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**ANTIAIRCRAFT ARTILLERY
FIELD MANUAL**



**BALLOON BARRAGE
CONTROL**



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G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

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RESTRICTED**ANTIAIRCRAFT ARTILLERY FIELD MANUAL****BALLOON BARRAGE CONTROL****CHAPTER 1****PRINCIPLES OF BARRAGE CONTROL**

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SECTION I**GENERAL**

■ 1. **SCOPE.**—This manual deals with the control of a balloon barrage and its coordination with other elements of air defense. It is intended for use by all military personnel concerned with controlling the operations of a balloon barrage. Except in specific instances so designated, it is equally applicable to LA and VLA barrages.

■ 2. **PURPOSE.**—It is the purpose of this manual to prescribe the general principles and methods considered necessary for barrage control.

■ 3. **REFERENCES.**—*a. Air defense.*—Since a balloon barrage normally does not operate alone in defense of an area, an understanding of the organization and operation of a coordinated air defense is needed as a prerequisite for the study of barrage control. (See FM 1-10, 1-25, 4-100, and 11-25.)

b. Barrage balloons.—An understanding of barrage control also requires a knowledge of barrage balloon operations. (See FM 4-181, 4-182, 4-187, and 4-188.)

SECTION II

DOCTRINE

■ 4. **MISSION.**—The mission of barrage balloons is to deny hostile aircraft use of the air space below the operating height of the balloons. To accomplish this mission, it is essential that AA balloon troops keep the balloons of a barrage flying or in a position of readiness to fly at all times. If a balloon is lost or destroyed, it must be replaced immediately.

■ 5. **REDUCTION OF HEIGHT AND GROUNDING.**—There are times when it is desirable to reduce the height of or ground (close-haul or bed down) balloons for one or more of the following reasons:

- a. To prevent balloon casualties that may be caused by lightning, wind, or other adverse weather.
- b. To service the balloon and balloon equipment.
- c. To provide training for balloon personnel.
- d. To avoid indicating the location of the defended objective to enemy bombers.
- e. To allow other members of the air-defense team the use of air space occupied by flying balloons.

SECTION III

RULING OPERATING HEIGHT (ROH)

■ 6. **DEFINITION.**—The ruling operating height (ROH) is the height at which any or all balloons are ordered flown by the barrage commander. This height may be changed as often as necessary in accordance with the considerations discussed in paragraph 7.

■ 7. **CONSIDERATIONS IN ESTABLISHING ROH.**—*a. General.*—The ROH may be the operating ceiling (see FM 4-182) of the balloons or some lesser height, depending on cloud layer, weather, or friendly air activity. No individual balloon should attempt to ascend above its operating ceiling regardless of the ROH ordered.

b. Cloud layer.—When a cloud layer exists below the operating ceiling of balloons, during periods of high visibility

balloons should be flown in the base of the cloud layer to prevent their indicating to hostile aircraft the location of the defended objective, and to lessen the effects of superheat.

c. Weather.—During favorable weather, the ROH normally should be the operating ceiling of the balloons. During adverse weather, the ROH may have to be changed to avoid lightning, icing conditions, and upper winds in excess of 50 miles per hour. During daytime, the ROH may be reduced to avoid valving of gas due to superheat.

d. Friendly air activity.—The ROH of all or any part of the barrage may be reduced to permit passage of friendly aircraft.

■ 8. **ANNOUNCING ROH.**—All higher commanders concerned and all balloon sites will be kept informed of the ROH. Any change in the ROH will be announced immediately as "ROH, operating ceiling"; "ROH, cloud layer"; or "ROH—feet."

SECTION IV

EFFECTS OF WEATHER ON BALLOONS

■ 9. **GENERAL.**—Balloon casualties are frequently caused by—

- a. Wind.
- b. Discharges of static electricity.
- c. Ice and snow.

