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COUNTRY USSR

REPORT

SUBJECT English-Language Soviet Manual Entitled Air Forces, Air Navigation Manual

DATE DISTR. 22 October 1963

NO. PAGES 1 50X1-HUM

REFERENCES

DATE OF INFO.

PLACE & DATE ACQ 50X1-HUM

THIS IS UNEVALUATED INFORMATION. SOURCE GRADINGS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

1. 93-page, English-language Soviet manual entitled Air Forces, Air Navigation Manual

The manual includes a description of the organization of the air navigation service, the rights and duties of personnel, navigation training and flight rules, and the technique of 50X1-HUM navigating in aircraft combat operations.

2. The manual serves as a guide for all flight personnel of squadrons, units and large units, as well as air headquarters, departments, institutions, and Air Force schools.

Distribution of Attachment (for Retention):

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Air: 1 copy
Air/FTD: 2 copies
SAC: 1 copy
DIA: 1 copy

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INFORMATION REPORT INFORMATION REPORT

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SECRET

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AIR FORCES

AIR NAVIGATION MANUAL

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SECRET

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The Air Forces Air Navigation Manual describes: the organization of air navigation service, the rights and duties of personnel, navigation training and flight rules, the technique of navigation service in aircraft combat operations.

This manual should serve as a guide for the entire flight personnel of squadrons, units and large units, as well as air headquarters, departments, institutions, and Air Force Schools.

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C h a p t e r I

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GENERAL

I. The Air Forces Navigation Service deals with problems concerning operational use of navigational and bombing equipment, its object being to ensure precise navigation and precision bombing.

2. The principal tasks of navigation service comprise:

- achievement of maximum accuracy in route-flying;
- attainment of the highest precision in pinpoint navigation with regard to time and place of approach to targets/on ground sea or in air/ and homing to the designated aerodrome of arrival.
- attainment of the best marksmanship in bomb or load-dropping on various targets.

3. Successful solution of these problems is reached by:

- systematic training of navigators /pilots/ in using the navigating and bombing equipment on ground and in flight, at different times of day and night, at various altitudes, under favourable or heavy weather conditions;
- constant improvement of theoretical knowledge by flight personnel;
- precise coordination of navigation service with other services engaged in organizing and servicing flights.

4. The commanders of large Air force units and air units and squadrons bear full responsibility for the condition and constant perfection of the navigation service and its alertness for the fulfillment of flight operations. 50X1-HUM

This responsibility imposes upon the commanders the following obligations:

- to carry on systematic control and guidance of the 50X1-HUM
service activities of subordinate navigators;

- to stimulate the participation of navigators in working out tactical operation problems, air training schemes and programmes;

- to control the navigation training, and navigational flight preparations of flight personnel of large air force units, air units, and squadrons.

5. Navigators, air units and large air units bear personel responsibility for the proper and thorough navigational training of flight personnel and for the standard of navigation service.

6. The entire flight personnel of the squadrons air units and large air force units is duty-bound to obey all navigational orders issued by the navigation officers of the given squadron or unit.

7. Appointments and transfers of navigator personnel are effected in accordance with the general rules and are subject to the approval of the higher navigation officer.

8. The servicing personnel are responsible for the timely preparation, maintenance and service of aircraft navigational and bombing equipment, the navigators of squadrons air units and large air force units being responsible for its proper operation and operational use.

9. The supply of air maps and official printed matter to flying crews, air units and large air force units is placed in the charge of navigational officers. 50X1-HUM

IO. Distribution of navigator's equipment and instruments is the duty of air service comman
orders issued thereto by the respective
navigational officers.

Chapter 2

OFFICERS' DUTIES

II. To the Air Force Navigation Service belong officers in the rank of military navigators or pilots.

I2. A navigation officer is assigned as member of flying crew on every aircraft which provides seat for a navigator.

On single-seater aircraft the pilot combines his own duties with the duties of navigator.

I3. In every branch of aviation a navigation officer is appointed to all services, squadrons or other units, namely, there is squadron navigation officer, an air unit navigation officer, or a large air unit navigation officer /senior navigation officer/.

I4. In large air force unit headquarters incorporating target director posts, navigators are appointed to each of these stations.

I5. Navigational support of flights on route airfields is the duty of garrison navigators, appointed from among the air unit or large air force unit stationed at the given aerodrome.

The appointment follows an order issued at the garrison and the navigator is, as a rule, chosen from the squadron or unit, whose commander is appointed as garrison commander.

The garrison navigation officer combines these duties with those arising out of his principal occupation.

I6. Instructor-navigators are appointed at all large air force units and institutions for the purposes of teaching and introducing new methods of air navigation and bombing, inspector-navigators being appointed t

condition of navigation service.

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17. Air navigators of all classes, their first officers and assistants, as well as the target director post navigators inspectors and instructors, enjoy the same rights as the Air Force flight personnel.

