I CERTIFY THAT I HAVE READ AND UNDERSTAND ALL SUBJECTS IN THE BOMBARDIERS' INFORMATION FILE LISTED IN FORM 24B, DATED MARCH, 1945

SIGNED ____________________

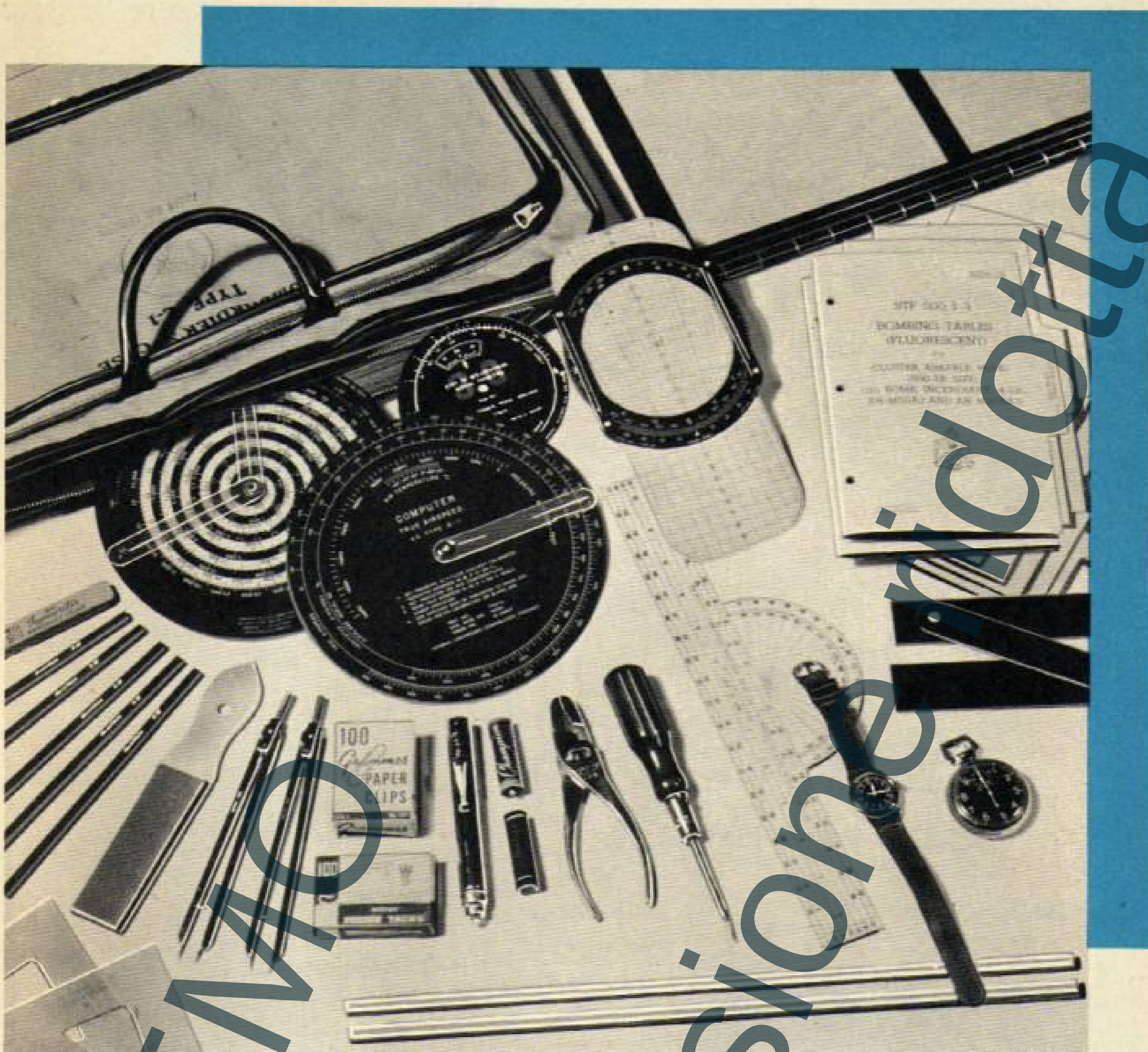
RANK ____________________

ORGANIZATION ____________________

DATE ____________________

When you receive your new Form 24B, dated June, 1945, remove this form, sign it, and give it to your Operations Officer to put in your Form 5 file.

★ 1945 · MARCH · APRIL · MAY · 1945 ★

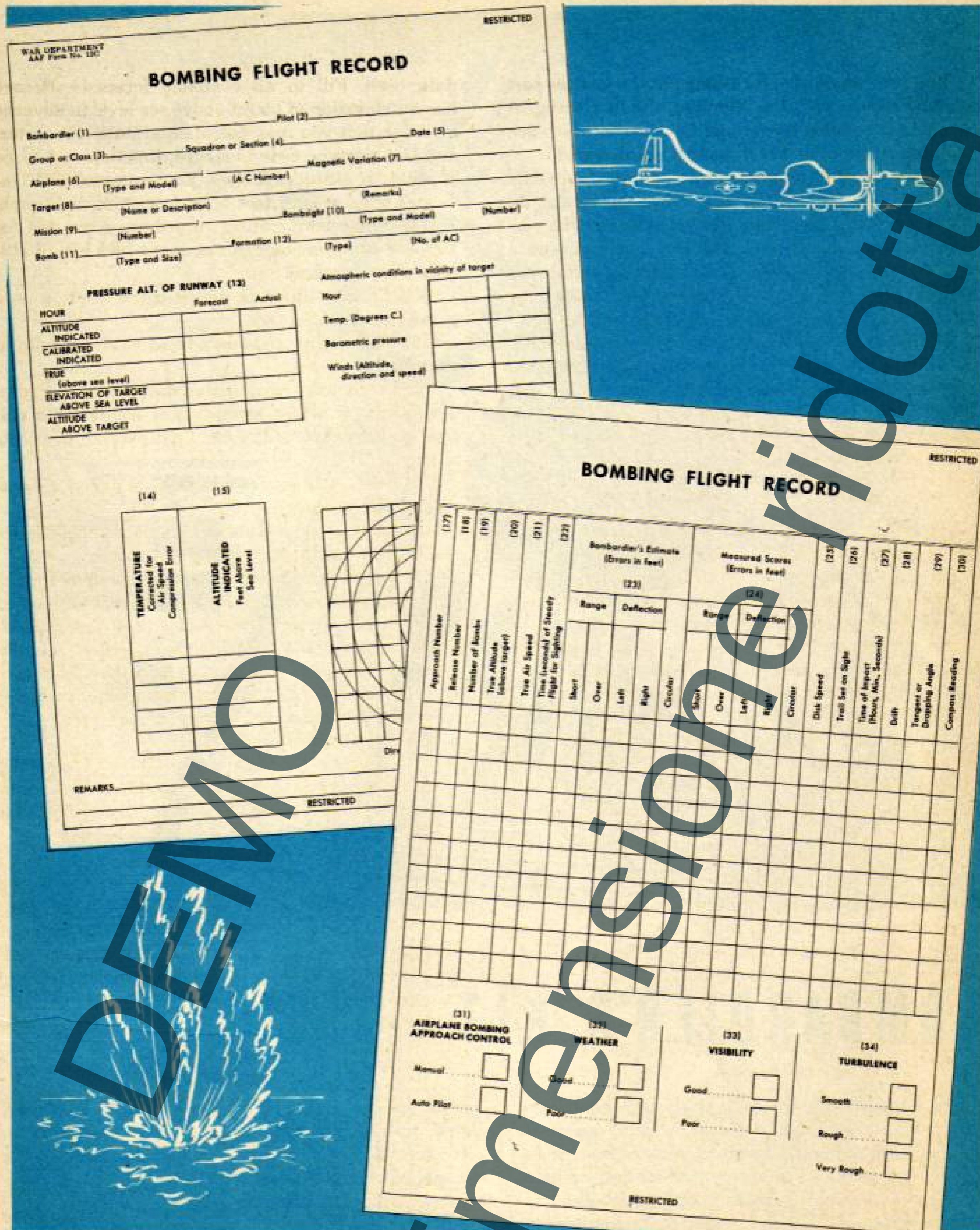


BOMBARDIER'S KIT

The bombardier's kit is a cloth case containing computers, tables, and pertinent working materials for use in maintaining bombing records and calculations. It is provided for every student and graduate bombardier through regular supply channels.

It includes: C-2, G-1, J-1, and E-6B computers; set of dropping angle charts for use with E-6B computer; stop watch and wrist watch; pen-type flashlight; bombing flight record holder; tools; drafting pencils; eraser; dividers; Weems plotter; parallel rule; transparent triangles; bombing tables.

REFERENCE: Technical Order 00-30-38-2



RESTRICTED

WAR DEPARTMENT
AAF Form No. 12C

BOMBING FLIGHT RECORD

Bombardier (1) ____ Pilot (2) ____

Group or Class (3) ____ Squadron or Section (4) ____ Date (5) ____

Airplane (6) ____ (Type and Model) ____ (A C Number) ____ Magnetic Variation (7) ____

Target (8) ____ (Name or Description) ____ (Remarks) ____

Mission (9) ____ (Number) ____ Bombsight (10) ____ (Type and Model) ____ (Number) ____

Bomb (11) ____ (Type and Size) ____ Formation (12) ____ (Type) ____ (No. of AC) ____

PRESSURE ALT. OF RUNWAY (13)

	Forecast	Actual
HOUR		
ALTITUDE INDICATED		
CALIBRATED INDICATED		
TRUE (above sea level)		
ELEVATION OF TARGET ABOVE SEA LEVEL		
ALTITUDE ABOVE TARGET		

Atmospheric conditions in vicinity of target

Hour		
Temp. (Degrees C.)		
Barometric pressure		
Winds (Altitude, direction and speed)		

(14) TEMPERATURE Corrected for Air Speed Compression Error	(15) ALTITUDE INDICATED Feet Above Sea Level

REMARKS ____

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BOMBING FLIGHT RECORD

(17) Approach Number	(18) Release Number	(19) Number of Bombs	(20) True Altitude (above target)	(21) True Air Speed	(22) Time (seconds) of Steady Flight for Sighting	(23) Bombardier's Estimate (Errors in Feet)					(24) Measured Scores (Errors in Feet)					(25) Disk Speed	(26) Trail Set on Sight	(27) Time of Impact (Hours, Min., Seconds)	(28) Drift	(29) Tangent or Dropping Angle	(30) Compass Reading
						Range		Deflection			Range		Deflection								
						Short	Over	Left	Right	Circular	Short	Over	Left	Right	Circular						

(31) AIRPLANE BOMBING APPROACH CONTROL
Manual ☐
Auto Pilot ☐

(32) WEATHER
Good ☐
Poor ☐

(33) VISIBILITY
Good ☐
Poor ☐

(34) TURBULENCE
Smooth ☐
Rough ☐
Very Rough ☐

RESTRICTED

SECTION 2

FUNDAMENTALS OF BOMBING...

In order to have your bomb hit the target, you must locate the proper point in space from which to release it. Your bombsight finds this point and automatically releases the bomb, provided you put the correct data into it and operate it properly. A thorough knowledge of the bombing problem enables you to understand what data you must set into the bombsight, how to set it in, and how the bombsight uses it to solve the bombing problem.

Bombing errors can be reduced to a minimum and in many cases can be eliminated. Whenever your bomb misses the target, there is a definite cause for it. Only by learning the cause can you avoid repeating it. When you thoroughly understand what causes bombing errors, you can sense and correct them before your bomb is released. Learn as much as you possibly can from every bomb you drop.

Lack of experience may cause you to miss the target occasionally but there is no excuse for missing it because you failed to use your bombing tables correctly. You should derive all the benefit they can provide. Know what's in them and use them accurately.

Learn reliable short cuts and rules of thumb. You don't need to be a mathematical genius to understand and use the basic bombing equations.

BOMBING PROBLEM

The moment a bomb is released from an airplane it encounters several forces. These forces are: gravity, true airspeed, air resistance, and wind. The combined effect of these forces determines the path (trajectory) that the bomb follows and where it hits.

Gravity pulls the bomb toward the earth at a continually increasing speed. It exerts the same force on all bombs, whatever their size, shape, or weight.

Since the bomb is part of the airplane up to the instant of release, it leaves it with the forward speed of the airplane. This forward speed of airplane and bomb relative to air is **true airspeed (TAS).**

Trail

Air resists the bomb in its flight and acts against the forces of gravity and TAS. This resistance keeps the bomb in flight longer and decreases its forward speed through the air. Thus it lags behind the airplane. The horizontal distance that it lags is its **trail.** Trail, consequently, is the horizontal distance measured on the ground from the point of impact to a point directly beneath the airplane at the instant of impact.

Remember that trail is the result of several forces acting upon the bomb. While TAS drives the bomb forward, air resistance tends to hold it back. While gravity pulls it down, air resistance tends to hold it up. When TAS increases, the horizontal resistance of the air increases; thus, trail is greater. Similarly, when the downward speed of the bomb increases, the vertical resistance of the air increases and trail is greater. The downward speed of the bomb depends on the height of the airplane above the target, that is, the **bombing altitude (BA)** from which the bomb is dropped.

The amount of resistance which the air offers to the bomb also depends on its size, shape, and weight. Ordnance engineers classify a bomb according to its ballistic coefficient (Ball. Coeff.), the relative amount of resistance the air offers to it. A bomb with a high ballistic coefficient falls faster and with less trail than a bomb with a low ballistic coefficient.

The amount of trail for each bomb at practical BA and TAS ranges has been determined by tests and is given in your bombing tables.

Trail increases as { **BA increases** / **TAS increases** / **Ball. Coeff. decreases** }

Wind

In addition to the forces of gravity, TAS, and air resistance, **wind** acts upon the bomb during its flight and affects the trajectory. Think of wind as the movement of the mass of air in which the airplane is flying. Wind does not affect the TAS of the airplane. Therefore, it has no effect on trail, since trail depends only on TAS, BA, and type of bomb.

Headwinds or tailwinds do affect the **groundspeed (GS)** of the airplane. When there is a tailwind it increases GS. Therefore, you must release the bomb at a greater distance from the target in order to hit it. Conversely, when there is a headwind, you must release the bomb closer to the target.

When there is a crosswind, **drift** enters the bombing problem. To compensate for drift you head the airplane into the wind sufficiently to make good a course the proper distance upwind of the target. This distance that the airplane must fly upwind of the target is **crosstrail (CT).** In other words, CT is the distance that the bomb is carried downwind while it is falling.

Improper Course

If you set up a Drift ∠ which is too small the airplane is not directed far enough upwind of the target and the bomb hits **downwind.** With too small a right Drift ∠ the bomb hits to the **right.**

When you set up an incorrect drift you set up an incorrect course and an incorrect crosstrail. They both occur in the same direction. Their total deflection error in feet is equal to:

$$\text{WR (ft)} \times \text{Sin drift error in degrees}$$

or

$$\frac{\text{BA} \times \text{Tan WR}\angle \times 18}{1000} \times \text{Drift error in degrees}$$

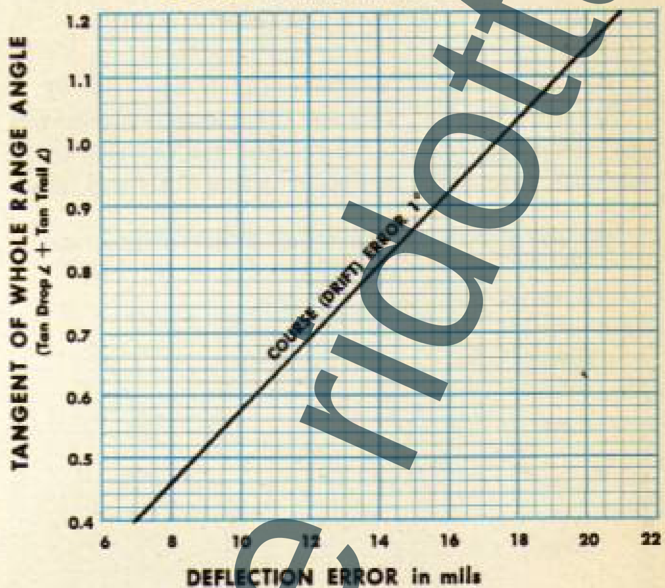
Be thorough in your preflight of stabilizer and course knobs. Pre-set your Drift ∠ whenever possible. Make smooth, positive course corrections which are easy for the pilot to follow. Pilot or autopilot should respond to your corrections with smooth, positive, coordinated turns. Make your large corrections **early** in the run, but don't make corrections faster than the pilot can take them out. As you near your release point, you should need only minor adjustments. Keep the fore and aft crosshair on the target and be careful not to overcorrect.

Teach your pilot how to adjust autopilot properly for bombing. When you set up course manually, perfect cooperation and coordination between you and your pilot are imperative.

Remember:

Drift **too small**—bomb hits **downwind.**
Right drift **too small**—bomb hits **right.**

DEFLECTION ERROR CAUSED BY COURSE (DRIFT) ERROR OF 1°



Improper Rate

If the lateral crosshair moves short of the target, or toward you, your rate synchronization is fast. You have solved for a faster GS than actually exists. Consequently, the Drop ∠ set up is too large and the bomb hits **short.**

The range error in feet resulting from improper range synchronization is equal to:

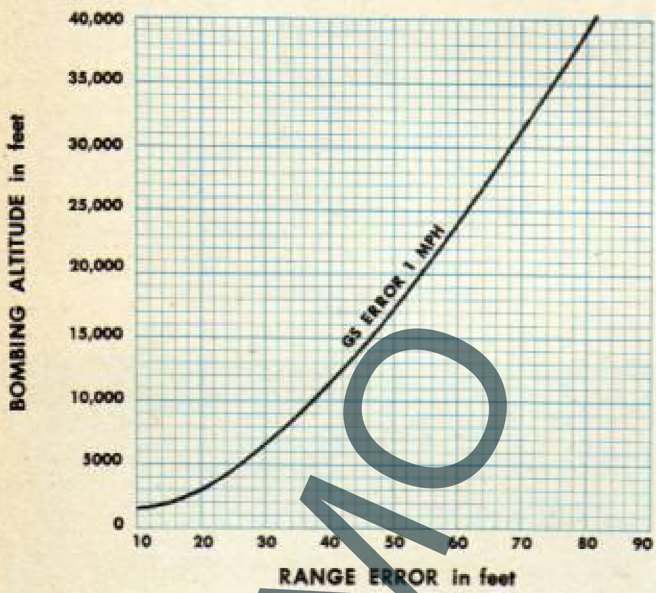
ATF × 88/60 × GS error in mph

or

BA (Tan Drop ∠ needed − Tan Drop ∠ used)

To find GS error, take the difference between GS you solve for with the bombsight and GS you solve for with your E-6B computer, using TAS and wind.

RANGE ERROR CAUSED BY GS SYNCHRONIZATION ERROR OF 1 MPH (AN-M64A1, 500-lb GP BOMB)



Be thorough in your preflight of bombsight rate end. Pre-set your Drop ∠ whenever possible. Set up a good course before attempting to refine rate. You should need only minor adjustments as you near the release point. Keep lateral crosshair on target and do not overcorrect. Be sure that you don't have extended vision rolled in.

