling in the body of the report is less than 3,000 feet and variable. Example: CIG 020V030 = ceiling height varying from 2,000 to 3,000 feet.

CEILING HEIGHT AT SECOND LOCATION: Ceiling height at a second location is coded as CIG_hhh_[LOC]. It is reported if a secondary ceilometer site is different than the ceiling height in the body of the report. Example: CIG 030 RWY 11 = ceiling height 3000 feet at runway 11.

PRESSURE RISING OR FALLING RAPIDLY: This is coded as PRESRR(pressure rising rapidly) or PRESFR(pressure falling rapidly). It is a rise or fall in station pressure at the rate of 0.06 inches or more per hour which totals 0.02 inches or more.

SEA-LEVEL PRESSURE: Sea-level pressure is coded as SLPppp, where ppp is the sea level pressure in hectopascals (hPa.). Example SLP 982 = 998.2 hPa. If sea level pressure is not available, it is coded as SLPNO.

ADDITIVE DATA: The following element groups are reported at specific times during the day:

HOURLY PRECIPITATION AMOUNT: Hourly precipitation (water equivalent) since the last METAR is coded as Prrrr and is coded in hundredths of an inch. A trace is P0000. Example: P0009=.09 inches of precipitation.

3- AND 6-HOUR PRECIPITATION AMOUNT: 3- and 6-hour precipitation (water equivalent) is coded as 6RRRR. The precipitation amount in hundredths of an inch for the past 3 hours is reported in 03, 09, 15, and 21 UTC observations. The precipitation for the past 6 hours is reported in 00, 06, 12,and 18 UTC observations. A trace is encoded as 60000. Example: 60116=1.16 inches of precipitation.

24-HOUR PRECIPITATION AMOUNT: 24-hour precipitation (water equivalent) is coded as $7R_{24}R_{24}R_{24}R_{24}$. The precipitation amount in hundredths of an inch for the past 24 hours is reported in the 12 UTC observation.

HOURLY TEMPERATURE AND DEW POINT: Hourly temperature and dew point are coded as $Ts_nT_aT_aT_as_aT_aT_aT_a$. Both are measured in tenths of a degree Celsius. s_n is coded as 1 if the temperature is below 0øC and 0 if the temperature is 0øC or higher. Example: T00241011 = the temperature is 2.4øC and the dewpoint is -1.1øC.

6-HOUR MAXIMUM TEMPERATURE: 6-hour maximum temperature is coded as $1s_nT_xT_xT_x$ and is measured in tenths of a degree Celsius. s_n is coded as 1 if the temperature is below 0øC and 0 if the temperature is 0øC or higher. Example: 10214 = 21.4øC, 11134 = -13.4øC.

6-HOUR MINIMUM TEMPERATURE: 6-hour minimum temperature is coded as $2s_nT_nT_nT_n$ and is measured in tenths of a degree Celsius. s_n is coded as 1 if the temperature is below 0øC and 0 if the temperature is 0øC or higher.

24-HOUR MAXIMUM AND MINIMUM TEMPERATURE: 24-hour maximum and minimum temperature are coded as $4s_nT_xT_xT_x s_nT_nT_nT_n$ and are reported at midnight local standard time. Both are measured in tenths of a degree Celsius. s_n is coded as 1 if the temperature is below 0øC and 0 if the temperature is 0øC or higher.

PRESSURE TENDENCY: This is coded as 5appp, where a is the character (trend) of pressure change and ppp is the change in pressure in tenths of hPa over the past three hours. Example: 58018 = pressure falling then falling rapidly 1.8 hPa.

SENSOR STATUS INDICATORS: These may be reported: RVRNO: RVR missing, PWINO: precipitation identifier information not available, PNO: precipitation amount not available, FZRANO: freezing rain information not available, TSNO: thunderstorm information not available, VISNO [LOC]: visibility at second location not available, and; CHINO [LOC]: sky condition at secondary location not available.

MAINTENANCE CHECK INDICATOR: The symbol $ will appear if the ASOS detects that a preventative maintenance check is needed.

DATA NOT AUTOMATICALLY PROVIDED BY ASOS

Weather elements not currently provided automatically by ASOS are listed. Elements marked with an asterisk (*) may be added by an observer (see Backup and Augmentation).