18. Pilots and navigators of the Air Forces, regardless of office, should systematically perfect their knowledge of the theory and practice of air navigation and bombing. They should keep aircraft navigational equipment and bombing armament in constant ready use, maintain the individual navigator's equipment and air maps in excellent condition and be thoroughly acquainted with the flight area, its geography and climate.

19. Air navigators and pilots of all air force branches should be:

- perfectly familiar with the navigation equipment and bombing armament of their aircraft, and be able to operate them intelligently during flights, so as to attain pinpoint precision in solving flight problems;
- thoroughly and completely prepared for the fulfilment of every flight regardless of its nature and repetition;
- navigate the aircraft exactly in accordance with the prescribed itinerary;
- ready to hit targets precisely and efficiently at the fixed time;
- able to make rapid and exact navigation and bombing computations and apply all available methods of navigation and bombing in flight;

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- able to regain lost contact in the fligh
- able to assess meteorological conditions

- informed at any moment about the fuel supply, and the time of flight until landing;

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- able to maintain the navigation equipment and bombing armament of their aircraft in constant ready use.

20. When flying with an air navigator on board, the pilot is duty bound to

- strictly observe the flight conditions prescribed by the navigator /course, speed, altitude/, making no changes without informing the latter, excepting such cases, when there is an obvious threat to the safety of the crew and aircraft;

- know the approximate aircraft location /keep orientation/;

- know the supply of fuel and lubricants, and the flight time until landing;

- just as the air navigator, carefully plan the flight from the point of view of navigation.

21. The navigation officer of an air squadron is in direct subordination of its commander and acts as his assistant in matters of flight navigation training and alertness.

The duties of the navigation officer are:

- to get the squadron ready for flight insofar as navigation is concerned;

- to participate in operational flight and training formation flights, as a member of the squadron leader's crew;

- to make the navigating computations required for the successful accomplishment of the flight;

- to participate in drawing up training time-tables and individual flight plans;

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- to instruct the flight personnel of the squadron in methods of air navigation and bombing;

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-keep records and control the proficiency of every pilot and navigator in these subjects;

- to supervise the condition and timely inspection of aircraft navigation equipment and bombing armament, and at least once every month check them on every aircraft of the squadron, as well as the air navigation and special maps and navigation equipment of the entire flight personnel;

- to see to the accuracy of squadron aircraft clocks before take off.

22. The air unit navigator is directly subordinate to the air unit commander and acts as his assistant in matters of navigational preparation.

His duties are:

- to supervise the navigation service of the air unit;

- to make the necessary navigation computations, request the provision of ground navigation facilities and necessary weather information and see to the fulfilment of his request; to participate in drawing up orders, air training schemes and programmes, as well as time tables;

- to prepare the air unit for operation from the point of view of navigation, as well as for point-to-point operation and training flights and to check the navigational readiness of flight personnel and equipment; take part in preparing and performing of air drills;

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- to participate personally, as member of the leading crew, in operational flights, runs and training flights of the air unit;

- to check the efficiency of ai

ing during combat and training operations, analyse the errors of air navigation and bombing, prepare the necessary data for flight analysis and to conduct critical analysis of these data from the point of view of air navigation;

- to indoctrinate squadron commanders and navigators in the art of navigation and bombing, as well as to check and keep record of their individual proficiency in these subjects, to keep note of and be familiar with the navigational skill of every crew member of his unit and accordingly report to his commander and superior navigation officer his opinion regarding the necessary transfers of navigators, their merits and faults;

- to teach squadron navigators the proper methods of instructing the flight personnel in the art of navigation and bombing; to check the quality of lessons conducted by squadron navigators, and, if necessary, instruct the latter in training methods at special lessons; to participate in drawing up schedules of exercises and to keep accounts;

- to provide the air unit with topographical maps, literature, reference data and navigator's forms;

- to look after the supply of navigation equipment, check the condition of aircraft navigation equipment and bombing armament, personnaly inspecting at least once a month the condition of navigation equipment and bombing armament of sqaudron commander's planes and of other unit planes, chosen at random for such inspection;

- to investigate personally all cases of loss of contact and faulty bombing, and immediately report them to the superior navigation officer; to take [redacted] such occurences;

- to bear responsibility for the equipment of air navigation and bombing classes;

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- to check systematically the movement and readings of timers, aircraft clocks and watches.

23. The senior /chief/ Navigation Officer of a large air force unit is directly subordinate to the commander of such a unit and acts as his assistant in matters of navigational preparation.