■ 10. **REDUCTION OF WEATHER CASUALTIES.**—In order to reduce balloon casualties from weather, the following steps must be taken:

- a. Establish a source of information as to the probable future weather. In LA balloon battalions, personnel is provided for the establishment of a weather station.
- b. Take timely precautions against adverse weather.
- c. In adverse weather, it may be advisable to send aloft one or more balloons to test the risk involved, before risking the loss of a large number of balloons.

■ 11. **WEATHER CLASSES.**—*a. Definition.*—For the purpose of simplifying operations and operational orders for flying balloons during different weather conditions, weather classes shown in table I will be used.

TABLE I.—Weather classes

Class	Degree of danger to balloons	Suggested proportion of balloons to be flown during air-raid conditions
I.....	None or very slight.....	All.
II.....	Possible.....	Two-thirds.
III.....	Definite.....	One-third.

b. Determining classes.—The barrage commander will announce the class of the existing weather. (See FM 4-182 for methods of determining weather classes.)

c. Use.—All balloons will be flown in class I weather. The barrage commander will determine which balloons will fly during class II and class III weather, taking into consideration the best defense possible with a reduced number of balloons. Normally, two-thirds of the balloons will be designated as class II balloons and will be the only balloons to fly in class II weather; likewise, one-third of the balloons will be designated as class III balloons and will be the only balloons to fly in class III weather.

SECTION V

METHODS OF BARRAGE CONTROL

■ 12. DEFINITIONS.—*a. Barrage control.*—Barrage control consists of directing the operations of a balloon barrage to meet tactical and weather situations, and is accomplished by means of putting alerts and controls into effect.

b. Alerts.—An alert is used to designate the presence of enemy aircraft and the action to be taken by balloon personnel. It is also used to designate adverse weather and the action to be taken by balloon personnel.

c. Controls.—A control is used to designate certain tactical and weather situations, and to restrain the flying of all or part of a barrage to meet these situations. Controls are used to modify alerts.

■ 13. ALERTS.—*a. Where used.*—Alerts are used between the AAA operations room and the barrage control room, and between the barrage control room and the sites.

b. Designation.—In order to simplify and standardize the transmission of orders and information, alerts are designated by colors. For the purpose of this manual, a list of typical alerts is shown in table II. The specific colors used in this table may be changed.

TABLE II.—Summary of typical alerts

Alert	Enemy action	Normal action taken by balloon personnel
RED	Planes approaching objective in vicinity of barrage.	Fly balloons at ROH and man local defenses.
PURPLE	Same as RED alert.	Close-haul balloons and man local defenses. If balloons are bedded down, bring them to close-haul.
YELLOW	Planes are known to be active and within striking distance of barrage.	Close-haul balloons. Bring bedded-down balloons to close-haul. Personnel stand by.
GREEN	Raids of a surprise nature only are contemplated.	Continue with normal maintenance or training program, commensurate with flying maximum number of balloons.
WHITE	No enemy action expected; adverse weather expected.	Bed down balloons. Take storm precautions when ordered.

■ 14. CONTROLS.—*a. Where used.*—(1) Controls imposed for tactical reasons are used between the AAA operations room and the barrage control room, or between a local airport or airdrome and the barrage control room. At the barrage control room, these controls are transformed into alerts for transmittal to the sites.

(2) Controls imposed because of weather are used between the barrage control room and the sites, and are transmitted in terms of classes of weather.

b. Designation.—In order to simplify and standardize the transmission of orders and information, controls are designated by name. The most common controls are shown in table III.

TABLE III.—Summary of typical controls

Control	Friendly action	Action taken by balloon personnel
DISTRESSED AIRCRAFT	A friendly airplane is in distress and must land within or pass through barrage area.	Ground a specified lane of balloons, or ground entire barrage if necessary.
LOCAL SAFETY	Aircraft desires to take off or land within barrage area.	Ground specified lane of balloons.
AIR COOPERATION	Radar must search through part of barrage. Friendly airplanes desire to fly below barrage height.	Reduce height or ground barrage, or specified sector of barrage.
WEATHER	Not applicable.	Secure all or part of balloons against effects of adverse weather.

c. Duration of controls.—Controls may be imposed on barrage balloons at any time. They override any alert and remain in effect until terminated by the authority ordering the control. The controlling authority will terminate the control immediately after it is no longer required.

d. Time required to put controls into effect.—The time required to put controls into effect will vary according to a number of factors, including the time required to transmit orders, the type of balloon matériel employed, and the speed and proficiency of balloon crews. Periodic tests should be conducted to determine the time required to put control

orders into effect. A barrage or subdivision of a barrage may be considered as flying when two-thirds of the balloons are reported flying, but a barrage may be considered grounded only when all of the balloons are reported as grounded.