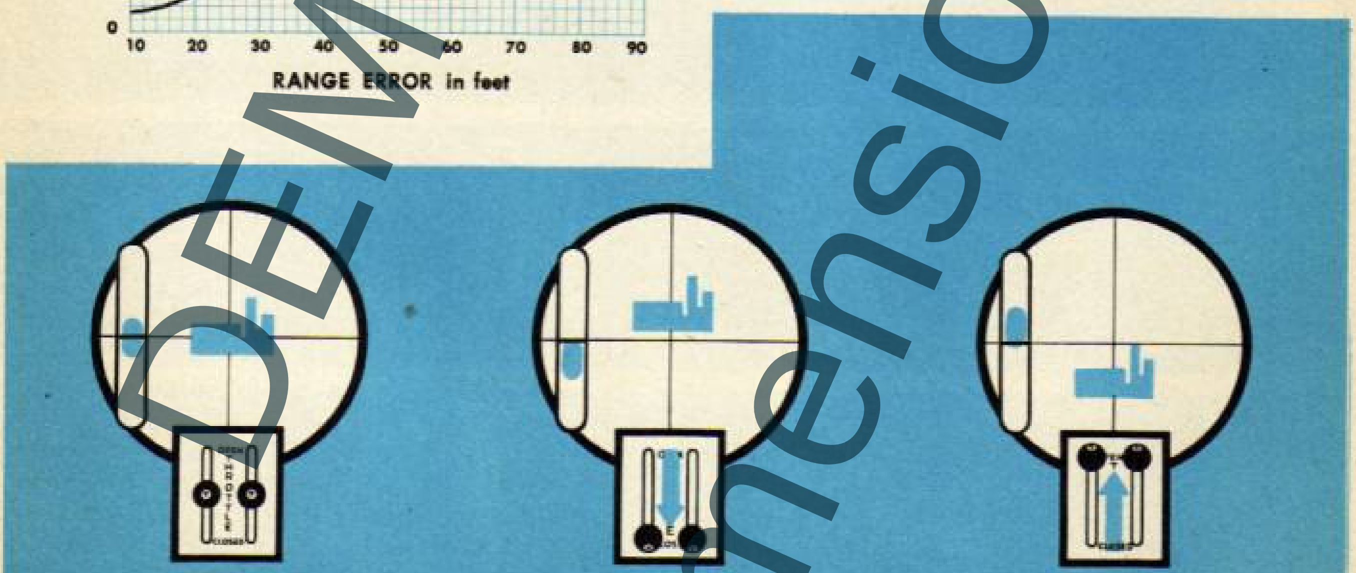
Teach your pilot how jockeying airspeed upsets your synchronizing for range. Teach him not to change altitude or airspeed too radically. Teach him to notify you before reaching bomb release point if either altitude or airspeed is off, how much it is off, and which way it is off.

Improper Release

As bombs are usually carried some distance behind the bombsight, they tend to hit that same distance **short** of the target.

After the bombsight has sent the release impulse to the racks, there is a slight delay in releasing the bombs because of rack lag. Allowable lag is from .03 to .06 second, depending on the condition of the racks. Since the bomb is carried longer than the bombsight intends, rack lag tends to cause the bomb to hit **over.** Errors resulting from rack lag are small unless the racks are not kept in proper condition and the lag exceeds the allowable limits.

Improper adjustments of the bombsight release contacts also can cause faulty release. These contacts should close when the sighting angle index reaches coincidence with the dropping angle index. If they close too soon the bomb hits **short.**



WHEN PILOT JOCKEYS AIRSPEED, BOMBARDIER CANNOT ACCURATELY LEVEL BUBBLES OR SYNCHRONIZE FOR RANGE.

FIXED-ANGLE BOMBING ERRORS

Fixed-angle bombing is subject to about the same errors that occur in synchronous bombing. In fixed-angle bombing, you pre-set the Drop ∠ for the BA and GS at which the bomb is to be released. Therefore, you must understand the effect of incorrect BA, TAS, wind, and fore and aft bubble level. Since you pre-set the Drop ∠, be especially careful in obtaining it from the bombing tables.

Incorrect Bombing Altitude

If you release the bomb from a higher BA than used in pre-setting the Drop ∠, the pre-set Drop ∠ is too large and the bomb hits **short.**

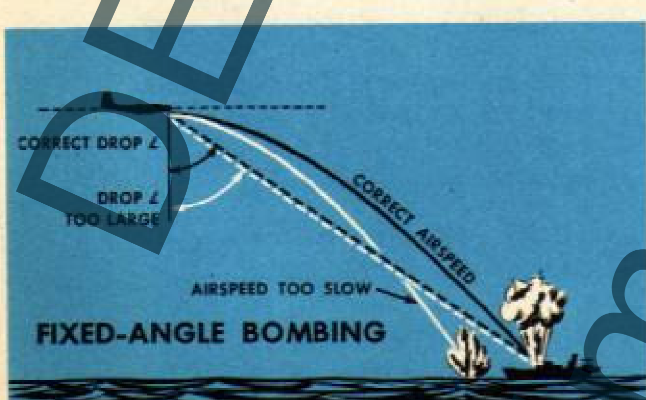
The range error in feet resulting from an incorrect BA is equal to:

BA (Tan Drop ∠ needed – Tan Drop ∠ used)

From your bombing tables find the Tan Drop ∠ needed for the BA actually flown. Tan Drop ∠ used is taken from the bombsight.

Incorrect Airspeed

If at the instant of release the airplane is flying at a slower IAS and hence a slower TAS and GS, the pre-set Drop ∠ is too large and bomb hits **short.**



The pre-set Drop ∠ is larger than needed for the slower GS actually flown. The accuracy of GS and consequently the accuracy of your Drop ∠ depends upon the correct solution for the wind. Therefore you must determine the wind accurately when you do fixed-angle bombing.

The range error in feet resulting from an incorrect airspeed is equal to:

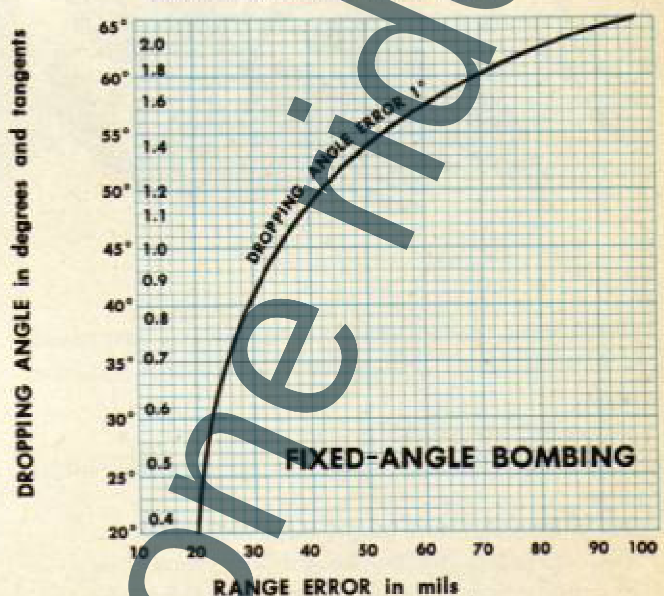
BA (Tan Drop ∠ needed – Tan Drop ∠ used)

or

ATF × TAS error in ft/sec

From your bombing tables find the Tan Drop ∠ needed for the GS actually flown.

RANGE ERROR CAUSED BY DROPPING ANGLE ERROR OF 1°



Incorrect Fore and Aft Bubble Level

In fixed-angle bombing, when the fore and aft bubble is forward, the Range ∠ at release is larger than the Drop ∠ and the bomb hits **short.** Since you do not synchronize for rate you do not have 2 errors which tend to compensate for each other, as you do in synchronous bombing.

The range error in feet resulting from an incorrect fore and aft bubble level is equal to:

BA (Tan Drop ∠ – Tan Range ∠)

Remember, in fixed-angle bombing:

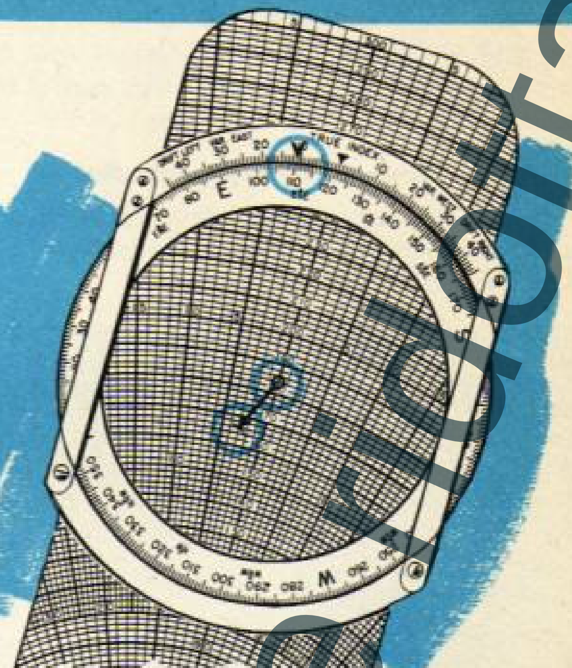
Fore and aft bubble **forward**—bomb hits **short.**

BA **too high**—Drop ∠ **too large**—bomb hits **short.**

TAS **too slow**—Drop ∠ **too large**—bomb hits **short.**

Incorrect bombing altitude or incorrect airspeed causes an error in the opposite direction to that in synchronous bombing.

BOMBING ANALYSIS



When your bomb misses the target, you can usually attribute it to one or more of these principal causes:

You computed TAS or BA incorrectly; or

You misread DS or trail from the bombing tables and/or

Set it into the bombsight incorrectly; or

You operated the bombsight incorrectly; or

The pilot flew the airplane unsuitably; or

The bombsight functioned improperly.

Plan of Analysis

On every mission, accurately record your data for each release. Then, if your bomb misses the target, study the data for that particular release. Follow a simple plan for analyzing your errors and finding out why they occurred.

Computations of BA and TAS

Carefully check your computations for BA and TAS. If you have any doubt of their accuracy, make a complete recomputation of both.

Bombsight Settings (Trail and DS)

From the bombing tables, obtain the correct trail and DS for your TAS, BA, and type of bomb. Check to see if you set them into the bombsight correctly.

Wind

Plot the wind, which you had over the target at your BA, on your E-6B computer. Use the wind obtained from the most reliable source, such as: metro prediction; navigator's computation; drift and groundspeed solution.

Now, use this wind to find your drift and GS in order to check course and range synchronization.

Range Errors

If your bomb missed the target in range, check for:

1. **Vertical**—level of fore and aft bubble.
2. **ATF**—BA flown and DS setting.
3. **Trail**—TAS flown, trail setting, and RCCT.
4. **Rate**—range synchronization.

Deflection Errors

If your bomb missed the target in deflection, check for:

1. **Vertical**—level of lateral bubble.
2. **CT**—TAS flown and trail setting.
3. **Drift**—course synchronization.

SECTION 3

COMPUTERS . . .

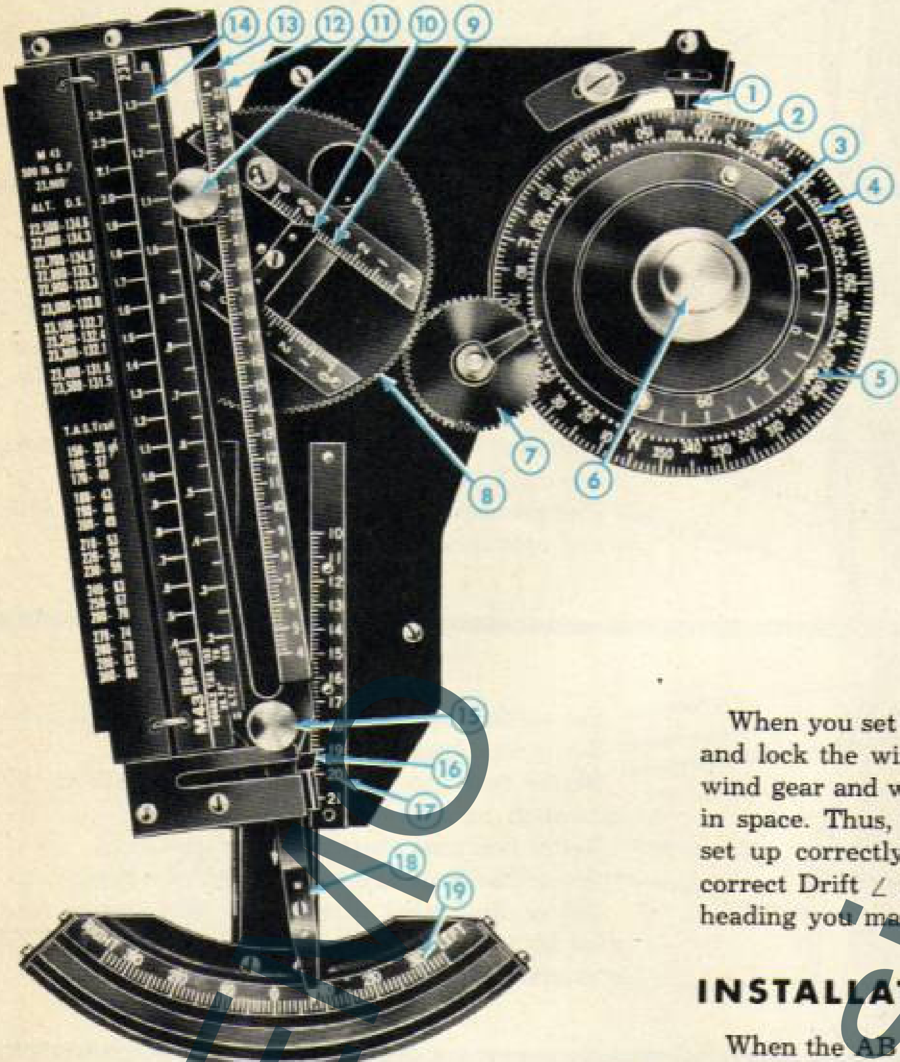
You have to make many calculations and you have to make them in a hurry. Computers, if you know how to use them, can solve your problems accurately, and they can do it quickly and easily.

The E-6B computer is so designed that you can use it for nearly all of your computations in navigation and bombing. However, there are other computers which supplement it and do special problems with equal and sometimes greater accuracy.

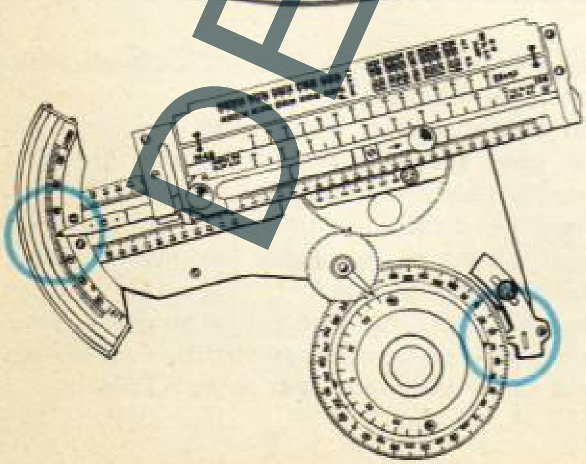
The AB computer, which is used with the M-series bombsight, enables you to solve for wind and automatically indicates the drift angle and dropping angle for any heading of your airplane.

You use the C-2 computer or the AN computer to solve for your bombing altitude. The G-1 computer enables you to find your true airspeed. The J-1 computer gives you a sighting angle for a 30- or 45-second bombing run.

AUTOMATIC BOMBING COMPUTER



1. LUBBER LINE
2. COMPASS ROSE
3. COMPASS ROSE LOCK
4. WIND GEAR
5. WIND ARROW (tail)
6. WIND GEAR LOCK
7. IDLER GEAR
8. WIND DISC
9. WIND SPEED SCALE
10. WIND SPEED INDICATOR
11. WIND SPEED LOCK
12. GROUNDSPEED SCALE
13. GROUNDSPEED BAR
14. TANGENT SCALE
15. TRUE AIRSPEED LOCK
16. TRUE AIRSPEED INDICATOR
17. TRUE AIRSPEED SCALE
18. DRIFT POINTER
19. DRIFT SCALE



When you set TAS and wind on the AB computer and lock the wind gear to the directional gyro, the wind gear and wind disc are held in a fixed position in space. Thus, when the vector triangle has been set up correctly for one heading it gives you the correct Drift ∠ and Tan Drop ∠ to pre-set for any heading you may fly on your bombing run.

INSTALLATION AND ZEROING

When the AB computer is installed correctly, you are able to match the dots on the idler gear with the dots on the wind gear and wind disc. If the dots do not match properly, remove the wind gear by unscrewing the compass rose lock and replace it so that all dots are properly matched. Then the wind arrow on the wind gear is parallel to and points in the same direction as the arrow on the wind disc.

When wind is set on the wind speed scale and the drift pointer is set at 0°, the lubber line must be opposite the point or tail of the wind arrow. If it is not, adjust the lubber line until it is. **This is a fast check for proper installation and zeroing of the AB computer. Make it before each mission.**

SECTION 4

INSTRUMENT CALIBRATION AND NAVIGATION...

The purpose of the bombing mission is to find the target, deliver the bombs with precision, and get home. The success of your mission may depend to a large degree on your ability to navigate by DR and pilotage and to use radio aids. An emergency may force you to take over the navigator's duties.

The accuracy of your navigation and bombing depends upon the accuracy of your computations. Your altitude, TAS, and course corrections for navigation and bombing are based upon readings taken from the free-air temperature gage, airspeed indicator, altimeter, compass, and bombsight or driftmeter. Accordingly your calculations can be no more accurate than the data taken from these instruments.

Aircraft instruments have scale or instrument errors and, more important, installation errors. When you calibrate an instrument you find the errors in its indication under specified conditions. You record the corrections for those errors on a convenient card. Then when you use the instrument you refer to the card and apply the corrections to the indicated reading.

FREE AIR TEMPERATURE GAGE

There are 2 types of free air temperature gages in common use.

The bimetallic gage has as its sensitive element a spiral composed of 2 strips of different metals welded together. Temperature changes have greater effect on one metal than the other, and so cause the spiral to coil or uncoil. This motion causes the pointer to move over the dial.

The sensitive element of the electric gage is a coil whose resistance increases as the coil is warmed. An electric current passes through the coil and indicator. Changes in temperature cause changes in the amount of current and thus in the position of the pointer. You can recognize this type of gage easily because it does not indicate temperature until the master switch has been turned on.

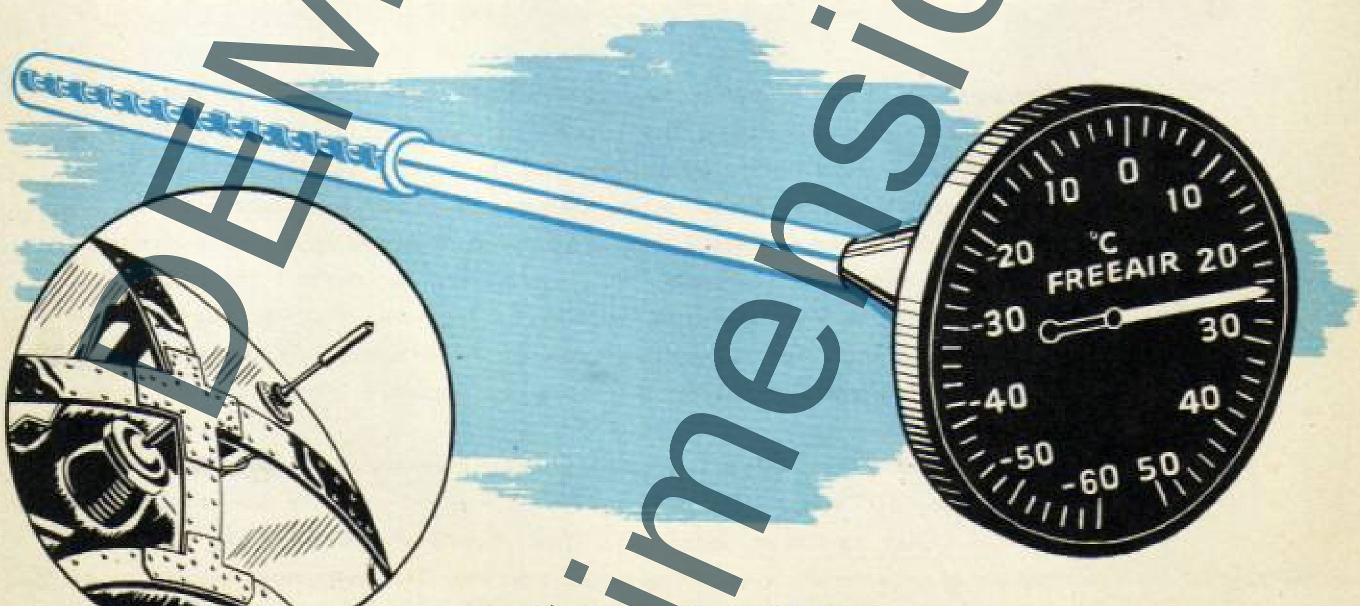
Calibration

To calibrate either of these gages for scale error you take a series of readings and compare them with the readings of a master thermometer. This work can best be done in an instrument shop where the sensitive element of the master thermometer and of the gage which is being calibrated can both be placed in the same medium and readings taken throughout the range of the gage. In case no instrument shop is available you may take a master thermometer on a mission and check the readings of your gage. The sensitive element of the master thermometer should be placed in the airstream as nearly as possible like that of the gage being tested. When you have determined the amount of scale error, make out a scale correction card and place it in the holder beside the instrument.