His duties are:

- to supervise the air navigation service of air units and squadrons;

- to organize the application of ground navigation facilities by the flight personnel and to control their operation;

- to make the necessary navigation estimates and report them to the air unit commander;

- to prepare the aviation units for combat missions and drill flights from the point of view of navigation, and to control their operation;

- to participate personally in flights, runs and combat training flights, acting as the leader of an aircrafts formation and for purposes of control;

- to participate in drawing up combat training orders and programmes, to control their fulfilment in air units and squadrons, to take part in preparing and organizing air drills and tacticals;

- to train personally the commanders and navigators of air units for air navigation and bombing; to control and keep record of every air unit commander's and navigator's progress in navigation training;

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- to conduct systematic methodol

and model lessons with air unit and squadron navigators;

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- to bring to the knowledge of air units and explain to them the significance of instructions issued by superior navigation officers on problems of navigating and bombing; if necessary, to supplement these instructions with his own directions;

- to study and keep records of aircraft unit and squadron navigator's professional skill;

- to keep records of navigational and bombing training of air units and squadrons and submit timely returns of the required format;

- to investigate personally all cases of lost contacts and bombing amiss; to report the conclusions regarding the causes of these occurences and the measures necessary for their elimination to the commander and to the higher navigation officer;

- to supply the air units and large air force unit staffs with topographic maps, manuals and reference books on navigation and bombing;

- to look after provision and condition of navigator's equipment by at least bi-monthly personal checks of navigation equipment and bombing armament on air unit and squadron commanders aircraft, as well as some other planes, chosen at random in each air squadron;

- to be responsible for the equipment of air navigation and bombing training classes at the large air force unit staff and to control the state of such classes in air units.

24. The air navigator of target director post is subordinate to the post commander and acts as the senior officer of the shift of a combat team.

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His duties are:

- to supervise the work of target plotters;

- to determine navigational data on target travel and through the intercept officer direct aircraft to objectives;

- to look after correct time reading at the target director post;

- by means of radar facilities, follow the flights of air unit (large unit) planes on the prescribed itinerary; plot the tracks of the planes and indicate the time that it took;

- upon receipt of special signals for the plane, make the necessary computations and inform the aircraft formation commander, through the liaison set, of his flight position and give him the aerodrome approach data;

- to have on hand different variants of time computations prepared in advance, giving the best fighter climbing courses in the direction of the most likely enemy appearance, and charts (tables) of computations for intercepting, encountering enemy planes;

- to be governed in all other matters by the rules concerning target detector posts in large force units.

25. Subordination and functional duties of instructor and inspector navigators are governed by special instructions concerning institutions and organizations with application to individual office ranks.

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Chapter 2

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ORGANIZATION OF NAVIGATIONAL SERVICE

26. The basic principle underlying the organization of navigation service in all force branches is maintaining the air units in constant readiness for flight operation and reducing to minimum the volume of work and time needed for the preparation of each flight.

The solution of this task is attained by:

- everyday persistent navigation drills of the flight personnel;
- careful maintenance and skillful preparation of flight maps;
- filling in air situation maps;
- constant study of the combat area (flight operation area);
- intelligent maintenance and timely preparation of the navigation equipment and bombing armament of the aircraft;
- keeping the navigation equipment completely ready for use;
- daily control of accurate timing;
- skillful application of ground facilities for navigation and bombing;
- organizing constant ground navigation control of flight performance;
- organizing post-flight navigation control, recording accumulated experience and keeping accounts.

Flight Personnel Navigation Training

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27. Excellent navigation training

nel constitutes one of the main conditions ensuring successful accomplishment of flight operations. 50X1-HUM

28. Flight personnel navigation training is carried out on the basis of the general training programme of each air unit (large air force unit).

29. Navigation training is chiefly based on systematic drills.

Training points for navigators:

- rapid and precise flight computation and flight map preparation;

- various methods of determining navigational elements and the position fix in flight;

- rapid regaining of cruise control by all possible means;

- precision bombing by various methods.

For pilots:

- rapid and exact flight map preparation and flight planning;

- cruise control by various means, while flying over different localities and at different altitudes;

- exact maintenance of the course, speed and altitude of flight, and the ability to make the necessary corrections in flight;

- developing capacities for mental navigational computation and estimation by sight;

- regaining of cruise control;

- precision bombing ensured by various methods.

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For both pilot and navigator

- thorough and skillful application of air navigation and bombing aids.

30. The navigational skill of flight personnel should be checked: 50X1-HUM

- upon arrival at a new duty station;
- after prolonged intervals between flights (over three months).

The checking should be made by:

- the air squadron commander or navigation officer, when it concerns private flight personnel;
- the air unit commander or navigation officer, when it concerns air squadron commanders or navigation officers;
- the commander of a large air force unit or the senior navigation officer of that unit, when it concerns air unit commanders or navigation officers.

Air unit commanders and navigation officers should carry out random inspections of private flight personnel.

Inspections should be made as to:

- knowledge of this Manual;
- knowledge of the combat area (flight operation area);
- knowledge of air navigational and bombing aids;
- the theory and practice of air navigation and bombing as applied to the given air force branch and in conformity to the training programme.

The results of an inspection and evaluations should be entered into the individual flight records file and published in an order of the day.

Storage and Preparation of Flight Charts

31. Every air unit should possess the necessary supply of flight maps depicting the terrain along the probable [redacted] directions of flight. 50X1-HUM

The supply of charts is drawn up directly after arrival at a new base area or at a new combat area. 50X1-HUM

32. Every flying crew (pilot, navigator) should have a ready for use set of flying area maps.

The map set (its scale and radius of flight of the day operation area) is specified by a large air force unit order issued to that effect and depends upon the particular aviation branches it is to serve.