■ 15. OPERATIONAL GROUPING OF BALLOON SITES.—*a.* For efficient control of balloons on extensions of airport runways, or in similar situations, it may be desirable to group balloons into operational units in order to facilitate the transmission

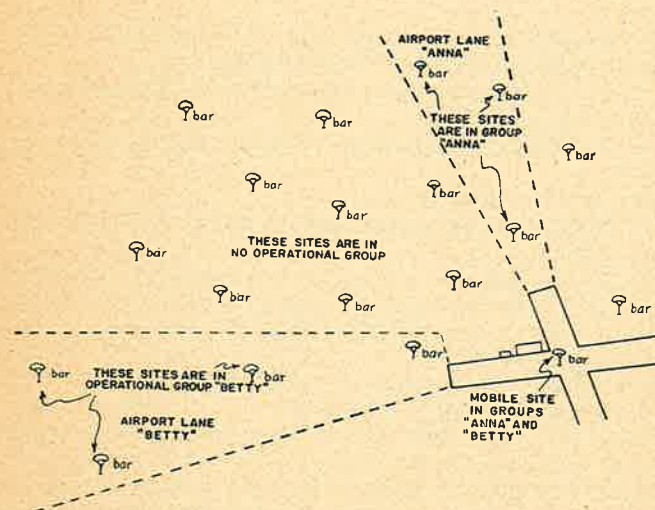


FIGURE 1.—Operational grouping of balloons.

of orders. This grouping is made with the advice of the area controller and all interested adjacent commanders. Each balloon site should have posted on or near its telephone or radio the operational group, or groups, in which it is located.

b. Figure 1 illustrates the operational grouping of balloons in a barrage area for distressed aircraft grouping of balloons, local safety control, and air cooperation control.

■ 16. PHRASING OF ORDERS.—By using a system of alerts and controls, there is little difficulty in making orders and reports terse and clear. In general, orders including both a control and an alert should state the control first. Orders illustrating desirable terseness in phrasing are given in *a* and *b* below.

a. Between AAA operations room and barrage control room.—(1) Alerts and controls ordered from the AAA operations room should be phrased as follows:

(a) SAMOPAC BARRAGE, ALERT RED.

(b) DISTRESSED AIRCRAFT CONTROL, GROUND BETTY.

(c) SAMOPAC BARRAGE, AIR COOPERATION CONTROL, REDUCE HEIGHT TO 2,000 FEET.

(2) The report sent back to the AAA operations room should be phrased as follows:

(a) SAMOPAC BARRAGE, ALERT RED COMPLIED WITH.

(b) BETTY GROUNDED.

(c) SAMOPAC BARRAGE, BALLOONS NOW FLYING AT 2,000 FEET.

b. Between barrage control room and sites.—(1) The same commands given in *a* above, when ordered from barrage control room to sites, should be phrased as follows:

(a) ALERT RED.

(b) BETTY ONLY, ALERT YELLOW.

(c) CHANGE ROH to 2,000 FEET.

(2) The reports sent back to the barrage control room should be phrased as follows:

(a) BATTERY A, ALERT RED COMPLIED WITH, or BATTERY B, ALERT RED COMPLIED WITH, EXCEPT FOR SITE(S) ——— AND ———.

(b) BATTERY C BETTY, ALERT YELLOW COMPLIED WITH.

(c) 3 — BN BALLOONS NOW FLYING AT 2,000 FEET, or 3 — BN BALLOONS NOW FLYING AT 2,000 FEET EXCEPT SITES ——— AND ———, WINCH TROUBLE.