Most free air temperature gages are subject to an installation error which you can determine by calculation. As the air strikes the sensitive element, heat is generated by compression and friction. As a result the temperature gage indicates a higher temperature than actually exists. Calculate the amount of this error for the TAS range of your airplane, and **subtract it** from the temperature gage indication when you take a temperature reading. Use this equation:

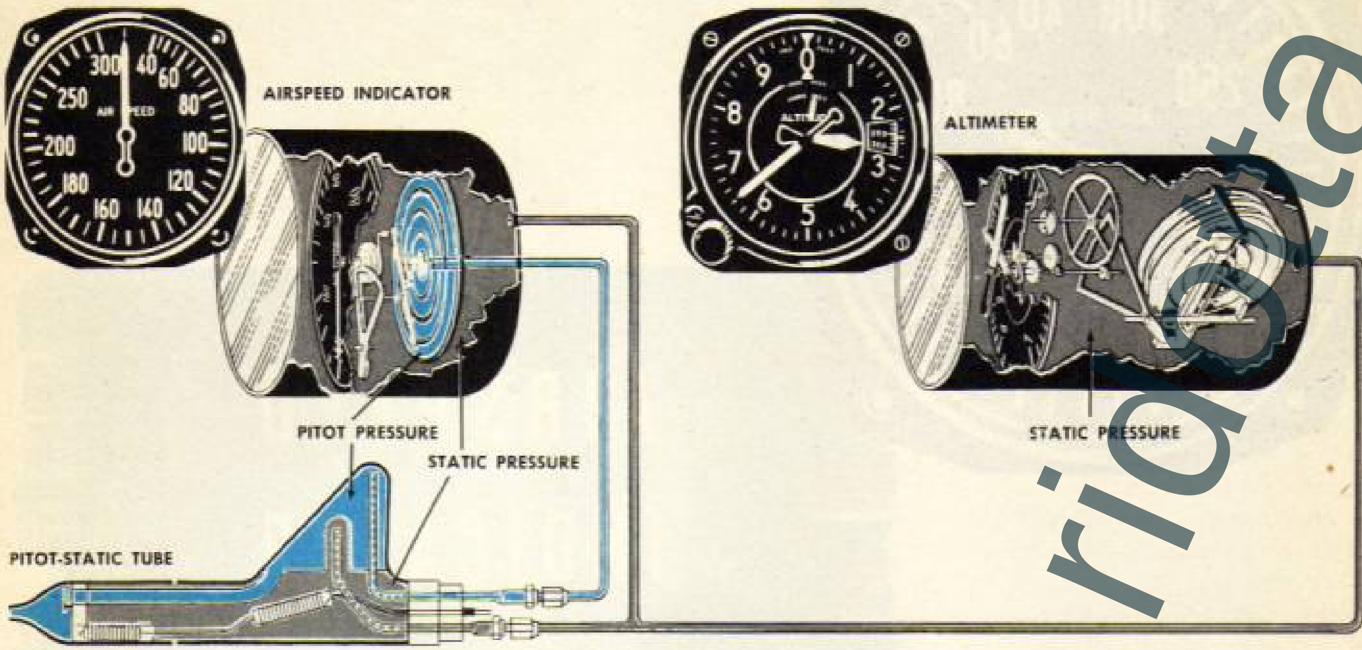
Correction (degrees C) $= -.00008 \times (TAS)^2$.

If your TAS is 200 mph the correction is $-3.2°$; for a TAS of 400 mph the correction is $-12.8°$. In using this correction, take the value to the nearest whole degree only.



BIMETALLIC TEMPERATURE GAGE

PITOT-STATIC SYSTEM



The pitot-static tube of the airplane projects into the airstream. The altimeter and the airspeed indicator are both connected to it. There are 2 compartments in the pitot-static tube. One of these compartments opens directly into the airstream. The pressure in this compartment is the sum of the static or normal barometric pressure and of the dynamic pressure caused by the motion of the airplane through the air. This total pressure is called **pitot pressure.** The openings into the other compartment are at right angles to the longitudinal axis of the tube and should not receive any dynamic pressure when the attitude of the airplane is normal. They should, however, receive the barometric or static pressure of the outside air.

Instruments that depend on the pitot-static tube are subject to installation errors resulting from static pressure errors at different airspeeds and loads. These static pressure errors occur because the attitude of the airplane changes when the airspeed or load changes and because conditions of turbulence around the airplane are different at different airspeeds.

Total or pitot pressure received in the pitot compartment goes to the airspeed indicator. The static pressure received in the static compartment goes to the airspeed indicator and altimeter as well as to certain other instruments.

You should check the pitot-static tube frequently to make sure that it is not dented, clogged, bent, or out of alignment. Such defects cause large errors in your instruments. When your airspeed indicator or altimeter is not working properly, check for water or leaks in the connecting tubes.

ATTITUDE AFFECTS FLOW OF AIR AROUND TUBE

AIRSPEED INDICATOR

The mechanism of the airspeed indicator is in a sealed case. Static pressure received from the static compartment of the pitot-static tube enters the case through an opening in the back. The sensitive element is a small diaphragm or drum-like unit which contracts or expands when the pressure inside it changes. Changes in pressure in the diaphragm are translated to the face of the instrument by a series of gears and levers. The pressure inside the sensitive element is the pitot pressure received from the pitot-static tube.

Since the pressure surrounding the element is static pressure, and the pressure inside the element is pitot pressure, the difference represents dynamic pressure. It is this difference in pressure which the airspeed indicator registers and converts to an indicated reading in mph.

If there is a scale error in an airspeed indicator the instrument section finds it when the instrument is inspected and installed. The inspector writes a card showing any needed scale corrections and attaches it near the instrument.

The airspeed indicator is calibrated for installation errors by comparing its readings with correct airspeeds calculated from known groundspeeds. Accurate groundspeeds are obtained by timing the flight of the airplane over a measured course or by using the bombsight. It is sometimes necessary to make separate calibrations with empty and loaded bomb bays. This is because when the airplane is loaded its attitude is different than when the bomb bays are empty.

Calibration with Measured Course

Calibration of the airspeed indicator by this method requires a course over practically level ground with an approximate length of 9 miles. The center section of about 5 miles length should lie between 2 parallel roads or other similar straight lines. There should be sufficient open space at each end of the course to permit the pilot to have a constant airspeed and altitude when he enters it.

1. Before takeoff, obtain accurate altimeter setting and set it on pressure scale of altimeter. If pointers do not then indicate surveyed elevation of field, adjust instrument as follows: Loosen screw in altimeter setting knob, pull knob out as far as it will come, and turn it until pointers indicate surveyed elevation of the field. Release knob and tighten screw. **Then set pressure scale at 29.92.**

2. Begin calibration by having pilot make run over course at low altitude and at IAS near top of

safe speed range of airplane. Heading must be perpendicular to roads that mark ends of course. **Pilot must not correct for drift.** Use stop watch to time run. Make another run at same altitude and IAS but on heading 180° from heading on first run.

3. Continue making pairs of runs on reciprocal headings, decreasing IAS from 10 to 15 mph on each pair. Do this throughout safe speed range of airplane.

4. On each run, record average IAS, pressure altitude (PA), temperature, and time to nearest tenth of second. Record data on AAF Form 21F, Calibration of Airspeed Indicator.

5. Calculate your GS on each run from equation:

$$\text{GS in mph} = \frac{3600 \times \text{length of course in miles}}{\text{time in seconds}}$$

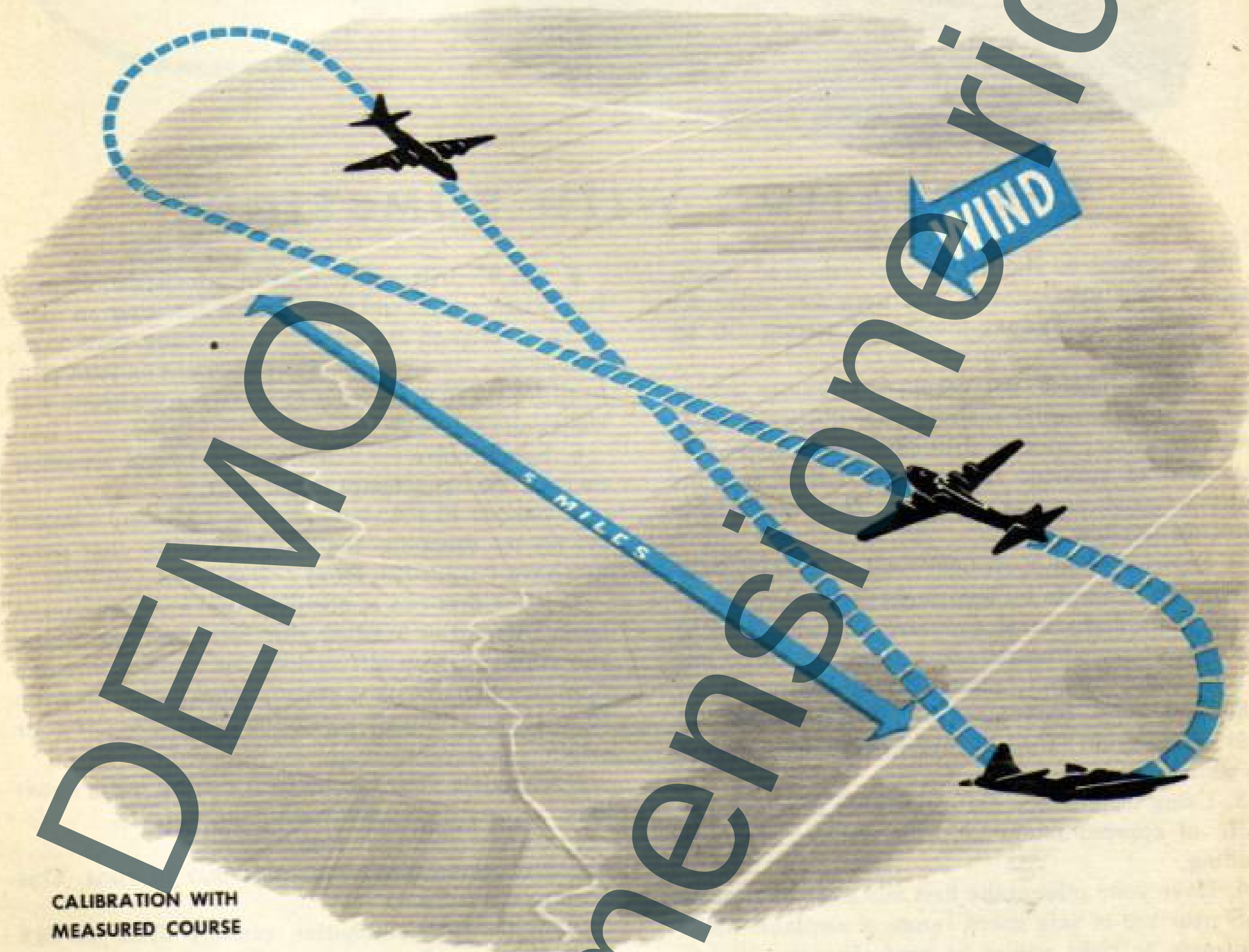
Find TAS by averaging groundspeeds for each pair of runs.

6. With your E-6B computer, convert TAS to find calibrated airspeed (CAS) corresponding to each IAS.

7. Plot your values of CAS against IAS on graph paper. Use straight edge to draw straight line that will pass through the most points.

8. From graph select IAS readings in even 10-mile intervals and note corresponding CAS on AAF Form 21E. Fill in IAS readings opposite corresponding CAS readings. Sub-divide 10-mile interval into 5 equal spaces to facilitate reading.

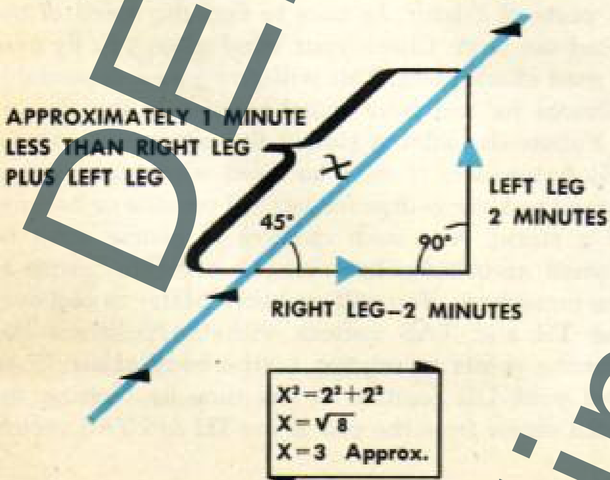
9. Place calibration card in holder near instrument when completed.



CALIBRATION WITH MEASURED COURSE

DEAD RECKONING NAVIGATION

Dead reckoning is the basic method of navigation. It is a method of navigating by means of instruments and computations when flying without the aid of distinct landmarks or when flying over water. It is often possible to navigate by DR when it is not possible to use any other method. Generally you use DR in conjunction with other methods. This greatly increases your assurance of successful navigation.



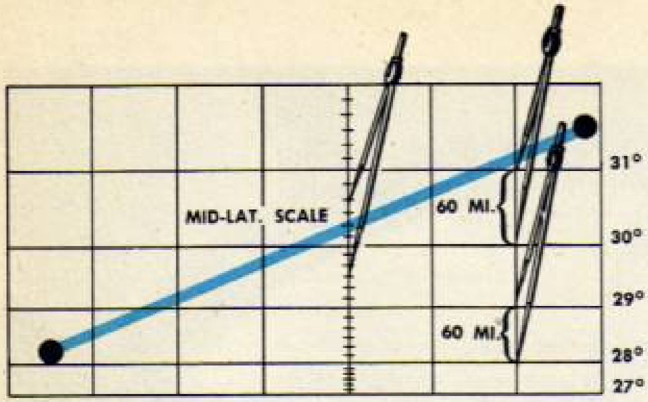
To navigate by DR successfully, you must read your instruments accurately and determine the correct wind. Consequently, make frequent checks to find if a change has occurred. Do not rely entirely on a metro wind. Use it only to set course. Then check it with a double drift or other wind solution and correct the heading. Remember, if you are making a double drift solution, **2 minutes spent on each leg cause a loss of 1 minute on course.**

DR logs are similar to pilotage logs in that they are simply an ordinary record of the flight. They are available as a reminder to do the various details of your work as you come to them.

When you take drift readings or compute GS, always use immediate heading, TAS, and wind direction and speed. Do not use average values.

In making position reports use time and distance from last known position. Do not use total time and distance as you do in pilotage.

Record positions by coordinates and altimeter readings in pressure altitude. You will find this makes it convenient in doing your computations.



Mercator charts are used in DR for they make the plotting of course angles and distances easy. Always remember to use the mid-latitude scale in measuring distances. If at any time while you are doing DR you need to check your location, it is easy to read the coordinates of your position from the Mercator chart and transfer them to a regional or sectional chart.

Groundspeed can be found quickly by use of the bombsight or driftmeter. When you use the B-5 driftmeter, determine the drift and while the driftmeter is still set on this drift, time the passage of some object from the front to the rear transverse wire. Use the circular computer on the side of the driftmeter. Set time for passage of object on the inner scale, opposite true altitude above object on outer scale. Opposite knots marker find GS in knots on outer scale.

When you use your bombsight to find GS, select any reasonable DS setting and 0 trail. Synchronize on some object on the ground. Record DS used and Tan WR∠ set up. Compute true altitude above object synchronized on and use this as BA in the equation:

$$\text{GS (mph)} = \frac{\text{DS x BA}}{7773} \text{ x Tan WR}\angle$$

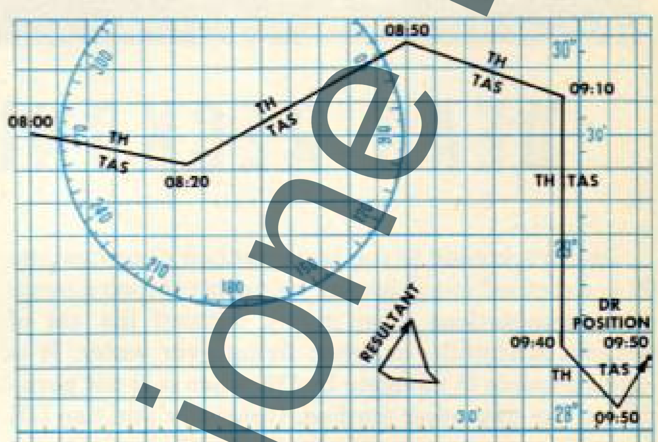
Solve this equation on your E-6B computer.

Controlled groundspeed is frequently used in order to reach your destination at a specified time. To do this you must determine the IAS necessary to make good a definite GS. This problem is simply the reverse of the regular DR procedure of determining GS from instrument readings and wind.

To solve the controlled groundspeed problem plot the TC from departure to destination and divide the distance by the time allotted for the flight. This gives you the GS which you must make good. Set TC, GS, and wind direction and speed on the E-6B computer to determine the TH and TAS you must make good. Then use the E-6B computer to determine the CAS needed to make good this TAS. Apply the calibration correction to the CAS to find the IAS at which the pilot must fly in order to achieve the required GS. Apply variation and deviation to the TH you must make good to find the compass heading at which the pilot must fly.

Air plot is a convenient form of navigation in that you may start it from any known position. In plotting values on the Mercator chart always use the average TAS and TH on each leg. Plot all of your winds from TH and use the average wind to plot the final wind vector. Be sure to keep an accurate record of the air plot. To avoid confusion, label the turning points as air positions. **Take sufficient readings to get good averages.**

You may average the wind by either of 2 methods. If the directions of all the winds which you are averaging are in the same quadrant, use mathematical averages. When the wind directions vary greatly or the wind speeds change over a large range, you can get a more accurate wind by adding all the winds vectorially and finding the resultant direction and speed. The resultant speed is for the elapsed time for all winds plotted. Since your computations are made



in units of 1 hour, be sure to find the speed of the wind per hour. Check your wind when you fly over a good check point. This will give you a dependable pilotage fix and your actual position in the air.

Follow the pilot is simply the reverse of regular DR procedure. It may be used when the pilot is forced to alter course for tactical reasons or because of a storm. Any such changes in course must be plotted accurately, however, in order to return to the home base. You will probably prefer to plot only the TH and TAS vectors with the positions and turning points in relation to the body of air. Then find your DR position at any time by plotting the wind vector from the end of the TH and TAS vector.

RADIO NAVIGATION AIDS

Radio aids are valuable in all navigation, contact or instrument. You should make the fullest practical use of radio facilities to aid you in your navigating. Obviously it would be foolish to depend upon radio navigation alone. Several conditions might arise that would make such navigation impossible.

Static, for example, is the greatest hazard to radio navigation. During electrical storms radio reception is sometimes impossible, making it necessary for you to use other methods.

Then too, atmospheric conditions affect navigation by radio. Sometimes you can't make contact with range stations 10 miles away. Don't think immediately that your radio is out. Fly out your ETA over the station and try contacting it again before you conclude that you are off-course.

Using Radio Range Beam Legs

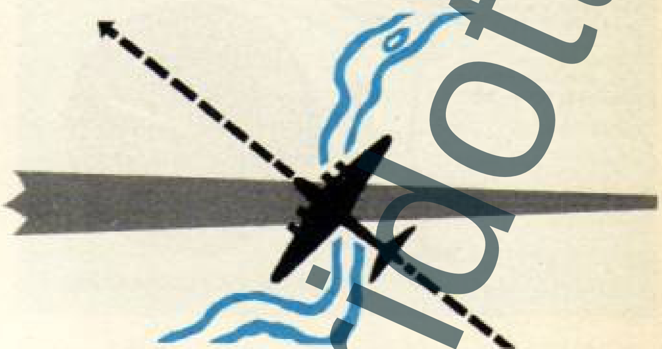
Use radio range beam legs just as you use visual check points. Use them at all times on both instrument and contact flights.

Here is an example:

Assume you have taken off from Charlotte to fly to Norfolk. After takeoff the radio is tuned to the Greensboro range to determine your position in area X thus: If west of the Greensboro southeast leg, you hear the Greensboro N signal; if east, the Greensboro A signal. In both cases the strength of the background (on-course) signal determines your proximity to the Greensboro southeast leg. A solid on-course signal of the Greensboro southeast leg indicates the general position along the line of flight. As you progress along the flight you can tune to successive stations adjacent to your route and identify your position relative to them.

International Morse Code is used for all code signals in radio navigation.