33. The preparation of regional flight maps includes:

- the selection and pasting together of the flight chart sheets of the given region;

- plotting of the state boundary or front line;

- plotting of the plain symbols marking the ground air navigation aids;

- convenient folding of charts to fit the chart case;

- the necessary marking for the use of radio and celestial navigation aids.

When the area is large and the large scale map is too big for convenient handling, maps may be made in sections overlapping certain parts of the region.

Plotting of maps for the use of radio and celestial navigation aids is carried out on the basis of an order issued by the senior navigation officer depending upon the aids at his disposal.

34. A sealed package of the flight maps should be constantly kept on board the plane in a special map compartment. 50X1-HUM

All other maps are kept at the air unit staff. It is prohibited to keep maps on aircraft, in [redacted] places, where their security cannot be [redacted]

35. In arranging for the storage of charts, it is necessary to provide for the timely combat alertness of air squadrons, air units and large air force units. The order of releasing charts to the personnel is established by the order of the day.

Flying Situation Map

36. The flying situation map serves for reference and navigational computation during preflight preparation and for the personnel to study the flying situation.

37. The flying situation maps showing the tactical situation are plotted by the navigation officers of individual units and serve as their staff working charts.

38. The flying situation map is plotted to cover the entire possible flight operation area, depending upon the radius of operation of the planes and upon the main flight direction.

39. The flying situation map should have the following plotted and coloured on it:

- state boundary, frontal restricted area or front line;
- main check points in the flight operation area;
- main altitude points of the area;
- aerodromes and landing grounds;
- restricted areas, entrance and exit corridors to zones with special flight conditions;
- magnetic declination and areas of magnetic anomaly;
- ground air navigation aids.

The flying situation map is supplemented by a natural light diagram, calculated for the light an
every month at the given locality (see app

Apart from the above, with a view of hastening flight computation, the flying situation map may contain other data needed by the navigation officer.

Study of the Combat Area (Flight Operation Area)

40. The combat area (area of flight operation) should be studied by the flight personnel under guidance of the air squadron (air unit) navigation officer, and independently by using maps of various scales, as well as diagrams, (air pilots), aerographic descriptions, flying situation maps and photographs of characteristic reference points.

In combat conditions, acquaintance with the area should, as a rule, end up with ranging of the combat area, while training exercises usually end up by ranging of the home aerodrome net.

41. As a result of studying the flight operation area, the flight personnel should know:

- the peculiarities of orientation in the given area, the system of characteristic ground linear, area and point references with consideration for season, light and dark hours, and any changes not reflected on the map;
- the distance and flight time up to the base points;
- the location of aerodromes and landing grounds and their fitness for alighting;
- the location, nature and operating procedure of ground air navigation aids in the flight operation area of their air unit; the magnetic course and no-wind time of flight from the nearest radio navigation posts -RNP- (FHT) up to home aerodrome;
- restricted areas in the flight

- the state boundary and front line; 50X1-HUM

- disposition of anti-aircraft defence facilities and the primary enemy targets;

- terrain;

- weather peculiarities of the flight operation area and local signs of weather changes;

- time of sunrise and sunset for the forthcoming period of time;

- magnetic declination and anomalies in the flight operation area;

- unified operating procedure of regaining lost orientation established for the given unit by special instructions;

- diagram for climbing and descent through clouds at the home aerodrome.

In addition to the above, the flight personnel should be able to identify their home aerodrome unmistakingly, under any weather conditions, from any altitude or direction.

42. The radius of flight operation area (radius of operation) to be studied by the flight personnel is determined for every air unit by the navigation officer of the large air force unit.

Maintenance and Preparation of Aircraft Navigation Equipment and Bombing Armament

43. The aircraft navigation equipment and bombing armament should always be in good working order.

It is prohibited to fly with incomplete or faulty equipment.

In order to keep the navigation equipment and bombing armament in constant readiness for flight, it is mandatory for the navigation officers:

- to carry out preflight, as well as periodic inspections and to check the condition and performance of equipment in flight;

- to check the compasses and aircraft sextants;

- to participate in checking the sighting and other navigation equipment and bombing armament.

44. The purpose of inspection is to:

- ensure the presence of the necessary equipment on the plane and to check its proper operation;

- ensure the presence of the necessary tables (charts) of corrections and check the date of their tabulation.

All defects and faults revealed during inspection at the aerodrome or in flight should be reported to the aircraft technician for elimination and then entered in the plane acceptance and release log. The elimination of defects is checked against this entry in the presence of the aircraft technician.

45. All navigation instruments and bombing armament should be checked at least once in two months.

46. Checking of magnetic compasses comprises:

- determination of the compass card lag and settling time in accordance with the fixed tolerances;

- measures to determine and reduce deviation.