SECTION VI

CONTROLLING AUTHORITIES

■ 17. GENERAL.—*a. Degree of control.*—As a result of its tactical use, the low altitude balloon barrage ordinarily is subjected to more control than the very low altitude balloon barrage. However, a very low altitude balloon barrage flown in tandem may be subject to the same amount of control as a low altitude barrage.

b. Control unit.—A balloon barrage may be formed by a single detached platoon, a battery, a battalion, or two or more battalions of AA balloon troops. Since the effectiveness of a barrage largely depends on the number and positions of balloons flying, the balloons must be controlled as a unit. No site, platoon, battery, or other echelon in a barrage will lower or raise its portion of the defense on the initiative of its own commander, except as provided in *c* below.

c. Maintenance and training.—To facilitate balloon maintenance and training, each battery commander should be permitted to control two balloons at any time, except during air-raid conditions, for purposes of topping-up, inspecting, and making minor repairs to balloons, or for training.

■ 18. BARRAGE COMMANDER.—The barrage commander is the senior balloon officer assigned to the AA unit or units operating the barrage. He is authorized to establish the ROH of his balloons (see par. 6), and to order a WHITE (weather) alert or a WEATHER control when in his judgment such action is necessary to prevent excessive balloon casualties due to adverse weather.

■ 19. HIGHER COMMANDERS.—*a. General.*—The fighter commander, wing commander, antiaircraft artillery commander, and region antiaircraft artillery commander will issue directives and standing operating procedures governing the control of barrage balloons in a combined air defense. All restrictions on flying balloons will be kept to a minimum.

b. Alerts.—The fighter commander will authorize the designations and meanings of the various alerts.

c. Controls.—If controls other than those listed in paragraph 14 are required to meet certain situations, the fighter commander will authorize the designation and meaning of such controls.

d. Coordination.—When the barrage is located in an organized fighter control area, the area controller, through the AAA operations officer, will impose the controls necessary to coordinate the operation of barrage balloons with other members of the air defense team.

■ 20. AIRPORT AND AIRDROME COMMANDERS.—Local civil and military airport and airdrome commanders may be authorized by the fighter commander to control specific barrage balloons for the safety of friendly aircraft taking off and landing at their fields.

CHAPTER 2

OPERATION OF THE BARRAGE

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SECTION I

BARRAGE CONTROL PERSONNEL

■ 21. BARRAGE BALLOON LIAISON OFFICERS.—An officer specially trained in barrage balloon operations is constantly on duty in the AAA operations room. This officer advises the AAA operations officer on barrage balloon matters, and on the status of the balloon barrages controlled from the AAA operations room. He transmits orders from the AAA operations room to the barrage control room.

■ 22. CONTROL DUTIES OF BARRAGE COMMANDER.—The barrage commander has the following specific control duties:

- a.* He will determine the ROH of his barrage.
- b.* He will cause the barrage to respond to any orders from the AAA operations room in the prescribed manner, and will report completion of the required operation.
- c.* He will determine which balloons will fly in any situation in which there is a weather risk to the balloons, and will impose a WEATHER control if necessary for the safety of the balloons.
- d.* He will establish WHITE (weather) alerts. For this purpose he will maintain a weather station in an LA barrage. In a VLA barrage he will secure weather information from the Army Air Forces or other appropriate agencies.
- e.* He will keep the AAA operations officer and other higher commanders informed of any major changes in the flying status of the barrage that will effect the efficiency of the combined air defense.

f. He will keep operations records and will make the periodic and special reports required by higher headquarters.

g. He may act as barrage balloon officer on the staff of the next higher AAA commander.

■ **BARRAGE CONTROL OFFICERS.**—Barrage control officers are staff officers, one of whom is on duty in the control room at all times to perform the following specific duties:

a. Act for the barrage commander in performing routine barrage control duties, according to announced policies.

b. Advise the barrage commander on all matters pertaining to barrage control.

c. Maintain constant vigil in the barrage control room and be prepared to take immediate and appropriate action upon receipt of an alert, imposition of a control, or receipt of a warning of an impending change in the weather.

d. Maintain records and reports so that the status of the barrage is known at any time.

e. Assist in supervising and training the enlisted barrage control personnel.