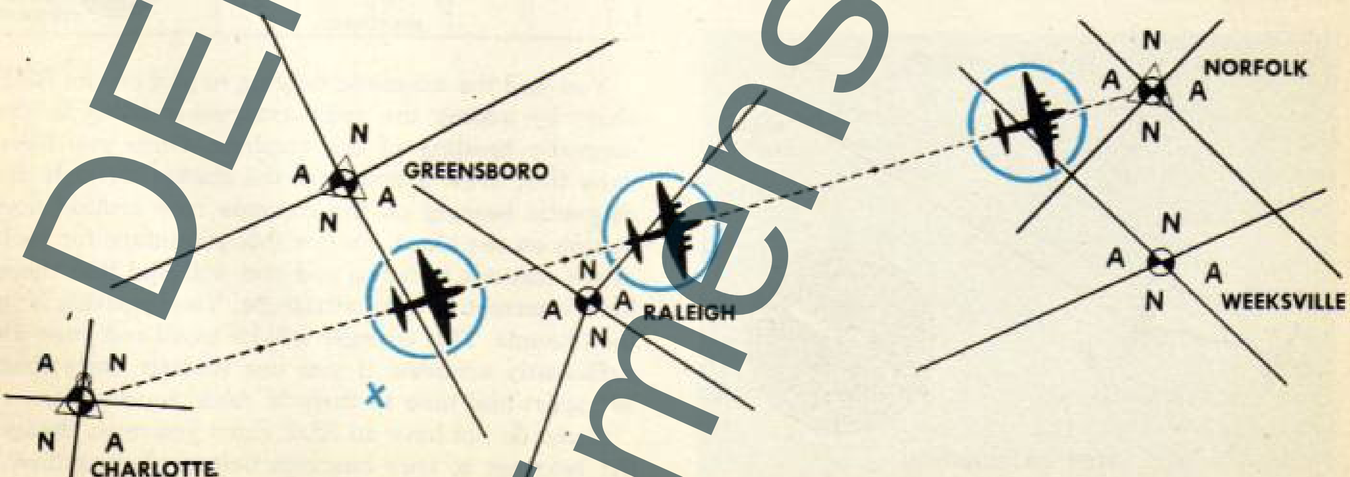
Radio in conjunction with visual checkpoints is an easy method of determining your position.



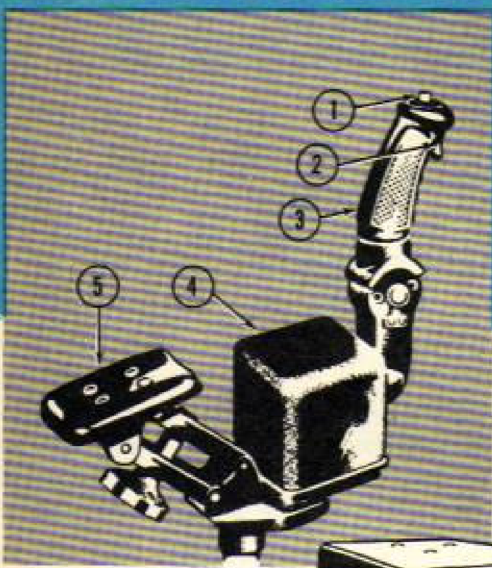
If you are flying off the airways you can find your exact position at the beam intersection by using both the beam and river as check points.

Radio Compass

The radio compass is a receiving apparatus which senses direction and therefore is a valuable navigational aid. When using the radio compass you depend upon the directional loop to determine your direction from the radio station to which you are tuned. The bearing indicator needle of the automatic radio compass points to 0° when the airplane is headed toward the station to which the set is tuned. A crosswind, of course, causes the airplane to drift to one side or the other of the bearing toward the station.



FORMATION STICK



FORMATION STICK AND JUNCTION BOX

1. TRANSFER SWITCH BUTTON
2. TRIGGER SWITCH FOR MICROPHONE
3. GRIP
4. CONTROL MECHANISM
5. ARM REST

The formation stick permits the pilot or copilot to maneuver an airplane quickly though using the autopilot. It gives him, with a minimum of physical effort, the additional control of the airplane necessary for formation flying.

In airplanes equipped with this device, there are 2 formation sticks in the pilot's compartment. One is at the pilot's left, the other at the copilot's right. Only one stick is engaged at a time. A control switch button on top of each stick makes it possible to transfer control from one stick to another.

The extent to which a pilot using the formation stick can control his plane through the autopilot depends on **function selector** setting. For example:

1. When function selector is OFF, autopilot operates normally and formation stick has no control.

2. When the function selector is at ON SERVO BOOST, the formation stick directly controls the servo units of the autopilot. The airplane must then be flown as if it had no autopilot, and as if the formation stick were connected directly to the control cables. The ON SERVO BOOST position is the best setting for the function selector when the airplane is flying in a tight formation and constant maneuvering is necessary.

3. When the function selector is at ON, the stick functions just as the autopilot turn control knob does, except that it provides elevator control as well as aileron and rudder control. This setting is best for lone flying, loose formation flying, or when little maneuvering is necessary.

4. When the function selector is at ON ELEVATOR ONLY, the formation stick controls the attitude of the airplane with respect to the pitch axis only. Moving the stick sideways has no effect on the aileron and rudder controls. This position is used on the bombing run when the pilot wants to use the formation stick instead of the elevator centering knob to control altitude.

The formation stick also has a trigger switch connected in the microphone circuit. It operates whether or not the formation stick or autopilot is engaged. This switch permits the pilot or copilot to use his microphone without releasing formation stick.

Release switches are installed in all airplanes equipped with the formation stick. These switches enable the pilot or copilot to release all three servo units quickly, thereby returning the airplane to manual control. The switches are conveniently mounted on the airplane's control wheels. They are effective whether the formation stick is in use or not.

Caution

Airplane must be level before function selector is turned from one position to another.

PDI must be centered when function selector switch is turned to ON SERVO BOOST.

Autopilot turn control must not be used when function selector switch is at ON SERVO BOOST.

SECTION **6**

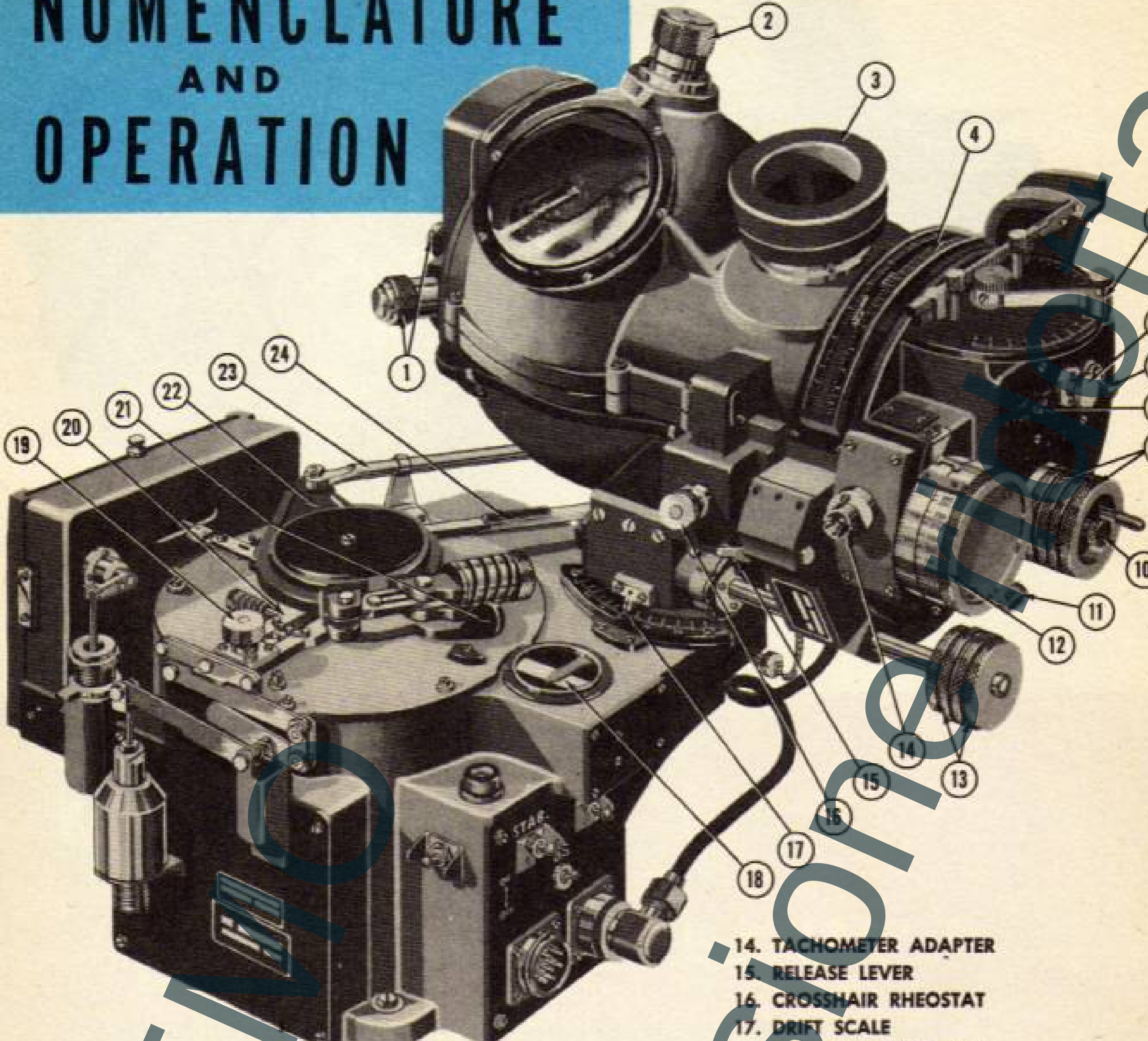
M-SERIES BOMBSIGHT . . .

You need to have a good understanding of how the bombsight solves the bombing problem, and what happens inside it when you turn the various knobs.

Your success as a bombardier depends not only on your own skill but also on the mechanical condition of your equipment. Accordingly you have to be able to make sure that your bombsight is working properly, as you do in the preflight inspection. You also need to know how to give it the care necessary to keep it in good condition. Even though there are usually maintenance experts available, you should know how to make field inspections and adjustments.

There are a number of attachments and modifications which extend the bombsight's range of operations. With the glide bombing attachment you can bomb accurately in climbs and glides as well as in horizontal flight. Anti-glare lenses help overcome bad conditions of visibility. The trail spotting device increases accuracy in train bombing. The reflex sight makes it easier to pick up the target. Trail and disc speed modifications enable you to bomb at exceptionally high altitudes and airspeeds.

NOMENCLATURE AND OPERATION



1. LEVELING KNOBS
2. CAGING KNOB
3. EYEPIECE
4. INDEX WINDOW
5. TRAIL ARM AND TRAIL PLATE
6. EXTENDED VISION KNOB
7. RATE MOTOR SWITCH
8. DISC SPEED GEAR SHIFT
9. RATE AND DISPLACEMENT KNOBS
10. MIRROR DRIVE CLUTCH
11. SEARCH KNOB
12. DISC SPEED DRUM
13. TURN AND DRIFT KNOBS
14. TACHOMETER ADAPTER
15. RELEASE LEVER
16. CROSSHAIR RHEOSTAT
17. DRIFT SCALE
18. PDI BRUSH AND COIL
19. AUTOPILOT CLUTCH ENGAGING KNOB
20. AUTOPILOT CLUTCH
21. BOMBSIGHT CLUTCH ENGAGING LEVER
22. BOMBSIGHT CLUTCH
23. BOMBSIGHT CONNECTING ROD
24. AUTOPILOT CONNECTING ROD

The bombsight has 2 main parts, **sighthead** and **stabilizer.** The sighthead pivots on the stabilizer and is locked to it by the dovetail locking pin. The sighthead is connected to the directional gyro in the stabilizer through the **bombsight connecting rod** and the **bombsight clutch.**

DISC SPEED AND TRAIL MODIFICATIONS

As ordinarily constructed, the M-series bombsight provides for a maximum trail value of 150 mils and a minimum disc speed of 102 rpm. These limits do not give sufficient range when you are bombing at exceptionally high altitudes and airspeeds.

The M-9 bombsight can be modified to permit trail and disc speed settings needed for bombing at altitudes up to 50,000 feet and airspeeds as high as 500 mph. Sights with trail modification only are designated M-9A. Sights with both disc speed and trail modifications are M-9B.

Disc Speed Modification

The disc speed modification gives you disc speeds of from 77 rpm to 186.5 rpm with the disc speed gear shift in low disc speed position. With the disc speed gear shift in high disc speed position you get disc speeds of from 186.5 to 450 rpm. These new speeds are obtained by changing the size of the gears on the rate motor shaft and the size of the idling gears in the disc speed change assembly.

Trail Modification

The trail modification permits you to set in trail values up to 230 mils. To obtain this greater range, the arc through which the trail arm swings is increased and the gear ratio between the trail arm and the nut gear is changed. An additional device is installed so that not more than 150 mils of trail can be set in the crosstrail mechanism.

TRAIL SPOTTING DEVICE

The trail spotting device permits you to reduce trail setting in the rate end without introducing an error in crosstrail. You use it in train bombing to get the center bomb, and thus the **mean point of impact**, of the train on the target. You can also use it when you want to reduce trail to compensate for RCCT error.

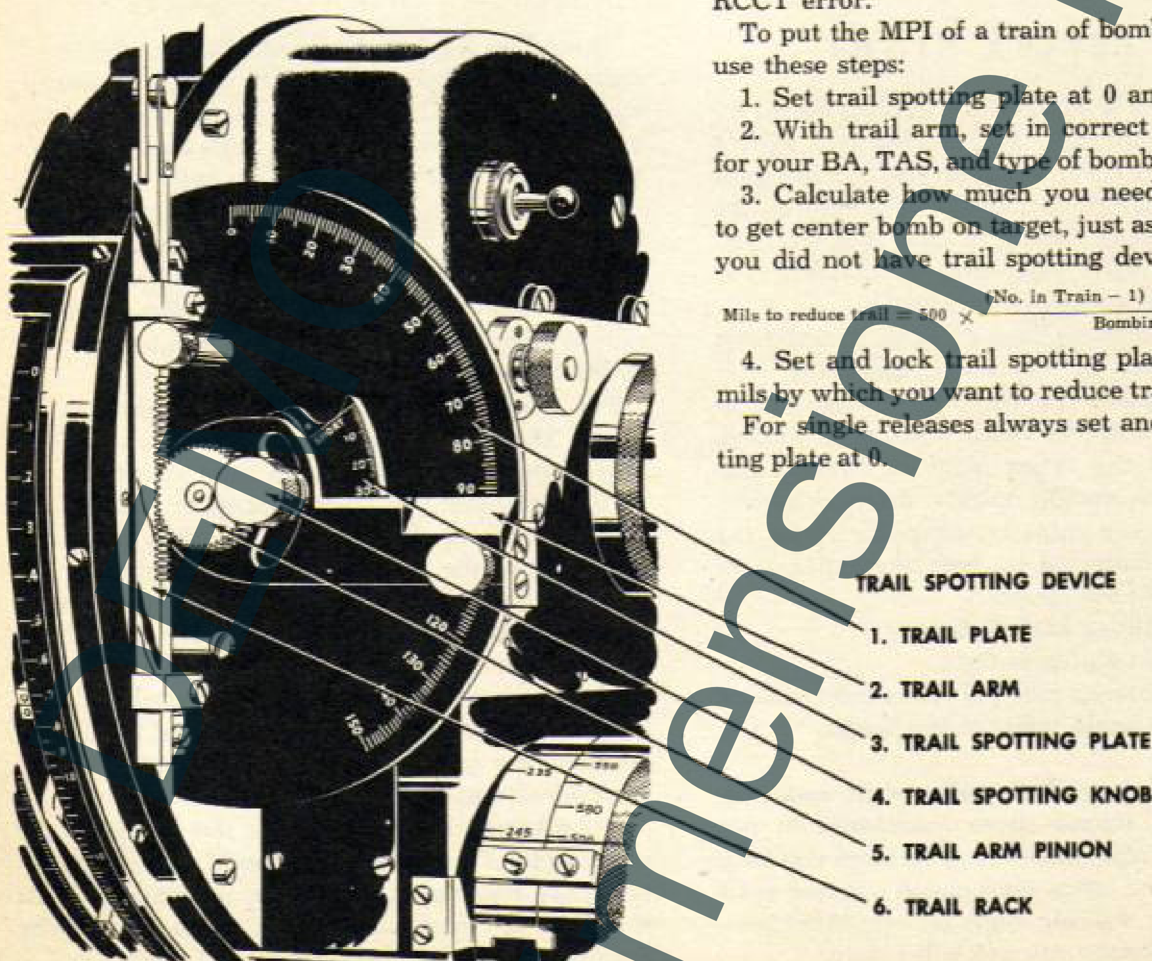
To put the MPI of a train of bombs on the target, use these steps:

1. Set trail spotting plate at 0 and lock.
2. With trail arm, set in correct amount of trail for your BA, TAS, and type of bomb. Lock trail arm.
3. Calculate how much you need to reduce trail to get center bomb on target, just as you would do if you did not have trail spotting device.

$$\text{Mils to reduce trail} = 500 \times \frac{(\text{No. in Train} - 1)\ (\text{Bomb Interval in ft.})}{\text{Bombing Altitude}}$$

4. Set and lock trail spotting plate at number of mils by which you want to reduce trail.

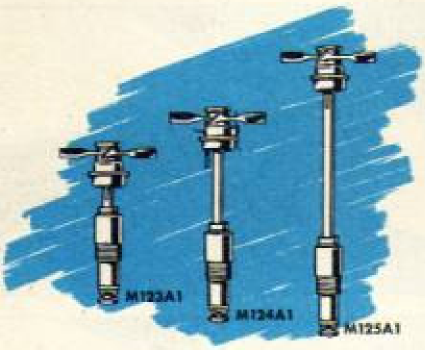
For single releases always set and lock trail spotting plate at 0.

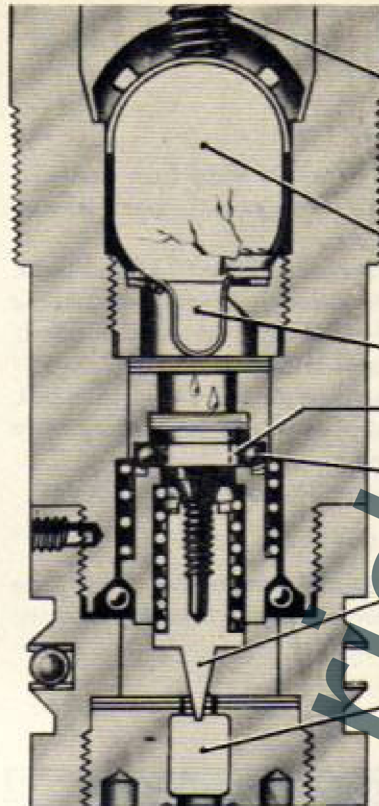


Arming Vane Tail Fuzes (M123A1, M124A1, M125A1)

These fuzes provide for delayed action of from 1 to 144 hours. The time delay is stamped on the fuze and cannot be seen after the fuze is in the bomb. **Caution: Never unscrew one of these fuzes, for the slightest attempt to do so detonates the bomb.**

The M123A1 fuze is used on 100 and 250-lb. GP bombs. The M124A1 fuze is used on 500-lb. GP and SAP bombs. The M125A1 fuze is used on 1000-lb. GP and SAP bombs and 2000-lb. GP bombs. These 3 fuzes differ only in size.