Radio compass and direction finder checking consists in:

- control tuning by listening in to one of the radio stations, as well as correcting the compass course angle of the radio station;

- determining radio deviation;

The determination and reduction of magnetic and radio compass deviation should be made in accordance with special

instructions, depending upon the type of plane and compass.

The periods of correction tests are indicated in the same instructions.

47. Speed indicators and altimeters should be checked by the engineer by the instruments provided for the purpose and under supervision of the navigation officer.

Furthermore, the flying crew should be informed about the value of speed indicator aerodynamic correction, depending upon the type and series of the plane. If necessary, its correctness should be checked in flight.

48. The checking of the aircraft sextant determines the value of constant index corrections, the correct level and lighting.

49. The results of checking the navigational instrument errors (for compasses, speed indicators and altimeters) are recorded in correction cards hung up in the navigator's and pilots cockpits in places convenient for their use. The result of speed indicator and altimeter checks for single-seaters are registered in the instrument logs.

50. Bombing armament checks should be made by armament personnel with the participation of navigators. Bomb sights, depending upon their type, should be checked in accordance with special instructions thereto. The performance of mechanical and electric bomb releases and bomb racks should be checked during individual and pattern bombing.

Sight checking consists in inspecting the sound condition of optics, computers and the precision of sight installations on the plane.

Maintenance and Preparation of Navigation Equipment

51. The navigation equipment is divided into: 50X1-HUM
the navigator's equipment and that of the pilot.

52. A navigator's equipment comprises the following items:

- case for maps, tools and other accessories;
- map scale;
- protractor;
- navigator's rule (speed-time-distance computer);
- wind drift computer;
- navigator's wrist watch (high-grade quality recording chronograph);
- pocket compass;
- table of radio beacon data;
- holders for flight log forms;
- pen knife;
- set of pencils and eraser;
- navigator's reference book;
- star chart;
- tables of dropping angles;
- Air Almanac (astromical data pertaining to air navigation).

In addition to the above, the navigator may of his own choice add various tables, reference books, nomograms and other accessories necessary for flight computation.

53. The pilot's navigation equipment contains:

- quadrilateral chart case for keeping maps;
- map scale; 50X1-HUM
- protractor;
- speed-time-distance computer;
- navigator's wrist watch;

- pocket compass;
- set of pencils with an eraser;
- pen knife;
- knee-pad.

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54. Every navigator and pilot should personally see to the completeness of his navigation equipment.

55. For the purpose of making precomputations before flight and for the convenience of work in flight, it is advisable for the flight personnel to include into the navigation equipment duplicate copies of navigation instrument correction charts for the plane they are flying on.

Precise Time Recording

56. Precise and safe flying, as well as the efficiency of aviation performance as a whole greatly depend upon the exactness of time recording.

Regular clock timing and precise time recording should be organized in all air units.

57. The duty of time observation rests upon the navigators of air units and constitutes part of their daily activity.

58. The precise recording and setting of clocks is accomplished by accurate radio time signals transmitted over broadcasts.

59. In all cases, whenever possible, accurate radio time signals should be relayed over radio transmitting nets, so that they may be heard in all service building and dwelling quarters of the unit.

60. When it is not possible to organize the transmission of radio time signals, they should be replaced by count signals given at least twice a day (during working time) and consisting of a preparatory and an exe

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otherwise, the transmission of radio signals should be arranged by telephone.

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61. In every air unit command post or meteorological station (MS) there should be a timer (chronometers), checked according to the accurate radio time signals twice every day. Near the timer a log should be kept, into which the chronometer corrections made and change over a day are entered.

The timers should be of high quality (with steady daily rate). They serve to define the necessary corrections of all other time pieces in the periods between accurate time signals and to determine the instants of accurate time sound signaling.

62. Not later than two hours before flight, all navigators should set their watches according to the timers or by the correct time signals. The accuracy of corrections made on navigation watches should be ±2 seconds.

63. The chronometer correction of aircraft clocks, as well as watches of the flight personnel should be made according to timer or accurate time signals at most two hours prior to flight. The difference between aircraft clocks and the personal watches of the flight personnel should not exceed half a minute.

64. The air unit (or air squadron) navigation officer should avail himself of every flight personnel line-up made by the air unit (or air squadron) commander, to check their personal watches, giving the time signal by his own checked watch.

Application of Ground Aids to Air Navigation

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65. Navigation officers of large a

by the navigation officer on duty from the Command Post (air-traffic Control point) of the air unit (large air force unit). 50X1-HUM

70. The navigation officer on duty at the command post (air-traffic control point) should have at his disposal:

- general survey chart, showing the net of related aerodromes and restricted areas;
- route map for the given day of flight operations;
- large scale map of the aerodrome and the target ground area with all zones plotted on it;
- map showing the bearings of the radio beacon and the radio direction finder;
- map showing the disposition of ground air navigation aids;
- a diagram of climbing and descent through clouds and over-the-top join-up procedures for the given aerodrome;
- operation instructions of the target ground and a diagram of it;
- instructions concerning the application of ground radio-direction finders and radar sets;
- exactly set and checked time-pieces, speed time--distance calculator, protractor, wind drift computer, map scale and pencils;
- command post or air-traffic control point log, kept by the navigation officer on duty;
- diagram and instructions for preventing loss of contact for the given net of related aerodromes;
- a radio receiver for controlling the operation of ground air navigation aids. 50X1-HUM

It is prohibited to begin the flight operations without checking the reliability and precision of ground air navigation aids.

