ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: MINIMUM SAFE ALTITUDE WARNING (MSAW)

1. **PURPOSE.** This Advisory Circular describes the capabilities and limitations of the Minimum Safe Altitude Warning (MSAW) function being implemented at terminal facilities equipped with an Automated Radar Terminal System (ARTS III).

2. **DISCUSSION.**

   a. Recognizing a need to assist the air traffic controller in his efforts to detect aircraft that are within, or are approaching, unsafe proximity to terrain/obstructions, the FAA has developed and is implementing, at all ARTS III facilities, a new computer function called Minimum Safe Altitude Warning (MSAW). The MSAW function will generate an alert to the controller when a tracked, Mode C equipped aircraft being processed by MSAW is at, or is predicted by the computer to go below a predetermined minimum safe altitude. Controllers will evaluate each alert that is generated and, when appropriate, will issue a radar safety advisory to the aircraft causing the alert. IFR aircraft with an operating altitude encoding transponder will automatically be processed by the MSAW function when it is operating. VFR aircraft with an operating altitude encoding transponder will be provided MSAW processing upon pilot request. It is expected that all ARTS III terminal facilities will be equipped with the MSAW function by mid 1977.

   b. Federal Aviation Regulations place the responsibility for safe altitude management on the pilot. The MSAW system is designed to provide the controller with information that he may relay to the pilot to assist him in his safe altitude management responsibility. It in no way relieves the pilot of his responsibility for safe altitude management.

c. MSAW Altitude Monitoring Logic

    (1) For general terrain altitude monitoring, the MSAW program
         requires a computerized grid map of each terminal area. The
         highest known obstruction in each grid bin is used to establish
         the minimum safe altitude for that particular geographical
         location. These bins are 2 miles square. The minimum safe
         altitude is 500 feet above the highest terrain/obstruction in
         each bin. The ARTS computer compares the current Mode C
         altitude of an aircraft against the minimum safe altitude
         established for the bin. It then looks ahead to see if the
         aircraft will enter a bin below the minimum safe altitude in
         30 seconds if it continues its present heading, altitude and
         rate of climb or descent established by the computer. At the
         end of the 30-second look ahead, the program assumes a 5-degree
         climb angle and checks to see if the aircraft will remain above
         the minimum safe altitude if it were to start a 5-degree climb
         immediately. For the look ahead a buffer of 300 feet predicted
         altitude, instead of 500 feet, above the highest terrain is used.

    (2) For final approach course altitude monitoring between the
         final approach fix and a point approximately 2 miles from the
         landing threshold, the program first checks 100 feet below the
         minimum descent altitude (MDA)/stepdown fix altitude. It then
         looks ahead down the final approach course using the rate of
         descent established by computer to determine whether or not the
         aircraft will get 200 feet below the MDA/stepdown fix in
         15 seconds.

    (3) When the aircraft is at, or is predicted by the computer to go
         below these altitudes the computer alerts the controller by
         placing the words "LOW ALT" in the aircraft's data block. An
         aural alarm is sounded to attract the controller's attention.
         The controller will evaluate the condition and, if appropriate,
         issue a radar safety advisory. The pilot is expected to evaluate
         the situation and take appropriate action when he is alerted.

d. Controllers will use the following phraseology to alert pilots:

    LOW ALTITUDE ALERT, CHECK YOUR ALTITUDE IMMEDIATELY.

e. It is solely the ·pilot's responsibility to determine what action
    he will take when an advisory is issued by the controller. The
    pilot is expected to inform ATC immediately of the action he will
    take as a result of the advisory.

f. There are certain conditions under which the controller will not receive an MSAW generated low altitude alert. These are:

   (1) ATC radar and/or ATC radar beacon interrogator are not operating.

   (2) The ARTS III computer with the MSAW program is not operating.

   (3) The aircraft is not being actively tracked by the ARTS III equipment.

   (4) The aircraft is not equipped with an operating transponder with altitude encoding capability (Mode C).

   (5) The aircraft's Mode A or C transponder is sending garbled, weak or erroneous signals. (Both Mode A and Mode C signals are required for MSAW processing.)

   (6) The aircraft is not within the radar coverage area, either because it is below line of sight or it is too far away from the radar site.

   (7) The aircraft is within 3 miles of the airport, except when on final approach to an instrument runway, in which case it is on final approach within 2 miles of the airport, or between the stepdown fix and the airport. (Because of the various types of activity in a normal airport traffic area, it is not currently practical to continue the MSAW processing within this area.)

   (8) The aircraft has been inhibited from computer processing for low altitude alerts. (Aircraft are sometimes operated at very low altitudes and MSAW processing for such aircraft will be inhibited by the controller. It would not make sense for the controller to be receiving continuous alarms, nor would the VFR pilot who is intentionally flying low want to be advised to check his altitude.)

g. Due to the radar antenna rotation time the computer needs about 10 seconds to establish a definite course change and/or altitude change. Because of this, there are two conditions which may result in low altitude alerts being issued by the controller too late to permit the pilot to take corrective action. These are:

   (1) An aircraft whose projected track is outside of a bin containing an obstruction makes an abrupt, rapid turn toward the obstruction.

(2) An aircraft operating at a safe altitude just above the programmed altitude makes an abrupt descent.

h. VFR pilots may also obtain MSAW by asking for it if their aircraft is equipped with an operating altitude encoding transponder. VFR pilots who request MSAW are expected to fly at altitudes which will clear all obstructions within 2 miles of their planned flight path by at least 500 feet.

Phraseology: "(Name of facility), (aircraft identification) request MSAW."

Example: "Los Angeles Approach Control, N457G request MSAW."

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