BOMB FUZES

CLASSIFICATION		ARMING	FUNCTIONING	BOMBS USED WITH:
AN-M103	NOSE FUZE	VANE	Selective: instantaneous or .1 sec. delay	All GP, light case, and depth bombs
M108		PIN	Instantaneous	100-lb. M47A2 chemical bomb
AN-M110A1		VANE	Instantaneous	20-lb. FRAG. bomb and 115-lb. M70 gas bomb
M111A2		VANE	5-93 sec. mechanical delay	M46 flare bomb
M118		VANE	4-5 sec. delay	All GP bombs
M119		VANE	8-11 sec. delay	All GP and depth bombs
AN-M120A1		PIN	Instantaneous	23-lb. AN-M40 and 23-lb. M72A1 FRAG. bombs
AN-M126A1		VANE	Instantaneous	100-lb. M47A2 gas bomb
AN-Mk219		VANE	Instantaneous	All depth bombs
AN-M100A2	TAIL FUZE	VANE	Interchangeable primer detonators for non-delay, .01 sec., .025 sec., or .10 sec. delay	100-lb. and 250-lb. GP bombs
AN-M101A2		VANE		500-lb. GP and SAP bombs
AN-M102A2		VANE		1000-lb. GP and SAP, 2000-lb. GP, 4000-lb. light case bombs
M112A1		VANE	Interchangeable primer detonators for 8-11 sec. or 4-5 sec. delay	100-lb. and 250-lb. GP bombs
M113A1		VANE		500-lb. GP and SAP bombs
M114A1		VANE		1000-lb. GP and SAP bombs, 2000-lb. GP bombs
M115A1		VANE	Interchangeable primer detonators for 8-11 sec. or 4-5 sec. delay	100-lb. and 250-lb. GP bombs
M116A1		VANE		500-lb. GP and SAP bombs
M117A1		VANE		1000-lb. GP and SAP, 2000-lb. GP bombs
M123A1		VANE	Marked for delay action of 1, 2, 6, 12, 24, 36, 72 or 144 hours	100-lb. and 250-lb. GP bombs
M124A1		VANE		500-lb. GP and SAP bombs
M125A1		VANE		1000-lb. GP and SAP, 2000-lb. GP bombs
AN-Mk228		VANE	.08 sec. delay	1000-lb., 1600-lb. AP bombs
AN-Mk229		VANE	Hydrostatic; selective depth setting of 25, 50, 75, 100, or 125 ft.	500-lb., 1000-lb. GP; light case, and 650-lb. depth bombs
AN-Mk230		VANE		500-lb., 1000-lb., and 2000-lb. GP bombs
M1A1		PIN	Instantaneous	100-lb. M38A2 practice bomb
AN-Mk224	LATERAL		Hydrostatic; interchangeable firing pin springs *See below	All depth bombs
AN-Mk234				

*For depths of 25 (yellow), 50 (black), 75 (black and green), 100 (yellow and red), and 125 (black and red) feet.

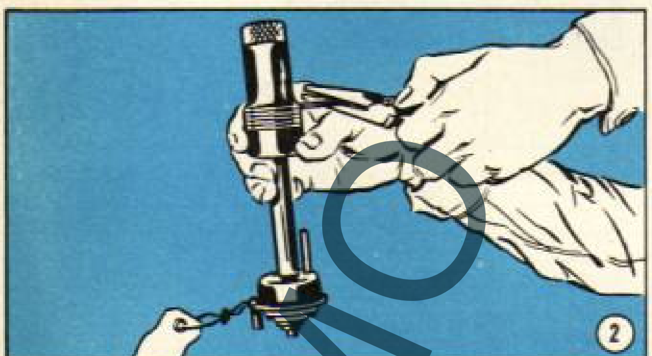
FUZE INSTALLATION

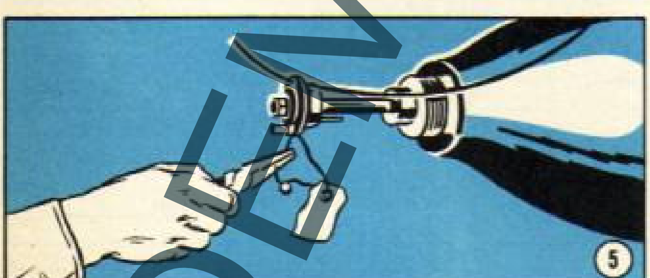
Tail Fuze

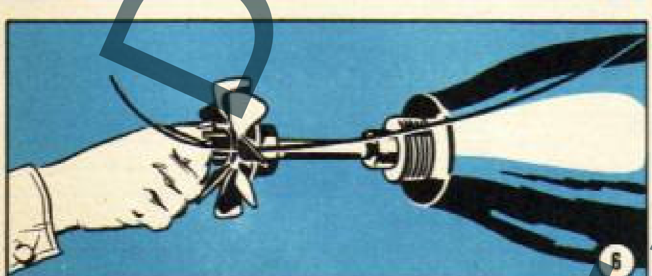
1. Remove tail plug; carefully wipe fuze cavity.
2. Remove fuze from container, inspect it, and withdraw safety cotter pin.
3. Insert fuze into cavity and screw in hand tight.
4. Pass arming wire through eyelets of arming wire holder. The fins must now be on the bomb.
5. Cut and remove seal wire.
6. Press vane into position and screw on vane nut.
7. Slip Fahnstock clip over end of arming wire and place flush with vane nut.
8. Snip off arming wire 2½ inches beyond clip.

Caution

Always know the type and functioning of any fuze you use. Then, if you have to make it safe or remove it in flight you will know how.

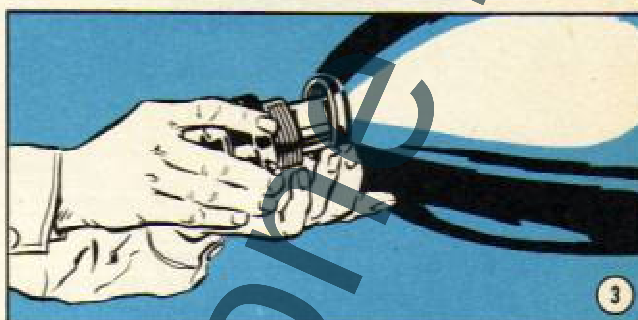


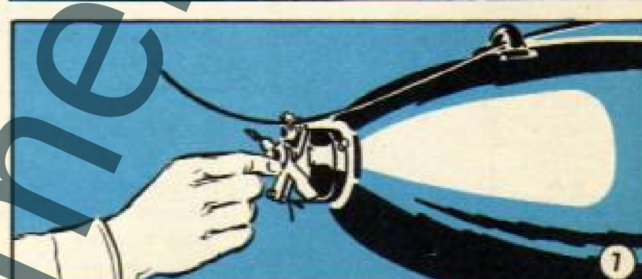




Nose Fuze

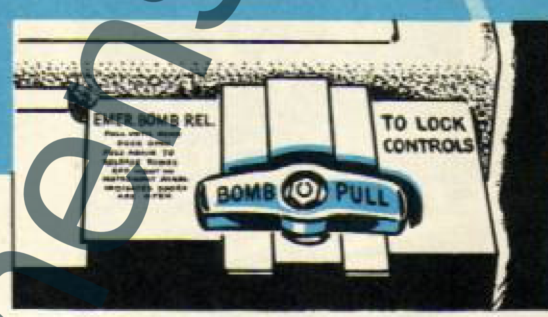
1. Remove nose plug and carefully wipe fuze cavity. Make sure no grit or dirt remains in threads.
2. Remove fuze from container and inspect it.
3. Insert fuze into cavity and screw in hand tight. Don't bump detonator against side of cavity.
4. Cut and remove seal wire.
5. Pass arming wire through eyelets of vane stop.
6. Slip Fahnstock clip over end of arming wire and place flush with vane stop.
7. Hold arming vane by hub, press it into position.
8. Snip off arming wire 2½ inches beyond clip.





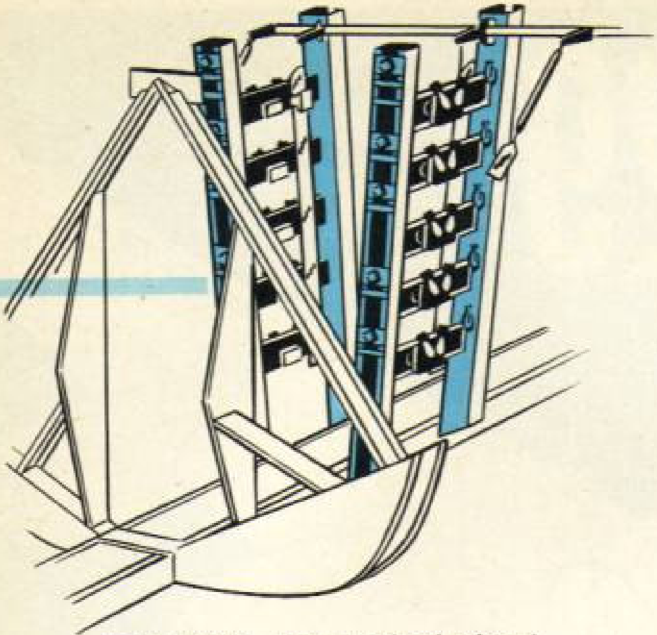
B-24 BOMB RACKS AND CONTROLS

AUXILIARY BOMB BAY DOOR RELEASE HANDLE

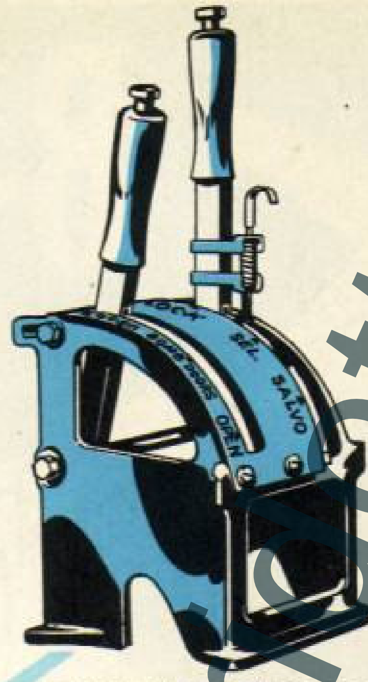


PILOT'S EMERGENCY BOMB RELEASE

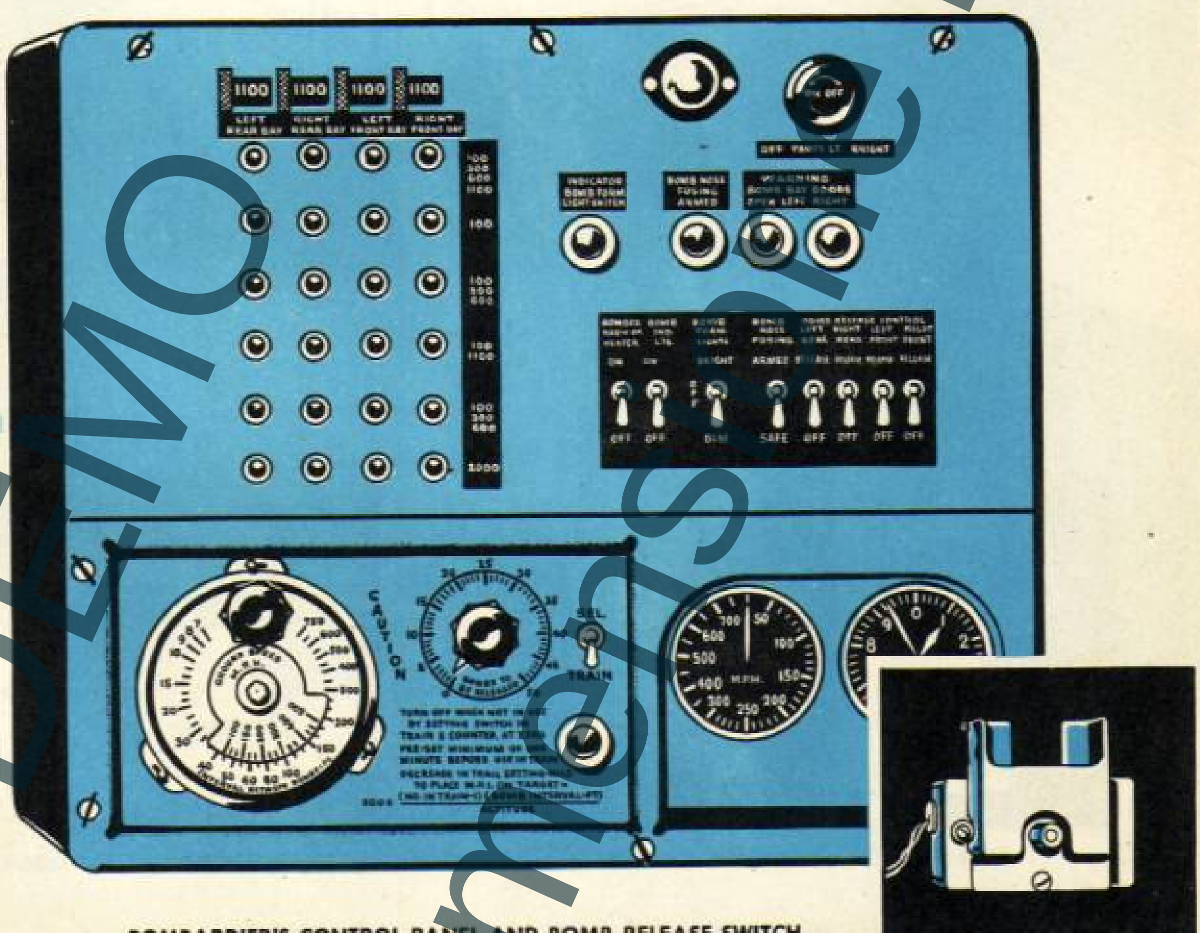
MECHANICAL-ELECTRICAL BOMB RACK CONTROL SYSTEM



BOMB RACKS (Using A-2 bomb release)



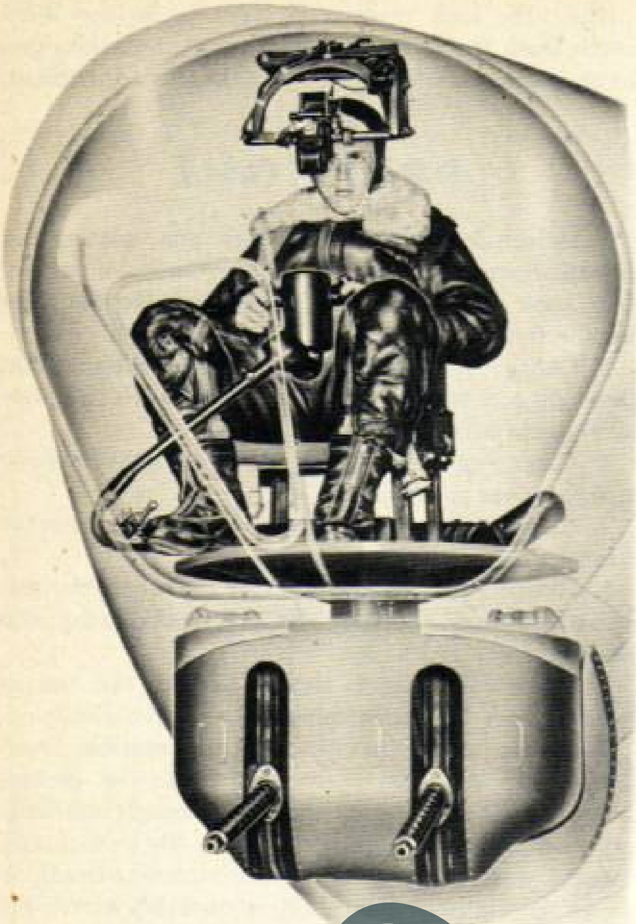
BOMBARDIER'S CONTROL STAND

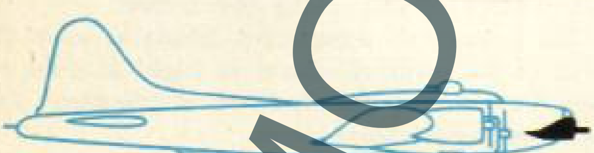


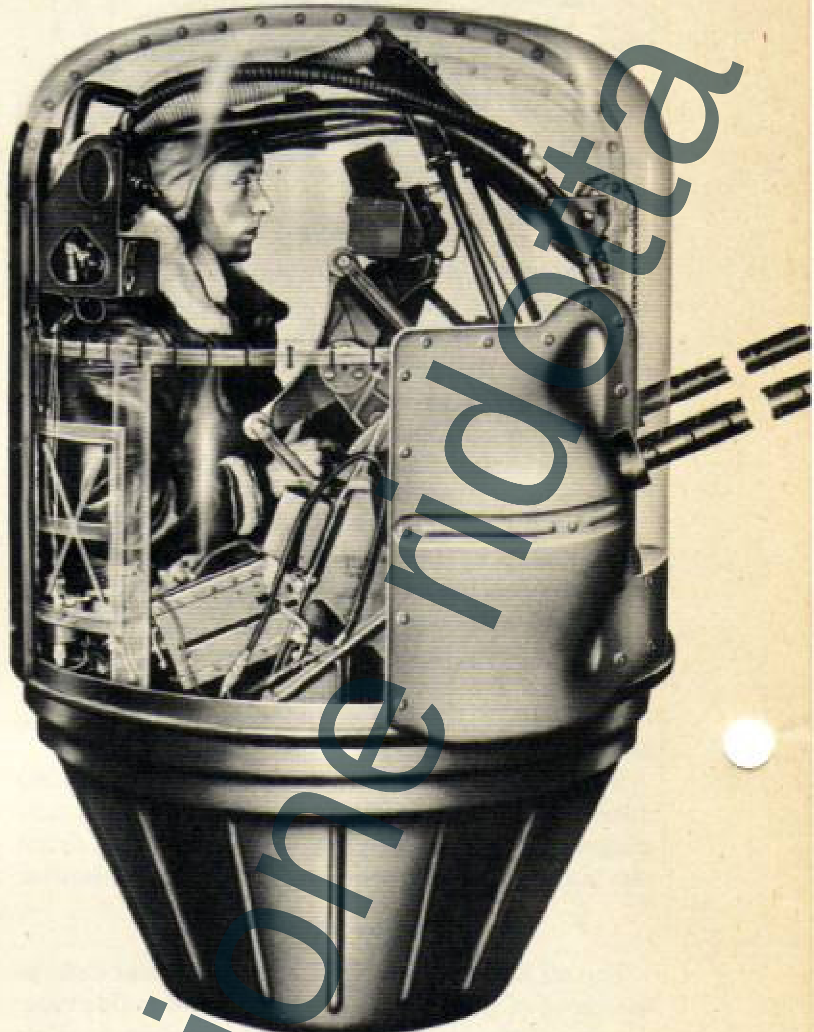
BOMBARDIER'S CONTROL PANEL AND BOMB RELEASE SWITCH

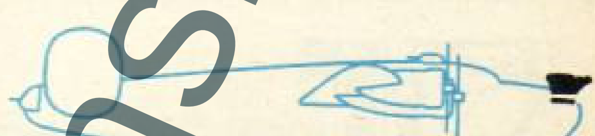
ALL-ELECTRICAL BOMB RACK CONTROL SYSTEM

GUN TURRETS









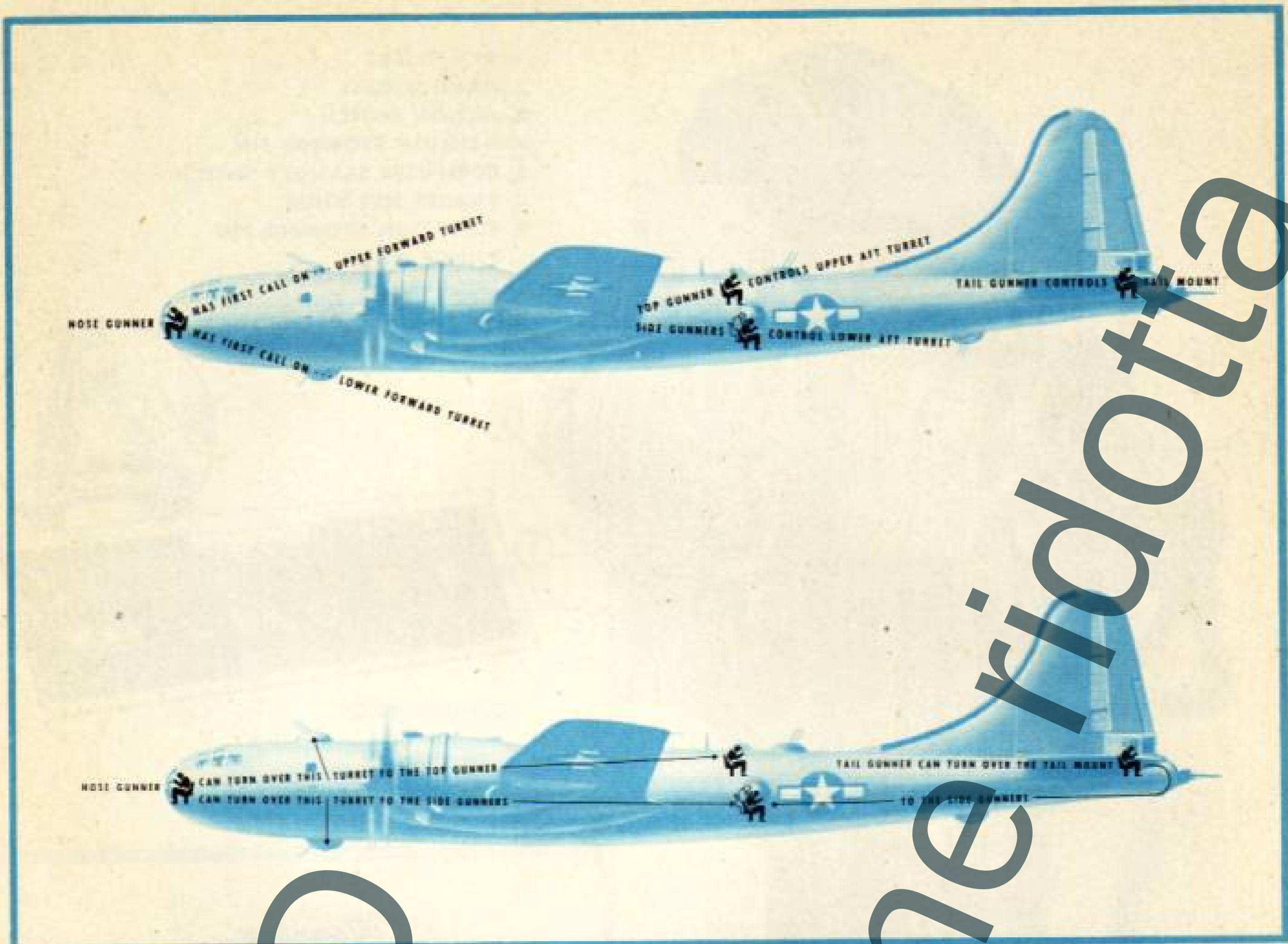
The bombardier is concerned primarily with those gun turrets he is most likely to operate. He is almost always responsible for control of the nose turrets in heavy and very heavy aircraft.