Air Weather Service

67. Air weather service is provided for the sake of ensuring precision of air navigation and in order to prevent the possibility of encountering dangerous weather phenomena in flight. This is attained by:

- proper organisation of weather reconnaissance;
- proper information of flight personnel about the meteorological situation and the weather changes;
- timely (not later than one hour before take off) and precise balloon sounding information about the wind velocity in the aerodrome area at every 500 m. of altitude;
- timely and exact determination of the wind on synoptical weather charts for various route sections.

Ground Navigation Flight Control

68. Ground navigation control of flight operations is accomplished by:

- organizing reliable radio communication between the plane and the command post (air-traffic control point) of the air unit (large air force unit);
- ground radio direction finders;
- radar control and identification system;
- control of aircraft from early warning posts of Air Defence;

- observation by help of special supervisers sent out to various points on route.

69. Navigation control of flight op

71. The pre-flight duties of the navigation officer on duty are: 50X1-HUM

- to receive the briefing from the air unit (large unit) commander;

- if necessary attend the flight preparation and briefings of aircraft personnel;

- study the itineraries and flight plans for each flying crew;

- study the flying situation in the flying area, especially the actual meteorological situation and the trend of weather for the period of flight operations;

- check the operation of requested ground air navigation aids;

- give timely information to the entire flight personnel about all changes occuring in the flying situation;

- make all necessary computations and recomputations of the impending flights on the basis of wind forecasting and introduce the necessary corrections in urgent flight computations.

72. During the period of flight operations, the navigation officer is in subordination of the flight operations officer.

By direct wire communication with the liaison set, radio-direction finding station, radar post, air defence early warning posts and ground air navigation aid stations in the acrodrome area, the navigation officer is duty-bound:

- to verify continuously that air unit (large air force unit) aircraft should fly strictly adhering to designated routes as to place, time and altit

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- plot on the chart the actual tracks a

by the navigation officer on duty from the Command Post (air-traffic Control point) of the air unit (50X1-HUM force unit).

70. The navigation officer on duty at the command post (air-traffic control point) should have at his disposal:

- general survey chart, showing the net of related aerodromes and restricted areas;
- route map for the given day of flight operations;
- large scale map of the aerodrome and the target ground area with all zones plotted on it;
- map showing the bearings of the radio beacon and the radio direction finder;
- map showing the disposition of ground air navigation aids;
- a diagram of climbing and descent through clouds and over-the-top join-up procedures for the given aerodrome;
- operation instructions of the target ground and a diagram of it;
- instructions concerning the application of ground radio-direction finders and radar sets;
- exactly set and checked time-pieces, speed time--distance calculator, protractor, wind drift computer, map scale and pencils;
- command post or air-traffic control point log, kept by the navigation officer on duty;
- diagram and instructions for preventing loss of contact for the given net of related aerodromes;
- a radio receiver for controlling the operation of ground air navigation aids.

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spent by the planes, to record estimated and actual data concerning the flight of each plane in its log;

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- to verify the work of radio direction finders, radio homing stations and other ground air navigation aids;

- to see that meteorological information on weather changes is transmitted to the flying crews;

-to be in readiness for directing flying crew or an aircraft formation to some other point en route or give orders to return when the weather threatens flight safety;

-to help a crew or aircraft formation to take the fixed flight line or to make their way towards the designated reference point when the planes sheer;

- to assist flying crew or aircraft formation in regaining lost orientation or direct them towards their home or the nearest aerodrome (depending upon the tactical situation);

- to be on the alert to direct a crew or group to some other airfield for landing in case of sudden weather changes threatening the safety of flight;

- during descent through clouds and in over-the-top join-up procedure, to assist the flight operations officer by preparing data and computations and checking computations made by air crews;

- in the event of loss of contact by a flying crew or an aircraft formation to prolong the operation of requested ground air navigation aids and engage other aids to navigation (if they are idle), such as radio-direction

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radio beacons, and keep them in action until the return and landing of the flying crew or aircraft formation, taking measures to inform the flying crews about th

ground navigation aids brought into service.

73. In line of duty the navigation officer on duty should be guided by special instructions based on concrete base conditions of the air unit (large air force unit) on the specific features of the particular air forces branch and the nature of the mission on hand.

Post-Flight Navigation Control, Accumulation of Experience and Keeping Accounts.

74. The air unit (large unit) navigation officer should organize in air squadrons (air units) post-flight control of the quality accomplishment of mission in respect of navigation and personally carry out this control work.