■ **24. ENLISTED PERSONNEL.**—Each shift in the barrage control room will require one switchboard or telephone operator and at least one clerk, with an additional clerk during the day shift to prepare records.

SECTION II

BARRAGE CONTROL ROOM

■ **25. BARRAGE CONTROL ROOM.**—*a. General.*—The barrage control room is the tactical command post of the balloon barrage. In this room orders and information from higher headquarters are received, information on the status of the barrage is maintained, and orders for balloon operations are issued.

b. Location.—(1) Where more than one balloon barrage operates under an AAA operations room, it is desirable to locate a barrage control room at each barrage.

(2) Where only one balloon barrage operates under an AAA operations room, it is desirable to locate the barrage control room in the AAA operations room. In this event the duties of both the barrage balloon liaison officers and the

barrage control officers can be performed by the same officers.

■ **26. EQUIPMENT IN BARRAGE CONTROL ROOM.**—A typical barrage control room is illustrated in figure 2. Equipment normally required is listed as follows:

a. Switchboard and telephones. (A switchboard is not required in the control room of a single battalion barrage.)

b. Balloon status board.

c. Balloon site map.

d. Weather board.

e. Equipment status board.

f. Local area map.

g. Operations log book.

h. Memory board.

i. Bulletin board.

j. Telephone call list.

k. Static indicator.

l. Typewriter.

m. Radio or teletype equipment.

■ **27. BALLOON STATUS BOARD.**—In order to give a continuous picture of the positions of the balloons in the barrage at all times, a balloon status board is needed. A simple and easily constructed balloon status board is illustrated in figure 3. The board should show the following information:

a. ROH for the barrage.

b. Alert status of the barrage.

c. Controls in effect.

d. Operational group and balloon class of each site.

e. The positions of the balloons at all times.

f. State of readiness of each site to fly its balloon.

■ **28. BALLOON SITE MAP.**—The balloon site map (scale: 1 inch equals 400 feet, or larger), should show the following:

a. Location of each balloon site, with roads leading thereto.

b. Operational grouping of the sites.

c. Balloon class of each site.

d. Type of mooring facilities at each site.

e. Type of balloon at each site.

f. Date balloon was put in operation.

g. Condition of balloon.