BENDIX CHIN TURRET (B-17)

The chin turret of the B-17 operates electrically by remote control from the bombardier's seat directly above it. It moves 86° to either side in azimuth, 26° above and 46° below horizontal in elevation. It uses the N-8 or N-6A optical gunsight. The bombardier's seat remains stationary; as he turns the gunsight, the guns swing around beneath. The bombardier's control unit, housing the gunsight, pivots out from its stowed position on his right and locks in place in front of him.

EMERSON NOSE TURRET (B-24)

The nose turret of the B-24 is an all-electric turret which uses the N-8 or N-6A optical gunsight. It moves in azimuth about 75° either side of the airplane's center line, and in elevation from 50° below horizontal to 60° above. It has 2 speeds, normal tracking and high. It contains armor plate, and bulletproof glass plate which moves with the guns.



REMOTE CONTROL TURRET SYSTEM (B-29)

The 4 turrets and tail mount of the B-29 all operate by remote control. The gunners sit at **sighting stations** inside the fuselage and manipulate their gunsights. Computers, connected to the sights, automatically figure deflections for any fighter within range.

A system of control transfer enables gunners to take over control of more than one turret for a single gunsight. For every turret there is a gunner who has **first call.** The nose gunner is given first call on the upper and lower forward turrets. This affords him the greatest possible fire power with which to meet a frontal attack.

If he doesn't need the lower turret, he can let one of the side gunners take it over. For instance, he might be using the upper turret to shoot at an enemy coming in high, while at the same time another hostile plane may be coming in low. In such a case, he would give one of the side gunners control of the lower forward turret. Similarly, he can release control of the upper forward turret to the top gunner.

In the nose sighting station there are 3 units of gunnery equipment that are of concern to you, the bombardier:

1. **Control box** with the necessary switches for operating the turrets and gunsight.
2. **Gunsight** and controlling equipment.
3. **Transfer switches.**

An auxiliary switch on the control box starts the compressor motors that operate the gun chargers. A **computer standby switch** turned to the IN position cuts the computing mechanism into the forward turret circuits.

To operate both forward turrets, turn both transfer switches to IN and press down on the **action switch.** The guns in both turrets then follow your gunsight and fire when you press the trigger.

TACTICAL VARIATIONS *by Theater*

Although there is no essential difference in bombing technique in the various theaters of operations, you must always consider the following factors in the particular theater in which you operate:

Type of weather in target area

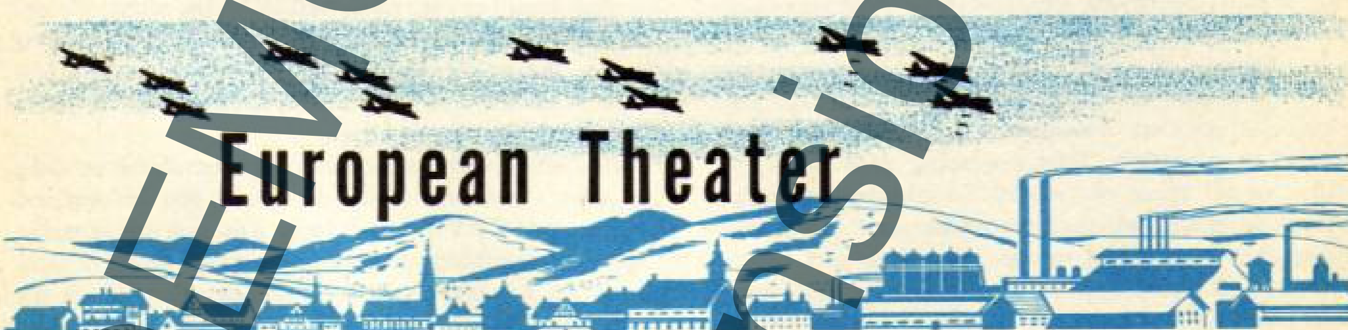
Similarity of terrain which makes targets hard to identify

Seasonal variation in terrain appearance

Type and magnitude of enemy defenses

Depending on the theater, targets vary in tactical and strategic importance. Your sighting methods are different when you make use of radar rather than visual means.

Learn all you can about the theater to which you are assigned, from experienced men on the spot. They can give you tips on target identification, evasive action, camouflaged areas, which you will never find in books.



European Theater

In this theater a vast body of experience in bombardment has been accumulated by the several air forces involved. Meteorological data and information on enemy defenses are extremely comprehensive.

Missions are planned with meticulous attention to detail. Wind, cloud formation, AA defenses, and proximity to fighter airfields are all considered in planning the route to the IP.

The IP for bombing approaches invariably is a readily identifiable landmark located as near the target as possible. Some attempt is usually made to confuse the enemy radio direction finders by laying the course of the formation midway between two strategic targets, by dispatching diversionary bomber raids and fighter sweeps, or by using chaff or a similar radar-jamming material.

SECTION **9**

EMERGENCIES AND PRECAUTIONS...

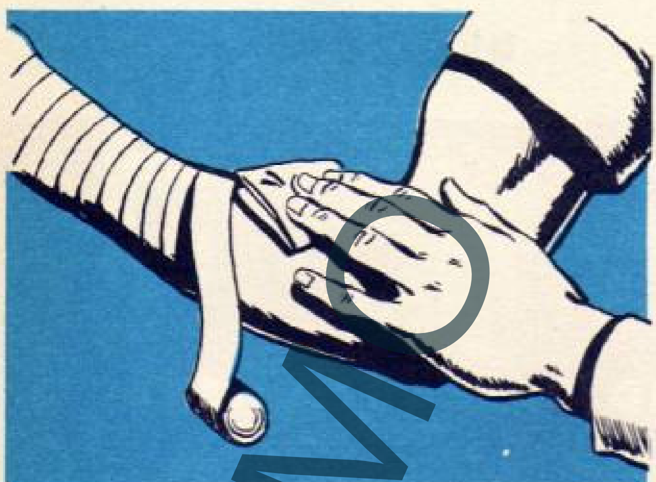
It is not enough to master the exacting details of successful bombing. To be of maximum value to an airplane's crew you must know how to keep yourself physically fit to endure bone-wearying flights without dangerous loss of efficiency. You must know how to give first aid to wounded crew members, recognize the hazards of high altitude, know when and how to use oxygen, what to do if the airplane's oxygen equipment fails. You must know how to improve your vision for bombing at night, how to fight fires in flight. A confident knowledge of emergency equipment and how to use it is vital if you have to bail out or the pilot must ditch your bomber. You should know how to signal for help after a crash landing. In this global war, you also need to learn how to be healthy and strong in any kind of climate.

Your airplane is a good first-aid station. You have the Kit, First-Aid, Aeronautic, and the Packet, First-Aid, Parachute. Oxygen is frequently available. Splints, or splint materials, are at hand. Hot drinks are often carried in thermos jugs. In certain bombers you will be provided with blood plasma. Familiarize yourself thoroughly with the first-aid supplies which you carry, and get clearly in mind just what you can do with them.

Wounds and Injuries

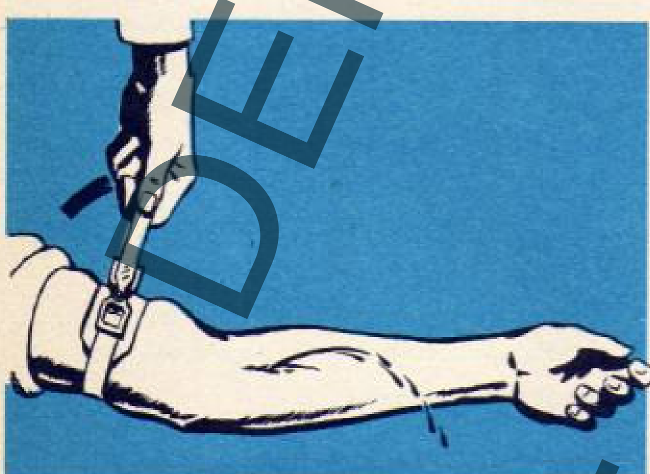
Wounds and injuries involve one or more of these problems: **pain, cuts, bleeding, broken bones, burns, frostbite, shock, and unconsciousness.** Generally you will have to deal with combinations of these, such as cuts which are bleeding, burns that cause pain, broken bones associated with cuts or burns, and so on. Shock usually comes on after a good deal of blood has been lost either inside the body (where you may not be able to see it), or on the outside. Shock also accompanies deep or extensive burns. Unconsciousness may be produced by a head injury, may follow shock, or may occur as a result of failure to get enough oxygen.

In giving first aid, try to size up the general situation accurately. Then attend to the most serious problems first. Above all, use common sense.



Cuts and Bleeding

1. Expose wound by cutting nearby clothing with scissors.
2. Cover cuts with sterile dressings and apply firm pressure.
3. If this does not stop the bleeding, elevate the bleeding part.
4. If these measures fail to stop bleeding in arms or legs, apply a tourniquet in the middle of the upper arm or middle of the thigh. The tourniquet must be released every 15 minutes for at least a few seconds, depending upon the amount of bleeding.



Tourniquet (Warning)

A tourniquet must be removed, or temporarily released, every 15 minutes. **Failure to release the tourniquet often enough or long enough to provide an adequate circulation to the blocked portion of the arm or leg may necessitate amputation later.**

Pain

Use morphine at once for severe pain. This makes it possible for the patient to lie quietly, preventing aggravation of the injuries. Do not use more than one tube (½ grain) of morphine at any one time.

When giving morphine, mark down the time and dose on the patient's forehead or clothing with a pencil. Remember that an excess of morphine can be fatal. Do not give morphine to a person who is unconscious, who has a head injury, or who is breathing less than 12 times per minute.

To Give Morphine

1. Paint any small area of skin with iodine.
2. Remove the transparent cover from the morphine syrette.
3. **Push in the wire loop to puncture the inner seal;** then pull the wire out.
4. Thrust the needle through the skin, using care not to press morphine out of the tube while doing so.
5. Squeeze the tube slowly to inject the morphine.

Shock

You can tell when a patient is in shock by the total picture he presents rather than by any single sign. Usually he will have:

1. Lost considerable blood, or
2. Suffered severe burns, or
3. Been subjected to intense pain, or
4. Received a head injury.

His skin is pale, cold, clammy, or moist.

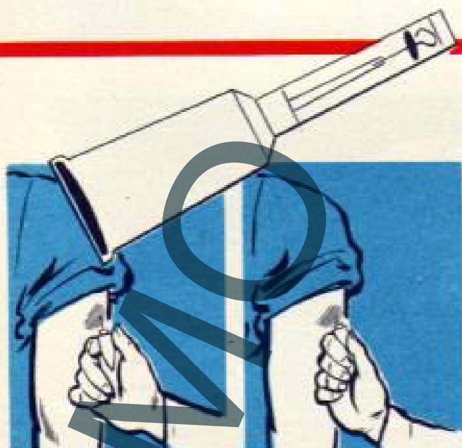
His breathing is shallow, and may be irregular.

His pulse is weak, rapid, thready, and often difficult to find.

Sometimes there is nausea and vomiting.

Treat shock by doing the following things as promptly as possible:

1. Stop any obvious bleeding.
2. Give pure oxygen to breathe. (Auto-Mix OFF)
3. Give morphine. (Exception: Head injury)
4. Keep the patient warm with blankets, extra clothing, or a sleeping bag, but avoid excessive heat.
5. Loosen any tight clothing.
6. Place the patient with his head slightly lower

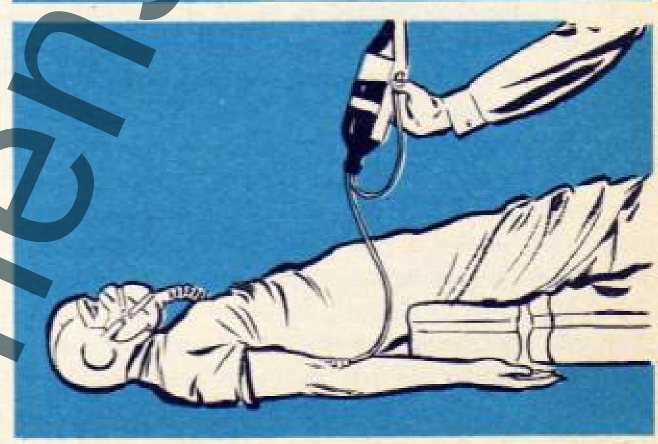


Give Morphine:

1. To stop pain.
2. To decrease shock.
3. To facilitate moving the patient.

Don't Give Morphine:

1. To an unconscious person.
2. To a person with a head injury.
3. To a person who is breathing less than 12 times per minute.



than his feet, to promote better circulation to the brain.

7. Inject plasma, when it is available, in accordance with the directions on the plasma package.

Fractures

1. If a broken bone is associated with a cut, sprinkle with sulfa powder and cover with a sterile dressing. If the dressing is firmly bound in place it will almost always stop the bleeding.

2. Give morphine.

3. Apply a temporary splint to the part, using wood, strips of metal, heavy cardboard, or any convenient pieces of equipment such as a machine gun barrel or fire ax.

4. **Do not attempt to set the bone. Manipulation causes shock.**

Burns

For minor burns:

Squeeze burn ointment onto a sterile dressing. Then cover the burn gently with the dressing.

For severe burns:

1. Give morphine.

2. Treat shock. (Oxygen; plasma, if available)

3. Apply burn ointment on sterile dressings, **and bind the dressings gently but firmly in place.**

4. Never open blisters resulting from burns.

For eye burns

Apply Metaphen ophthalmic ointment directly to the eyeball. Then apply the boric acid ointment to the inner surface of the eyelid. Cover the eye with a dressing and secure in place with adhesive strips, provided the skin around the eye is not burned. Do not touch the eye with your fingers, and do not rub it—either before or after the ointment has been applied.

Transportation of Wounded

If it becomes necessary to move an injured crew member improvise a litter with 2 poles and a pair of flying jackets. Turn the sleeves inside out and insert the poles through them. Then close the jacket over the outside of the poles. Additional support can be obtained by using boards or cardboard splints inside the jackets. Litters can also be improvised with poles and blankets. Take great care to be as gentle as possible in moving an injured person onto a litter. Keep his body as flat as possible at all times. Have 3 or more persons move and support him by placing their arms under his legs, buttocks, back, shoulders, and head.

Unconsciousness and Near-Unconsciousness

Oxygen lack, carbon monoxide poisoning, and head injury are important causes. Immediate treatment is vital, especially if breathing has stopped.

1. Give artificial respiration:

First, lay the patient face down with one arm bent at the elbow, his face resting on his hand, and his other arm extended beyond his head.

Second, open his mouth and remove all foreign substances such as false teeth and chewing gum. If his tongue has fallen back into his mouth, grasp it with your fingers and pull it well forward.

Third, give him pure oxygen (Auto-Mix OFF) **If the patient has stopped breathing, turn on the emergency flow.**

Fourth, kneel astride the patient's thighs with your knees about even with his. Place the palms of your hands against the small of the patient's back, with your little finger over the lowest rib.

Fifth, with your arms stiff, swing your body forward slowly so that your weight is applied over the patient's back. This should take about 3 seconds.

Sixth, release your hands with a sudden snap and swing backward to remove all pressure from the patient. After about 2 seconds repeat the cycle.

Continue giving artificial respiration without stopping for 2 hours or longer, unless the person to whom it is being given begins to breathe normally.

2. Keep the patient warm.
3. Do not give morphine.

Frostbite

1. Fingers, toes, ears, cheeks, chin, and nose are the parts most frequently affected.
2. Numbness, stiffness, and whitish discoloration are the first symptoms.
3. Wrinkle your face to find out if it is numb; watch for blanched faces of your crew mates.
4. If frostbite occurs, warm the affected part gradually. Never rub or attempt to thaw it rapidly.
5. If blisters develop, do not open them.

Failure of Oxygen Supply

If a crew member's oxygen supply fails above 10,000 feet, make every effort to replace his equipment or give him an emergency supply. If this is not practicable, notify pilot. He will descend to 10,000 feet as fast as safe operation permits. Loss of oxygen above 20,000 feet is critical, but there is no need for panic. **Get oxygen, or get down.**

Wound Disinfectants

1. Sprinkle Sulfa powder in open wounds.
2. Use iodine only for small cuts and scratches, which should not be covered by a dressing.
3. Never put iodine on or into large or deep wounds.

FIRST AID KITS

CONTENTS

OUTSIDE PACKET

- Iodine swabs, (1 package)
- Bandages, gauze, adhesive, 1 pack

LARGE COMPARTMENT

- Dressings, first-aid, large (2)
- Dressing, first-aid, small (1)
- Bandage, gauze, compress (1)
- Morphine Tartrate, ½ gr., 2 tubes
- Water Purification Tablets, halazone, 1 bottle
- Scissors, 1 pair
- Burn-Injury Set, boric acid ointment (1)
- Eye-Dressing Set (1)
- Sulfanilamide Crystals, 5 gram, 5 envelopes
- Sulfadiazine, 0.5 grm., 8 tablets
- Tourniquet (1)

The **Kit, First-Aid, Aeronautic** is a standard unit in all military aircraft (Medical Department Supply Catalog No. 9776500). It is designed for use of air crews and should not be opened by ground personnel unless there is urgent need. The contents of the main compartment are protected by a sealed zipper. Break the seal only when you need the contents of the inner kit for the treatment of injuries. A small packet on the outside of the kit contains iodine swabs and adhesive bandages for the treatment of minor injuries. When the seal has been broken, notify your Personal Equipment Officer or Medical Supply Officer, so that he can check the contents and replace missing items. Keep your kit intact. Make sure it is sealed. Your life may depend upon it.

KIT, FIRST-AID, FOR PNEUMATIC LIFE RAFT

Medical Supply Catalog No. 9776900

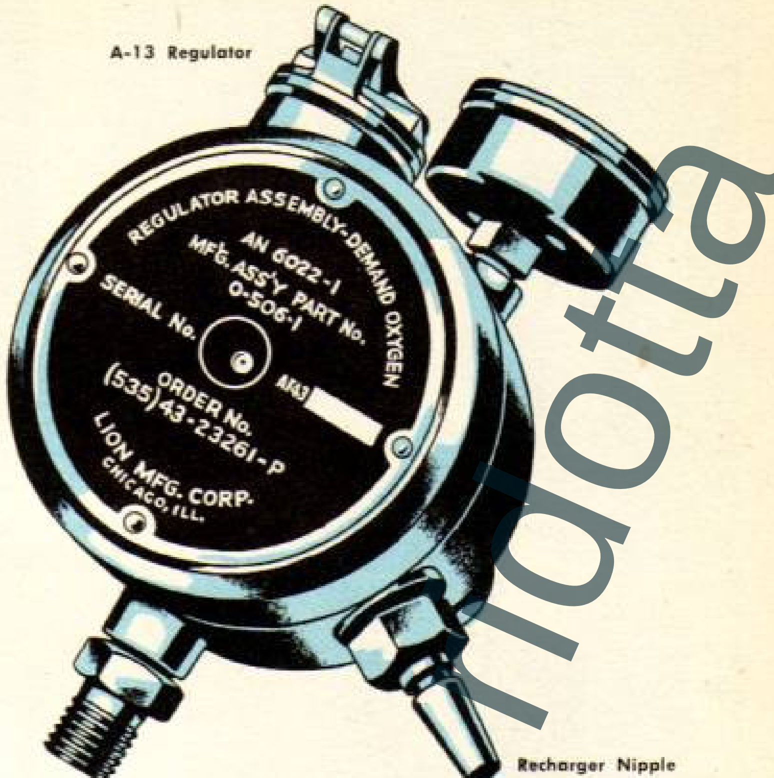
This is a part of the life raft kit (See BIF 9-17-2). It contains morphine syrettes, bandage compresses, sulfanilamide powder, sulfadiazine tablets, and burn ointment.