Tornado*	Snow fall
Funnel cloud	Snow depth
Waterspout	Snow water equivalent
Thunderstorms*	Clouds above 12,000FT
Hail*	Virga*
Ice crystals	Distant precipitation
Snow pellets	Distant clouds
Snow grains	Local variations in
Ice pellets	visibility
Drizzle	Tower visibility*
Freezing drizzle	Specific visibility values above 10 miles
Volcanic Ash*	Blowing snow
Dust	Blowing sand
Ground fog	Smoke
Blowing dust	Ice fog
Blowing spray	Cloud types

NOTE: The degree of augmentation at service level A or B sites includes other parameters in addition to those with the asterisk.

MISSING DATA AND NON-EVENT DATA

In the event that the precipitation identifier sensor is not operational, the remark PWINO (present weather information not available) will be placed in the STATUS REMARKS

section of the observation. In this case, ASOS will not be able to report RA, SN, or UP. If the Freezing Rain sensor is not operational, the remark FZRANO (Freezing rain information not available) will appear in the STATUS REMARKS. When no precipitation is occurring and the temperature or dew point are inoperative, an obstruction to vision is reported as haze if the visibility is 4 or 5 statute miles. If the visibility is less than 4 statute miles, fog or mist will be reported. If the temperature or dew point sensor, and the visibility sensor are inoperative ASOS cannot report an obstruction to vision. The Maintenance Check Indicator ($) will appear in the STATUS REMARKS if the ASOS requires repair or if routine preventative maintenance is needed. In the example below, wind speed and direction, RVR, and temperature are missing, so they are omitted. The Maintenance Check Indicator ($) at the end of the observation shows that the ASOS requires maintenance

METAR KABC 121755 AUTO 1SM BKN015 A2990 $

BACKUP AND AUGMENTATION

Backup is the process of manually editing specific elements within the observation or providing a complete manual observation and alternate means of dissemination in case of total ASOS failure. Backup includes substituting manually observed data for "missing" or un-representative data to ensure that observation content is correct and complete.

Augmentation is the process of adding information to an ASOS observation that is not provided or observed automatically. This information is derived by an observer. An example of augmentation would be adding the occurrence of a thunderstorm to the observation.

VOICE MESSAGES

ASOS computer-generated voice message are made available through telephone dial-in access and are broadcast directly to pilots via ground-to-air radio (where installed). The information contained in the ground-to-air radio broadcast message and the telephone dial-in message are identical. The voice message is composed of the body of the ASOS observation and selected remarks. Selected remarks can include variable visibility, tower visibility, or Density Altitude when 1,000 or more feet above airport elevation. Control tower personnel may add Notice to Airmen (NOTAM) or other information. Note that wind direction in the voice message is given in degrees magnetic.

SENSOR DESCRIPTION

SKY CONDITION: ASOS sky condition is determined by a laser ceilometer referred to as the Cloud Height Indicator (CHI). The CHI is used to detect the presence of clouds directly overhead up to 12,000 feet AGL.

VISIBILITY: ASOS visibility is based on light scattering . The visibility sensor projects a beam of light over a very short distance, and the light that is scattered is detected by a receiver. The amount of light scattered and then received by the sensor is converted into a visibility value.

PRESENT WEATHER AND OBSTRUCTIONS TO VISION: There are two ASOS present weather sensors. The Precipitation Identifier (PI) sensor discriminates between rain (RA) and snow (SN). The Freezing Rain (FZRA) sensor detects freezing rain. ASOS evaluates multiple sensor data and infers the presence of obstructions to vision.

The PI sensor has the capability to detect and report -RA, RA, +RA, -SN, SN, +SN. When rain and snow are mixed and the prevailing precipitation type can not be determined, ASOS will report UP.

The Freezing Rain sensor measures accumulation rates as low as 0.01 inches per hour. If freezing rain is detected and the PI sensor indicates no precipitation or rain, then freezing rain is reported. If freezing rain is detected when the PI indicates snow, then snow is reported.

Obstructions to vision are not directly measured by ASOS, but inferred from measurements of visibility, temperature, and dew point. There are only two reported by ASOS: Fog (FG) and Haze (HZ), and only when the visibility is below 7 statute miles.

TEMPERATURE AND DEW POINT: The ASOS temperature and dew-point sensors directly measure the air and dew-point temperatures.

WIND: ASOS senses wind speed and direction using a rotating cup anemometer and wind vane. Wind character and peak wind are obtained by comparing average and maximum wind speeds.

PRESSURE: Because pressure measurement is critical, three separate and independent pressure sensors are used at larger airports. Two pressure sensors are used at other locations.

PRECIPITATION ACCUMULATION: ASOS uses a Heated Tipping Bucket precipitation gauge.