Post-flight navigational control should pursue the following purposes:

- to ascertain whether the flying crew (air squadron) has approached the target or seen the object of reconnaissance in the palce indicated, and thereby check the authenticity of the report made by the flying crew (pilot);

- to ascertain whether hitting actually took place during bombing and determine its effects;

- to reveal the errors and faults in the navigator's navigational and bombing activities, in order to raise the accuracy of navigation and precision of bombing during subsequent flights; to prevent possible failures to arrive at a target, bombing amiss or loss of contact; to ascertain the crew's skill;

- to reveal examples of excellent operation, generalize the combat (drilling) experience and pass them on for the benefit of other crews;

- to accumulate documental data fo[illegible] and evaluating the flight operation of [illegible]

individual planes, in task-squadron

force units).

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75. The principal and most unbiassed method of post--flight control is by way of air photography.

Other methods of control may be by:

- first-hand observation by the air unit (large unit) navigation officer (commander) in flight;

- interrogating flying or individual members of the same flying crew;

- checking the entries in aircraft logs and the plotting on charts;

- checking the computation figures and actual data;

- obtaining inforamtion fromland forces about bombing results; by commissioning representatives to the land forces units for this purpose;

- reverse planning of the route, with consideration for recent balloon sounding information about the wind.

76. The shortcomings in the crew's navigation should be pointed out to it and its commander personally or during critique of the flight operation, with the view of eliminating similar deficiencies during subsequent flight.

77. The study, generaliztion and recording of navigational experience should be the duty of navigation officers, beginning with air squadron officers and higher up.

The navigation officer of an air unit (large unit) should reveal and take into account;

- the advantages and shortcomings of various navigational and bombing methods, as well as new suggestions of the flight personnel, confirmed by their flight experience;

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- the experience of organizing and

operations and bombing under heavy meteor

- the experience of organizing and performing flight operations and bombing under heavy meteorological conditions;

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- the experience of applying ground air navigation aids;

- the merits and demerits of aircraft navigation equipment and bombing armament, navigator's equipment, sighting devices, bomb-releases, computers, references, practical manuals and maps;

- the experience of navigation personnel of air squadrons, air units and large air force units.

78. The air unit (large unit) navigation officers, accumulating practical navigation experience, should apply it in their own air units, and after supplementing this data with their own suggestions for improving navigation service, present reports to their senior navigation officers, using the standard report forms.

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Navigation Service in Combat Operations

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General

79. When assigning and performing combat missions and adopting decisions, the air units and large air force units commanders should bear in mind the flying situation and the level of the navigational attainment of the air unit flight personnel.

80. The air unit navigation officer should be made familiar with the combat mission immediately upon its receipt from the superior staff office.

81. Upon receiving instructions from the commander or Chief of Staff, and having studied the mission on hand, as well as the tactical situation and the weather forecast, the navigation officer prepares his report to the commander, concerning his suggestions and computations on the following points:

- the best possible route and flight profile;
- air unit (large unit) join-up procedures and rendez-vous with the escort fighters;
- the endurance of flight up to the target and the take off time ensuring mission fulfilment in the alloted time;
- target manoeuvring;
- the bombing method, the best bomb-loading from the point of view of the nature of the target and bombing probability calculations;
- return run and time of landing;
- procedure of using radio navigati[illegible]

for the purpose of navigation and bombin[illegible]

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- break-up pattern procedure and procedure of descending through clouds prior to landing; 50X1-HUM

82. The navigation officer's presence is necessary, when the commander adopts a decision and also when assigning combat missions to be performed by air squadrons (air units) and services.

83. When the combat order is given by the commander orally, the navigation officer upon demand of the commander, announces his instructions pertaining to navigation, bombing and the application of ground air navigation aids.

84. When the commander issues a written combat order, the navigation officer supplements it with his navigational flight plan or with directives for navigation support depending upon the way the combat mission is to be carried out.

The navigational flight plan is issued, when all the air squadrons of the unit are to fulfil the mission along one and the same route.

The navigation directives are issued when the unit squadrons receive missions to be performed on different routes.

85. After assigning the combat mission to the air squadrons (units) the navigation officer should organize and check up:

- the provision of ground air navigation aids for the flight and the flight personnel's knowledge of them;

- the level of navigation training of the flight personnel of air squadrons (and units) to carry out their combat mission; 50X1-HUM

86. The navigation officer reports through channels about the air units (large units) navigational readiness to fulfil the combat mission on hand. 50X1-HUM

87. The Unit Navigation Officer should simultaneously with ensuring the alert condition of his air unit (large unit), make timely and thorough personal preparations for flight.

Bombardment Aviation

88. Navigation service in bombardment aviation provides for:

- join-up procedure of bomber formations into combat order and their rendez-vous with the escort fighters;
- navigation of planes and aircraft formations over different ranges and at different altitudes, either by day or by night, under different weather conditions and in the absence of ground visibility;
- location of the designated targets and precisely timed approach to them;
- precise target hitting;
- photographic control of bombing results;
- homing the planes to the assigned aerodrome of arrival upon completion of the mission.