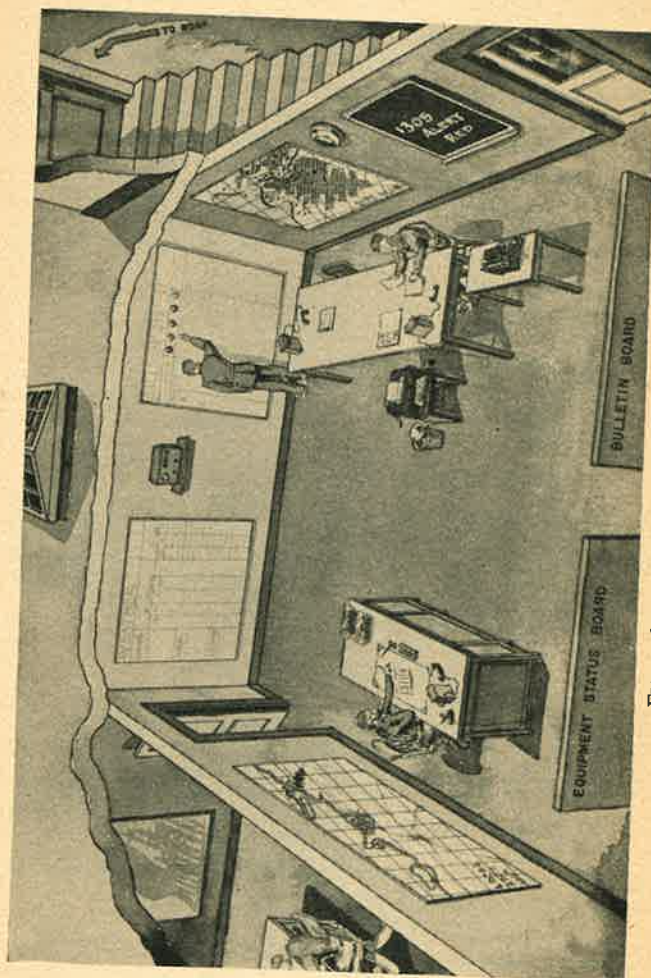


FIGURE 2.—Typical barrage control room.

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FIGURE 3.—Balloon status board.

■ **29. WEATHER AND EQUIPMENT STATUS BOARDS.**—Figures 4 and 5 illustrate boards for posting weather information and the status of balloon equipment.

■ **30. LOCAL AREA MAP.**—A map (scale: 1 inch equals 1 mile) of the general area surrounding the barrage should be posted in the barrage control room. This map should show all other defenses in the area, the defended objectives, and the power lines and other vital installations liable to be damaged by break-away barrage balloons.

■ **31. OPERATIONS LOG BOOK.**—A continuous record of control operations should be kept in a bound book, ruled as shown in figure 6.

■ **32. MEMORY BOARD.**—The memory board is a blackboard on which is written the last order involving the balloons, and the time of its issuance. This keeps the barrage control officer informed as to where the balloons should be according to his last order, while the balloon status board shows where they actually are.

■ **33. BULLETIN BOARD.**—A bulletin board should be provided for posting SOP's from higher headquarters, important reminders, and duty rosters.

■ **34. TELEPHONE CALL LIST.**—An especially important item to be kept in the barrage control room near the telephone is a list of telephone numbers to be called when a balloon breaks away carrying cable.

■ **35. STATIC INDICATOR.**—The static indicator, a device located on a balloon site near the barrage control room, is connected to a remote bell station in the barrage control room by wire. The static indicator reveals the presence of a static or lightning condition which may be dangerous to the balloons in a barrage if they continue to fly.

WEATHER MESSAGE		PRESENT WEATHER CLASS					WINDS ALOFT									
		HOURLY OBSERVATIONS				WIND	ELVN	DRCN	SPEED							
TIME		GIG	CLOUDS	TMP/DWPT			1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
SPECIAL MESSAGES																
MOONRISE AND MOONSET																

FIGURE 4.—Weather board.

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BALLOON BARRAGE CONTROL

FIGURE 6.—Operations log.

SECTION III

BARRAGE CONTROL OPERATIONS

■ 36. **STANDING OPERATING PROCEDURES.**—*a. General.*—Efficient control of a barrage will be facilitated by publication of standing operating procedures (SOP's) under which the barrage will be operated. These procedures should cover all routine operations likely to occur repeatedly in the barrage.

b. Kinds.—Many barrage operations and orders lend themselves readily to standardization. In general, control SOP's issued by a barrage commander will be of two kinds—those intended for use in the control room only, and those intended for the entire barrage.

(1) SOP's for use in the control room may include a brief resumé of alerts and controls, as established by higher headquarters, a statement of policy by the barrage commander as to what balloons will be flown in class II and III weather, and the methods of determining the ROH.

(2) SOP's issued for the barrage as a whole will cover the following subjects:

- (a) Instructions for transmitting tactical orders.
- (b) Establishment of operational groups.
- (c) Schedule for checking and topping-up balloons.
- (d) Reports required of balloon sites.
- (e) Schedule for training.
- (f) Action to be taken during lightning and wind storms.
- (g) Composition, equipment, and employment of retriever details.

■ 37. **BREAK-AWAY BALLOON.**—*a.* When notified that a balloon is adrift, the barrage control officer will immediately inform the AAA operations room and warn all civilian agencies concerned. Among the agencies to be informed are local power companies and local police agencies.

b. Upon report of the location of a break-away balloon, the barrage control officer will dispatch the retriever detail to the location for its recovery.

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