PACKET, FIRST-AID, PARACHUTE

Medical Supply Catalog No. 9778500

To be attached to the parachute harness or Mae West life vest for constant availability. Should be carried in gun turrets and other cramped spaces where the larger Kit, First-Aid, Aeronautic is not accessible. Contains tourniquet, morphine, wound dressing, 8 sulfadiazine tablets, and 5 envelopes of sulfanilamide crystals. You can open the packet by tearing either end of the outer container at the notch.

PORTABLE OXYGEN EQUIPMENT



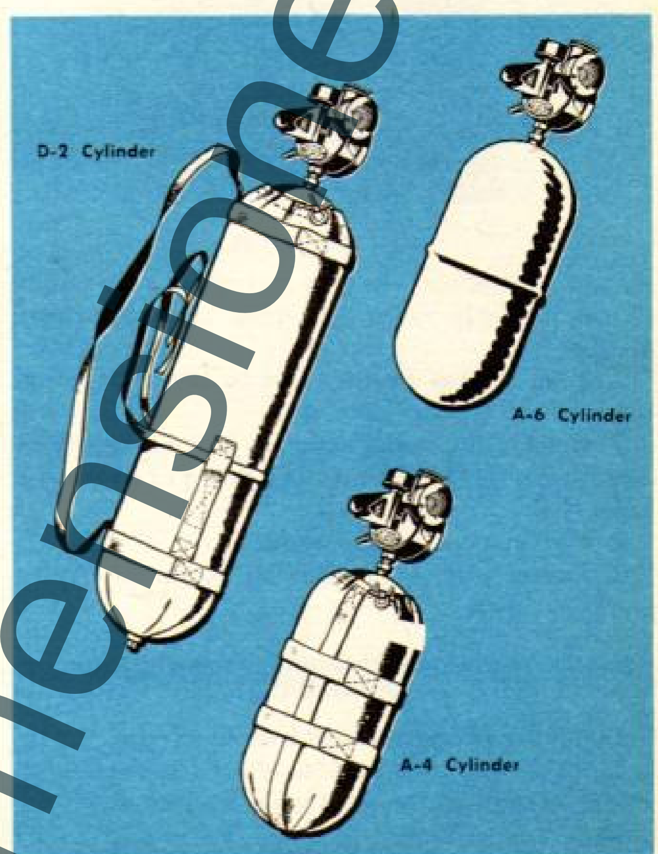
Walk-Around Bottle

Large airplanes are provided with portable oxygen equipment consisting of walk-around oxygen cylinders and regulators. This equipment allows you to walk away from your oxygen station in the plane and provides an emergency source of oxygen.

Three types of portable assemblies are in use:

1. The A-4 cylinder and A-13 regulator. Duration of supply, 3 to 8 minutes.
2. The D-2 cylinder, which has a harness for the shoulder, and A-13 regulator. Duration of supply, 20 to 50 minutes.
3. The A-6 cylinder and A-15 regulator, which has clip for attachment to the clothing or parachute harness and an Auto-Mix mechanism (but no lever). Duration of supply, 15 to 40 minutes.

The duration of supply is variable, depending upon the altitude and how much work you are doing. The only safe rule for using walk-around equipment is to watch the gage. Fill your cylinder before take-off and refill it from the plane's oxygen system whenever the pressure falls below 100 pounds per square inch.



To Use the Portable Unit

1. First check the pressure gage to make sure the pressure is at least that of the airplane's oxygen

H-2 BAILOUT BOTTLE

system. If it is not, recharge the cylinder by means of the portable recharging hose at each oxygen station.

2. Take a deep breath, hold it, then disconnect mask hose from regulator hose.

3. Quickly lift spring cover on walk-around regulator and plug in tight the male fitting of your mask hose.

4. Now start to breathe again.

5. Fasten unit to yourself by means of clip or shoulder strap.

On all flights above 30,000 feet. Keep your bail-out bottle connected to your oxygen mask. This gives you most protection in an emergency.

Oxygen for Ditching

If you have to ditch, prepare for underwater escape from your plane by wearing your oxygen mask connected to your walk-around bottle and A-13 regulator. The duration of the A-4 portable cylinder is short under water, but with the D-2 portable cylinder you can breathe for about 6 minutes at a water depth of 10 feet.

6. Watch for twisting or kinking of hose.

7. **Keep bottle filled! Refill at 100 pounds!**

8. Never leave your oxygen station at high altitude without a walk-around bottle.

BAILOUT OXYGEN CYLINDERS

H-1 BAILOUT BOTTLE

Two bailout oxygen cylinder assemblies are available for parachute descents from high altitudes. Both are completely self-contained units with pressure gage and release valve.

Either cylinder must be tightly fitted and securely tied in a pocket sewn to the flying suit or harness.

Before takeoff, check the cylinder's pressure gage. It should read at least 1800 pounds per square inch. Either cylinder assembly can be used in parachute descents above 30,000 feet. Sometimes it is used as an emergency oxygen supply in fighter aircraft if the regular oxygen supply suddenly fails.

Type H-1: Before jumping, grip pipe stem between your teeth and completely open flow valve.

Type H-2: Before jumping, pull the release to open flow valve. Then, disconnect the main oxygen tube and tuck it inside your jacket. If this is impossible hold your left hand over the free end. Then jump, keeping free end of main oxygen tube covered until parachute opens.

FLAK SUITS

Flak suits consist of armored vest and apron assemblies. They are not personal issue, but they should be delivered to the plane before the flight and picked up afterward for inspection. You couldn't carry one anyway, with everything else you're lugging. Report to the pilot if you don't find a flak suit in the plane for you.

Wear the suit when you approach the target area. It's heavy but it's guaranteed that you won't notice the weight when the fight begins to get hot.

Note: Ask your Personal Equipment Officer to have a tab sewed on your flak suit for your oxygen mask hose clip.

Bombardier's flak suit has full armor. When he pulls ripcord at suit's center, entire suit falls off.

FLAK HELMETS

The flak helmet is personal issue. If you have worn both your flak suit and flak helmet on the mission, you have a good chance of returning the helmet to the supply room **personally** after the flight.

VISION AT NIGHT

Some animals see as well at night as during the day. Man cannot. But your efficiency in night flying and your effectiveness in night combat depend on your night vision. Learn how to improve it.

Night vision differs from day vision. In daylight the center of the retina, or lining of the eye, is the most sensitive part of the eye. At night, however, the center of the retina can't see at all. It is called the night blind spot. In dim light the off-center parts of the retina are most sensitive. Try it. You see best at night when you look slightly off-center or to the side of the object you wish to see. The off-center parts of the retina also detect movement more easily than does the central part.

When searching the sky, earth, or surface of the sea at night, the most effective and simplest method is scanning. Keep your line of sight fixed in one direction for about a second. Then move your eyes or head in jumps of 10° to 20°, as in reading a book, and pause for a second or two at the end of each jump. In this way you cover the entire field in a series of eye or head movements and pauses.

If you remain in a dark room your eyes gradually see things which they could not see at first. This is known as **dark adaptation.** By adapting your eyes to darkness you increase their sensitivity 10,000 times. That is, after only 30 minutes in the dark you can see a light 10,000 times dimmer than any you could have seen in bright light. You can also adapt your eyes in a light room by wearing red-lensed goggles. It takes a half-hour to adapt to dark, but you lose your adaptation temporarily by exposing your eyes to bright light for only a brief period.

The retina is highly sensitive to oxygen lack. So on all night flights, except low altitude training missions, **use oxygen from the ground up.** It pays.

Ability to see at night depends upon your body's content of Vitamin A, obtained chiefly from eggs, butter, milk, cheese, liver, carrots, squash, peas, apricots, and peaches. Eat them liberally.

Dirt, oil, and scratches on your plexiglas windows or goggles make night vision more difficult. They scatter light and produce glare. Keep your goggles and the plexiglas nose scrupulously clean and free of scratches.

Aids to Night Vision

Adapt to the dark. Stay in a dark room or wear red-lensed goggles (Goggles, Assembly, E-1, Class 13, Stock No. 8300-331450) for a half-hour before any night operation.

Protect your adaptation. Don't expose your eyes to bright lights before takeoff or during flight, either inside or outside airplane.

Avoid lights. Keep all non-essential lights in plane turned out and dim all essential lights.

Make readings fast; then look away. Don't look too long at lighted instrument panel or charts. Or use only one eye; the other will retain its dark adaptation.

Use red light in your compartment, if possible. But remember then that red lines will not show as red on your charts.

Use oxygen from the ground up on night flights.

Keep plexiglas nose and goggles clean and free of scratches.

Avoid looking at white paper or other white objects; they reflect light.

Practice off-center glances at night.

Get enough Vitamin A. Eat the proper foods.

Don't Stare at Night

If you stare at a light in a dark room, you soon think the light has begun to move. The same thing happens when you stare at a light outside the cockpit while flying at night. Don't stare at the tail light of your lead plane when flying formation at night.

Fire Fighting

Use all extinguishers applicable and always aim at the base of the fire.

Keep your parachute away from the fire. Put it on as soon as possible.

Move to your proper position for bailout when a crash seems imminent.

Engine Fires

At the first sign of a fire, if conditions permit, the pilot will take all necessary action to control it from the cockpit. His actions depend upon the type of equipment he has.

In any engine fire your only duty is to give the pilot any useful information you have and to stand by for orders.

Flare Fires

If flares in the racks ignite, release the flares at once. Pry them loose if they stick in the racks.

Fuel Tank Fires

1. Locate source of fire.
2. Inform pilot.
3. If fire is accessible, use hand equipment in addition to the built-in equipment.

Cabin Fires

1. Give pilot and radio operator necessary information.
2. Close windows and all openings.
3. Locate source of fire.
4. Use all extinguishers available. (Open windows as soon as the flames are extinguished.)

Other Fires

The pilot will attempt to extinguish wing fires or drop tank fires by slipping the airplane away from the fire or dropping the tanks.

Your only duty is to give the pilot whatever useful information you can provide.

> In case fire occurs while the airplane is carrying bombs, at pilot's command salvo bombs. Then close bomb bay doors immediately.
>
> In case of fire when the airplane is not carrying bombs, don't open emergency hatches or bomb bay doors in the air, except for bailout. External fires may be drawn into the cabin. Drafts will cause cabin fires to flare up.
>
> Open emergency hatches just before landing, if fire makes a crash landing necessary, to permit escape or rescue.

On the Ground

If a fire occurs while the pilot is starting the engines:

1. Help other crew members use portable fire-fighting equipment.
2. **Notify tower to rush crash equipment.**
3. Make sure everyone has cleared the airplane.
4. Remove the bombsight.

DEATH STRIKES WITH WHIRLING BLADES

More than half a hundred persons were killed or seriously injured at Army airfields in continental United States during 1944 when they were struck by revolving propellers. One-fifth of those who died were fatally injured by walking into propellers during the excitement of leaving a burning airplane or hurrying to put out such a fire.

Don't lose your head if a fire occurs! Remember, if the airplane's engines are still running, their propellers are a far greater potential menace to you than the flames.

In nearly every case, inexcusable negligence caused these propeller accidents. Of the bombardiers who were killed, two alighted from B-24 airplanes through the bomb bay and walked into the No. 3 propeller. A third, carrying camera equipment, **attempted to walk between the fuselage and the No. 3 propeller.**

Fire Fighting Equipment in Airplanes

LEARN THE LOCATION AND PROPER USE OF FIRE EXTINGUISHING EQUIPMENT INSTALLED IN YOUR AIRPLANE

"Fyr Fyter" hand-type fire extinguishers, having a carbon tetrachloride base, are found in most airplanes. Use this extinguisher primarily for fighting fires in the cockpit or cabin. It is unsuitable for extinguishing fires outside the fuselage during flight.

Aim at the base of the fire, remembering that your supply is limited and must be used effectively. The "Fyr Fyter" extinguisher in your plane has enough fluid to last for about one minute of continuous use. Its effective range is approximately 20 feet.

CO_2 hand-type fire extinguishers, using carbon dioxide, also are found in large airplanes. Use this extinguisher for fighting fires inside the airplane.

The CO_2 extinguisher has an effective range of only 3 feet. The charge will last only 15 to 30 seconds, according to size of the unit. So aim at the base of the fire and move in close, on the upwind side. **Then pull the trigger release, directing the CO_2 straight at the base of the fire.** Move the discharge nozzle slowly across the flame area.

AIM AT BASE OF FIRE

Know the location of all extinguishers, their limitations, and how to use them.

AIM BEFORE PULLING TRIGGER

Both of these extinguishers are effective in combating fuel, electrical, and wood or fabric fires. CO_2 is rapid, clean, and easy to use. However, because of the small quantity in the cartridge, it might not be final in action.

Built-in CO_2 (carbon dioxide) systems are installed in some types of airplanes, so that engines, hulls of amphibians, gasoline tank compartments, or even cargo sections may be flooded with carbon dioxide gas in case of fire. First, set the extinguisher selector valve to direct the CO_2 charge to the desired location. Then pull the release handle. The operating controls are marked clearly to indicate their method of use.

Precautions

Stand back, but within effective range, when using the "Fyr Fyter" carbon tetrachloride extinguisher. Open windows and ventilators after fire is extinguished. **The fumes generated are poisonous.** See a doctor as soon as you land if you have inhaled excessive amounts of the gas or have swallowed even a small quantity of the liquid.

Don't touch any portion of the discharge nozzle of the CO_2 extinguisher. The extremely cold temperature of the carbon dioxide may cause severe burns.

Parachutes

All persons aboard Army airplanes will be equipped with standard-type parachutes. Wear your parachute whenever possible. The pilot will see that all persons aboard have parachutes, are instructed in their use, and know the bail-out plan. It is an excellent precaution to carry an extra parachute in multiplace airplanes.

CORRECT LANDING POSITION

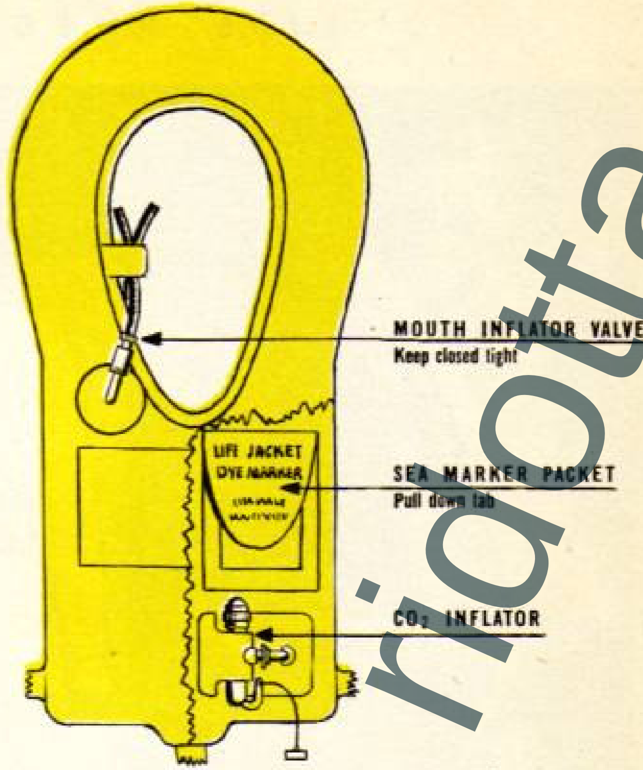
BEFORE THE FLIGHT

Inspect your parachute. Remember, you may have to jump with it! Check the date of the last inspection. The packing interval should not exceed 60 days in the United States or 30 days in the tropics. Open the flap; make sure that the ripcord pins are not bent and that the seal is not broken. A bent pin or jammed wire may make it impossible to pull the ripcord. See that the corners of the pack are neatly stowed so that none of the silk is visible. See that the six or eight opening elastics are tight. Inspect each parachute you draw.

Put your parachute on and be sure the harness fits properly. The shoulder and chest straps should be snug without play; the chest buckle should be twelve inches below the chin. The leg straps should be snug. In fact, the harness should be comfortably snug when you are seated and disagreeably tight when you stand up.

Sea Marker Packet

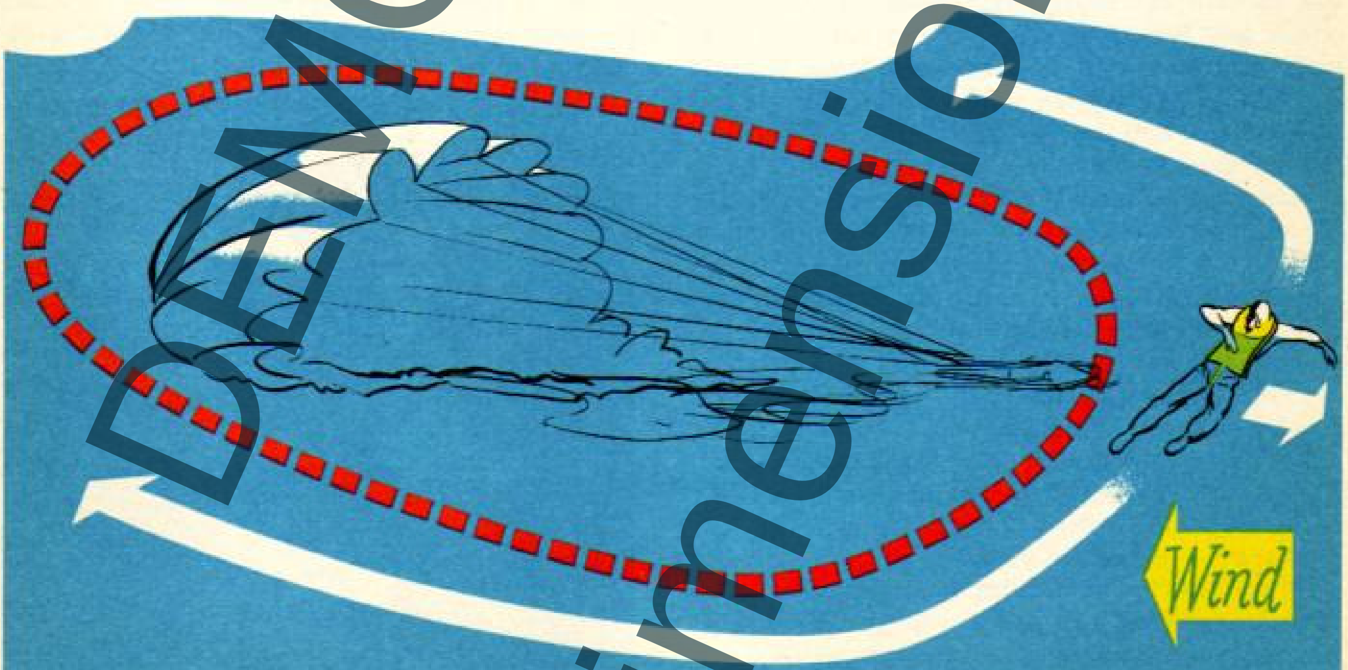
A sea marker packet is cemented to the life vest. When friendly airplanes approach, release the packet by pulling down on the tab. The dye will form a large green area lasting three to four hours. This will help airplanes to find you.



> **Caution**
>
> Before takeoff be sure your life vest cartridge containers are loaded with live CO_2 cartridges, **and that the container caps are screwed down tightly.**
>
> Always make certain that the mouth inflator valves are tightly closed before pulling the inflating cords.
>
> Turn in your life vest for inspection every six months.

WARNING: STAY AWAY FROM YOUR CHUTE IN THE WATER

After parachuting into water you will have a tendency to drift downwind into the fallen parachute as soon as you inflate your life vest. To avoid entanglement with harness and shroud lines, work upwind, away from the chute, and stay clear. If you have a raft, salvage your parachute for sail, cover, and extra lines. If not, get away from the chute and stay away.



Swimming Through Fire

When an airplane is ditched at sea there is always the possibility that a smashed wing tank and engine will spread flaming oil and gasoline on the water. By using the following procedure, however, you can swim to safety through such a fire, even when you wear a life vest.

1. Jump feet first upwind of your airplane. Cover your eyes, nose and mouth with both hands. Take a deep breath. Hold breath until you rise to the surface.

2. Just before you reach the surface, make a breathing hole in the flames. Swing your arms overhead to splash flames away from head, face, and arms.

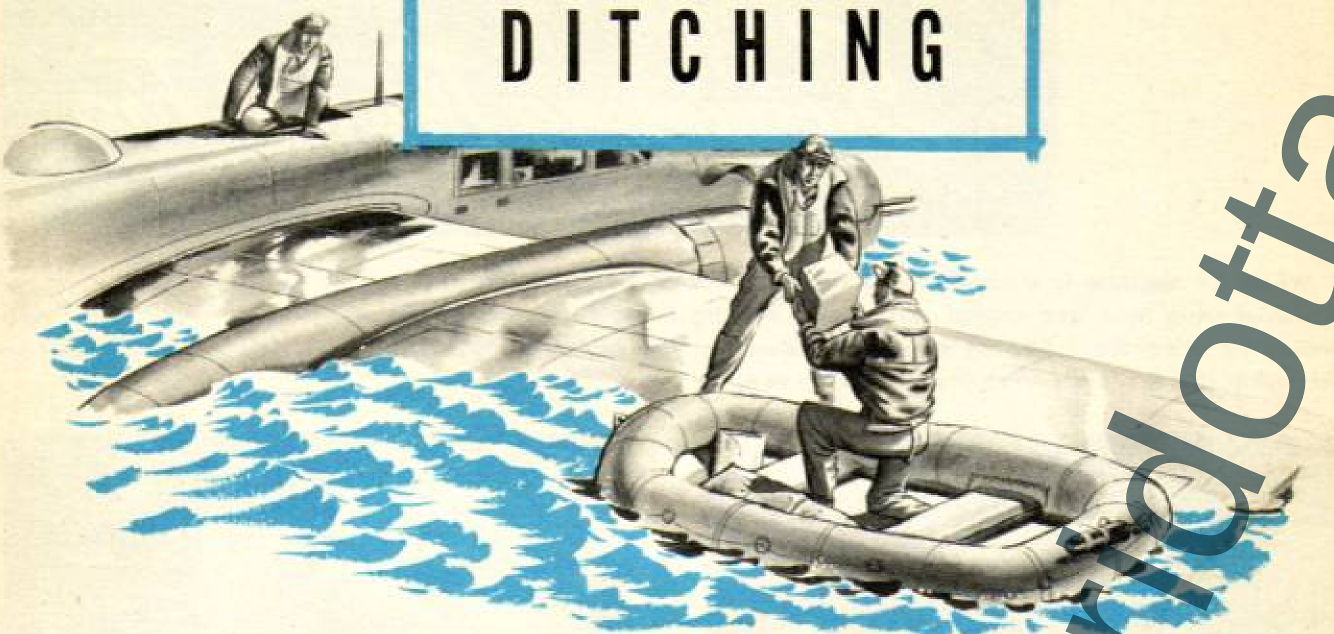
3. Swim into the wind. Use the breast stroke. Before taking each stroke splash water ahead and to the sides. Keep mouth and nose close to the water. Duck your head every third or fourth stroke to keep it cool. If there are several men, swim single file. Let the strongest swimmer splash a path so the rest can follow safely in his wake.

Swimming Under Water

If the heat is too intense or flames too high, swim under-water—out of the danger area. To do this:

1. Splash flames away from body.
2. Hold head near water level.
3. Deflate life vest by releasing valves.
4. Take a deep breath but do not inhale fumes.
5. Sink beneath the surface, feet first.
6. Swim upwind as far as possible.
7. Splash away the flames as you come to the surface. Take a deep breath and submerge again. Repeat procedure until you are beyond the fire.
8. Re-inflate life vest by mouth.

DITCHING



Some day you may be forced down at sea. Now is the time to start preparing for such an emergency. Here is how to do it:

1. Know the part you play in ditching a land airplane on water.
2. Know the use of emergency equipment provided for ditching purposes.

Ditching and dinghy drills will familiarize you with the duties you are to perform when the order, "Prepare for ditching," is given. Master these drills so that you can carry them out in a darkened airplane under unfavorable conditions.

Inspections

However, before taking off on a long over-water mission, there are several additional points of importance to consider:

1. Be sure all your emergency equipment functions properly and that you have all you may need in the airplane. Pay particular attention to CO_2 cartridges on your life raft and Mae West. See that the valves are closed.
2. Test your escape hatch. Know—don't hope—that it will operate if the need arises.
3. Recheck life vest adjustments. Blow the vest up by mouth and see that the waist and leg straps fit you properly. Make sure they won't bind if you have to inflate the life vest in an emergency.

Before Ditching

At the pilot's command, "Prepare for ditching," you must:

1. Acknowledge the order by saying, "Bombardier ditching."
2. Remove your oxygen mask as soon as you are below 12,000 feet. Loosen shirt, remove tie. Take off heavy boots and flak suit, but keep on flying clothing and helmet for protection.
3. Remove parachute, except when you need the one-man life raft attached to the harness.
4. Do not remove life vest. Keep it on at all times. **Do not inflate it until out of the airplane.** If you inflate your life vest while you are still in the airplane, you will find it difficult, if not impossible, to get out through an escape hatch.
5. Dismount bombsight and throw it overboard.
6. Open bomb bay doors. Jettison bombs, if the plane has sufficient altitude. Bombs and depth

SMOKE GRENADES

M8 GRENADE

M3 GRENADE

Airplanes to be flown over sparsely settled regions will be equipped with either an M8 or an M3 smoke grenade. In the event of a forced landing, use the grenade as a marker to aid searching parties in locating the airplane which otherwise might be difficult to find.

Pilots observing smoke of the type produced by M8 or M3 smoke grenades will immediately attempt to locate the source.

The M8 smoke grenade burns about 3½ minutes, giving off a dense **gray** smoke, and is intended to be used primarily in heavily forested regions. It is easily distinguished from wood fires which give off a blue-gray or black smoke.

The M3 smoke grenade is designed to be used in snow-covered regions. It gives off a dense **red** smoke for 2 minutes which can be distinguished against a white snow background for about 4 miles by a person in an airplane.

Method of Firing M8 Smoke Grenade

1. Grasp the grenade with lever held firmly against grenade body.
2. Withdraw safety pin, keeping a firm grip around the grenade and lever.
3. Either throw the grenade with a full swing of the arm, or place on the ground and release.
4. As the grenade is released from the hand, the lever drops away, allowing the striker to fire the primer.

Method of Firing M3 Smoke Grenade

1. Pull the 3 vanes on the side of the grenade up and away from grenade body.
2. Place grenade in snow so that it is supported by the vanes in an upright position.
3. Keep lever held firmly against grenade and withdraw safety pin.
4. Release lever.

Safety Precautions

To avoid a fire, do not throw or place the grenade within 5 feet of dry grass or other readily inflammable material.

After the grenade is ignited, **stay at least 5 feet away from the burning grenade,** as heavy smoke develops and there is a tendency to throw off hot particles of residue.

Keep these smoke grenades dry. If the chemical contents of a grenade become wet, it will ignite.

All smoke grenades will be shipped and handled in accordance with Interstate Commerce regulations. These regulations prohibit the shipment of these smoke grenades in personal baggage.

REFERENCE: Technical Order 01-1-38

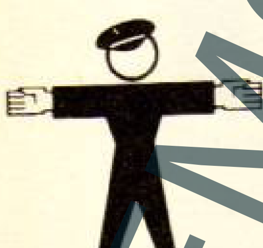
Body Signals

If a rescue plane flies low and circles your location and you are sure that you have attracted the pilot's attention, you can transmit messages by the emergency body signals shown on this page. When performing the signals stand in the open. Make sure that the background as it will be seen from the airplane is not confusing. Make the motions deliberately and slowly, and repeat each signal until the pilot indicates that he understands.

Need Medical Assistance—Urgent (Lie prone)

All O K
Do Not Wait

Can Proceed Shortly
Wait if Practicable



Need Mechanical Help
or Parts—Long Delay

Pick Us Up—
Plane Abandoned

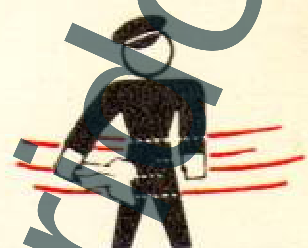
Do Not Attempt
to Land Here

Land Here (Point in
Direction of Landing)

Our Receiver
Is Operating

Use Drop
Message

Affirmative (Yes)

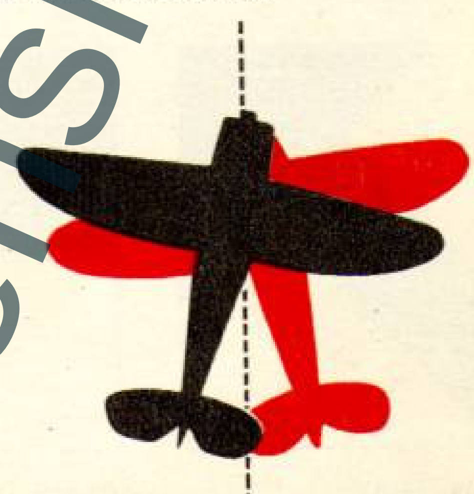


Negative (No)

HOW PLANE ANSWERS

The pilot of the rescue plane will answer your messages either by dropping a note or by dipping the nose of his plane for the affirmative (yes) and fishtailing his plane for the negative (no).

Affirmative (Yes). Dip Nose of Plane

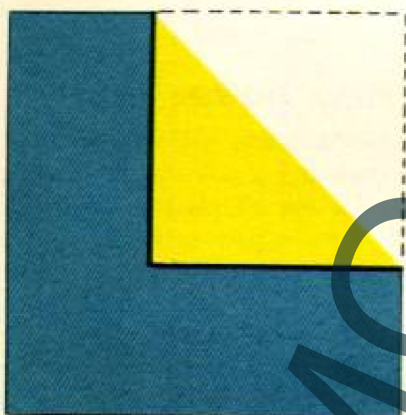


Negative (No). Fishtail Plane

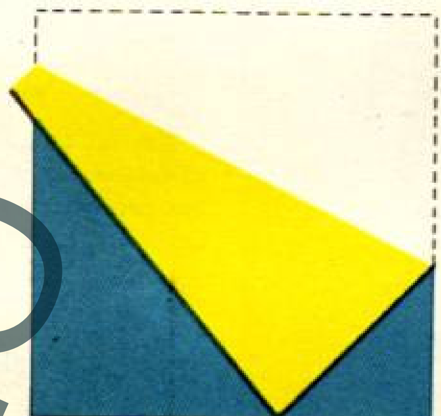
Panel Signals

Many of the emergency kits now supplied contain a large signal panel (roughly 10 feet x 10 feet). It is are fluorescent yellow on one side and blue on the other. Immediately after you are forced down this panel should be spread out on the ground flat—yellow side up on dark backgrounds and blue side up on light backgrounds. The color will help rescue pilots to find you. Once a rescue pilot has located you, messages can be transmitted by folding the panel as indicated in the illustrations on these pages. If it is windy, hold the folds in place with rocks, sand, sticks, or improvised stakes if it is necessary. If several messages are to be transmitted don't change the folds too quickly. Allow enough time for the pilot of the rescue plane to read each signal and indicate that he understands it (generally by dipping the nose of his plane several times). These same signals can be transmitted with the square yellow-and-blue sail now a part of the equipment supplied with the large inflatable rubber life raft.

The emergency signal panel also can be used as a tent since its blue side is coated with a waterproof compound. Also, the blue side can be used as an excellent camouflage cover for a life raft if enemy aircraft are sighted.



Need Gasoline and Oil, Plane is Flyable

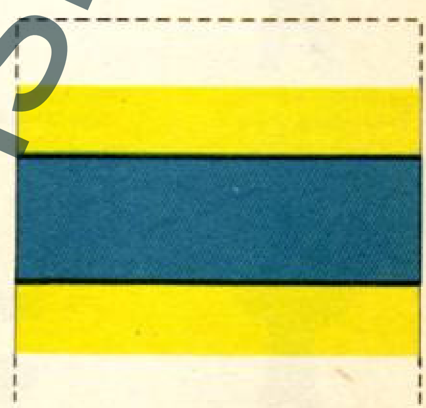


Need Tools, Plane is Flyable

Need Medical Attention

OK to Land, Arrow Shows Landing Direction

Do Not Attempt Landing



Indicate Direction of Nearest Civilization

Clothing

All clothing should fit loosely. This applies particularly to your socks, boots, and gloves. Tight-fitting clothing interferes with the blood circulation and makes you more susceptible to frostbite. Individual garments should be light and porous. Wear several layers if possible. Two light garments afford better insulation than a single heavy one. Wear long woolen underwear on all flights over cold regions. Wear two or three pairs of loose-fitting woolen socks in sub-zero climates, but be sure that your boots fit loosely over them.

Leather shoes are dangerous in extreme cold. They not only afford poor protection, but may cause harm if they fit tightly over your socks. Don't wear ordinary GI shoes inside your winter flying boots. Use woolen socks and felt liners or electrically heated shoes instead.

If possible wear two pairs of gloves or mittens—a rayon or other light pair inside heavier ones (either A-9's, A-12's or electric gloves). Mittens are better than gloves, for they allow your fingers to come in contact with each other and help keep them warm.

Keep your socks and underwear clean. After they have become soiled by body oils and excretions, they lose much of their insulation value.

Keep Your Clothing Dry

Wet clothing is almost worthless in protecting you from the cold. If any part of your clothing becomes moist, either by accident or through perspiration, take it off and dry it over a fire or change to dry clothing immediately. Wet feet and hands are particularly dangerous in cold climates for they fall easy prey to frostbite.

Exercise to keep warm but guard against overexertion in extreme cold. Overexertion makes you sweat and the perspiration may turn to ice inside your clothing. This is dangerous. If necessary to perform much physical work, open or remove some of your clothing in order to prevent perspiration. Don't put on a heavy suit until just before takeoff. Wipe your body dry; then dress slowly. Once dressed, exercise no more than necessary.

Electrically Heated Flying Suits

Electrically heated flying suits permit you to fly for long periods at extreme altitudes without getting cold. They have the advantage of eliminating bulkiness and permitting greater ease in manipulating the controls. There is one great disadvantage, however, in relying on them while flying over cold regions. If your electric system fails, if you are forced down, or if you have to bail out, you are left without adequate protection against the cold. Always carry additional heavy clothing with you on such flights.

Know how to use your electrically heated suit, and treat it carefully. The electric heating elements are fragile. Hang your suit up to dry between flights, if possible, and have it tested by your Personal Equipment Officer. Two types are now in use, the F-2 and the F-3. They will protect you down to –40°F. If lower temperatures are encountered, add other flying clothing.

How to Wear the F-2 Suit

1. Wear your F-2 electrical suit over long woolen underwear. (If your suit is the F-1 type, wear additional clothing over it as well.) The F-2 suit affords adequate protection down to –40°F. If operating at lower temperatures, add other flying clothing.

2. Put on the shoes with inserts over lightweight woolen socks. Then connect the snap fastener tabs on the trouser leg to the corresponding snaps on the shoe insert. **Be sure that both pairs of snaps are properly connected.**

3. Connect the tab at the top of the trousers to the corresponding snap fasteners on the inside of the jacket at the right. Make certain both pairs of snaps are securely snapped together. Connect 6-foot lead cord to jacket pigtail.

4. Put on regulation flying helmet and auxiliary equipment. Protect your neck from the cold by wearing a wool or silk scarf.

5. Put on lightweight rayon gloves. Snap the tabs on the jacket sleeves to the corresponding snaps on the heated gloves. Then put on the electrically heated gloves.

How to Wear the F-3 Suit

1. Begin to dress by putting on long woolen underwear, woolen socks, GI trousers, and shirt.

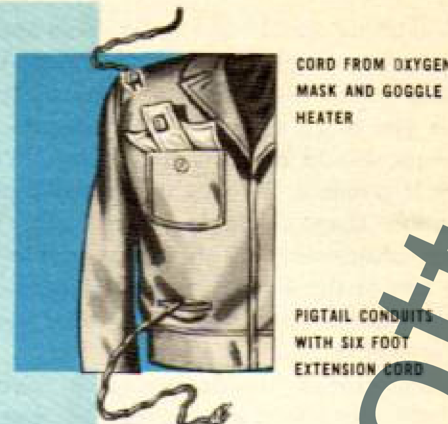
2. Then add the F-3 electrically heated trousers. Adjust the shoulder straps to fit comfortably. Your F-3 heated jacket goes on next. Make sure both trousers and jacket fit properly.

3. Connect cord on right underside of jacket to receptacle at waistline of trousers. **Make certain both prongs of plug fit into receptacle.**

4. Now put on heated shoe inserts. Type F-2 is used for both F-2 and F-3 suits. **Connect both snap fasteners** on each leg of the heated trousers to snaps on shoe inserts.

5. Next come the A-9 alpaca-lined trousers. Reach inside right or left pocket and pull electric cord or

F-2 ELECTRICALLY HEATED FLYING SUIT



Your complete F-2 wardrobe should contain the following items of clothing:

1. Jacket
2. Jacket Insert, Heated
3. Trouser
4. Trouser Insert, Heated
5. Helmet
6. Shoes, Felt
7. Shoe Insert, Heated
8. Gloves, Heated
9. Rayon Glove Inserts
10. A-12 Mittens
11. Scarf
12. Lead Cord
13. Woolen Shirt
14. Light Socks
15. Long Underwear

pigtail through. Then put on the B-10 jacket.

6. Now, the finishing touches: outer boots, helmet, and scarf. Connect 6-foot lead cord to pigtail.

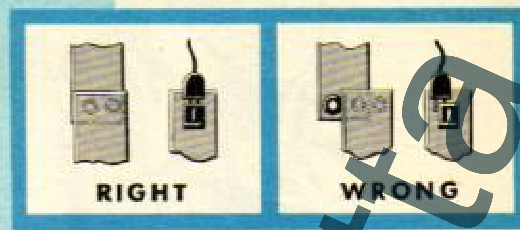
7. Check all previous steps. Then add your gloves; first, the rayon or silk gloves. Then snap tabs on sleeves of heated jacket to snaps inside gauntlets of electrically heated gloves. Now put on your heated gloves. Take along a pair of A-9 mittens, in case of emergency.

8. You can plug an oxygen mask heater or electrically heated goggles into the connecting block on the front of your trousers.

Connect your extension plug in the left receptacle of the built-in rheostat before takeoff and be sure that the suit is working properly. The plug can be locked into position by a simple clockwise twist. When in flight, keep the rheostat at the lowest comfortable heat. Don't ride hot, it will make you sweat.

Never rely on electrically heated suits alone when flying over cold regions. They are safe for use over temperate or tropical zones where cold is experienced only at high altitudes.

F-3 ELECTRICALLY HEATED FLYING SUIT



MAKE CONNECTIONS PROPERLY

Your complete F-3 wardrobe should contain the following items of clothing:

1. Jacket, Alpaca lined, Type B-10.
2. Jacket, Heated, Type F-3
3. Trousers, Alpaca lined, Type A-9
4. Trousers, Regulation GI
5. Trousers, Heated, Type F-3
6. Helmet
7. Shoes, outer felt or Type A-6
8. Gloves, Heated, Type F-2
9. Gloves, rayon or silk
10. Mittens, Type A-9
11. Scarf
12. Lead Cord
13. Shirt, Regulation GI
14. Socks, Regulation Wool
15. Long underwear

Check your suit after each flight. Look for excessive wear at all flexion points where electric wires might short out or break. If an ohmmeter is available, check the resistance of your suit at frequent intervals. The resistance in ohms is marked on the trousers, jacket, and each shoe and glove. If the ohmmeter shows the resistance to be more than 10% off, turn in the item for a new one.

Frostbite

Frostbite occurs most commonly in the fingers, toes, nose, ears, chin, and cheeks. It may set in gradually and painlessly and without your being aware of it. Numbness, stiffness, and a whitish discoloration of the affected part are among the first signs. Wrinkle your face frequently when exposed to cold air; if it feels numb, warm the affected part with your ungloved hand until sensation returns.

Crew members should watch each other's faces and be on the alert for areas of blanching. In this way serious trouble can be prevented. Frostbitten tissues may later become painful. Such tissues should

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