89. In readying the bombardment aviation flight personnel for navigation, it is necessary to pay special attention to:

- the ability to find camouflaged enemy targets and precisely run the planes aircraft formations over them, without losing assume combat formation;

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- the ability to make precision sighting on short course of operational flight;

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- coordination of crew activities during bombing, bearing in mind that bombing precision depends equally upon the pilot and navigator.

90. During actions of large aircraft formations, the leading navigator should inform the leaders of separate bombing aircraft formations about the wind data received at the control point. During dive bombing and sighting by individual planes, the leading navigator also radios sight data to all flying crews.

91. When hitting targets located in close proximity to friendly troops, special care should be taken that all crews recognize the signals marking the front line.

Attack Aviation

92. Navigation service in attack aviation ensures:

- rapid readying for urgent sorties;

- accurate coordination with ground forces both as to time and place;

- safety of friendly troops when bombing targets located close to the front line.

93. While preparing the attack aviation flight personnel for flights, it is necessary to pay special attention to:

- knowledge of the flight operation area and especially of the target area, where the pilot should know the necessary typical landmarks, elevations, hollows, ravines and their directions, the minor inhabited points and their characteristic features;

- the ability to introduce mental cor

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for winds, target travel and mode of operat

changes.

94. An important part in ensuring the [illegible]y and reliability of attack aviation navigation is played by the stationary and mobile control identification check points, marking the front line, run of route approach to target and to aerodrome of arrival.

The positioning system of these check points should be simple and easy to remember.

95. A run over home territory should be planned with the least number of bends by the most characteristic reference points, at and in proximity to advance fighter plane aerodromes, in order to ensure landing of damaged planes and to cut-off pursuing enemy fighters. From the front line to the target and back, the route should be laid away from large inhabited points, aerodromes, anti-aircraft defence facilities and the main communication lines of the enemy.

The distance between the check points should not exceed 50 km.

Special attention should be paid to chosing the final reference point, removed about 5-10 km from the target site, as this reference point serves as the initial point for ground strafing. This point should be chosen on a large-scale map based on local topography.

96. Navigational flight plans of attack aviation should be made up in the form of diagrams. Apart from the general problems, the navigation plan should provide for computation of bomb sighting on the basis of wind forecasting in the target area, with subsequent introc

corrections in flight, computations of the compass courses and the time of the run by balloon sounding [illegible] about wind velocity.

97. While bombing targets located close to the main line of resistance, special orientation and s[redacted]recision should be ensured, to avoid hitting friendly troops.

98. Photographic control of attack aircraft bombing is, as a rule, made by one air crew specially assigned for this task, on behalf of the entire aircraft formation. In view of the difficulty of establishing the results of bombing on the battlefield, it is of primary importance to make photographs of the target before and after bombing.

99. During operations of solitary attack airplanes, it is necessary:

- to define the combat area (flight operation area), study the reference points bordering it, work out the track along the points of probable targets location, lay the track to the entrance reference point and from the exit reference point of the flight area towards the point of arrival in the terminal area;

- to consider the best combination of bomb ammunition sets, depending upon the nature of the probable targets.

100. During interaction of attack aeroplanes with mobile elements, it is necessary to plan in advance the tracks leading to the chosen control reference points, located along the axis of displacement of the mobile elements. These check points will serve as basic check points on the route, when the attack aeroplanes make their run when ordered up. Upon arriving at the basic route check point, the attack aeroplanes should proceed towards the indicated target upon command of the target director post or from the commander of the mobile elements command post.

In the absence of such direction, the attack planes make their approach to the target along the desig[illegible] 50X1-HUMse and in the appointed time, paying special attention to avoid destruction of friendly troops, for which purpose they should carefully examine the target, observe the recognition signals and the revealing signs of the targets.

IOI. During preparation of attack aeroplanes for night operation, special attention should be paid, to support plane navigation along the route and in the target area, by providing light beacons, light signal bombs and also radio--homing aids.

The target run should be made from the last light check point on the course and in time.

The principal method of night bombing is by low angle dive bombing.

The search for a target, its identification, and, if necessary, illumination, are entrusted to specially chosen and well drilled flying crews; the use of night bombardment aviation flying crews for this purpose is allowed.

Fighter Aviation

IO2. Fighter aviation navigation service ensures:

- constant alertness for rapid sorties by unknown routes within the area of operation;

- the best join-up procedure of fighters;

- rapid and precise solution of all tactical navigational problems, connected with escorting and guiding to enemy planes;

- homing.

IO3. During navigational preparation of 50X1-HUM pilots for flight special attention should be

- excellent knowledge of the combat area and the base area, memorization of the magnetic track angles and the time of flight to the principal typical landmarks; knowledge of the area and of the orientation methods should be perfected to such a degree, that every pilot after an air battle should be able to regain orientation immediately and take the direction for his home aerodrome;

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- knowledge of the location of radio-range and homing stations and the procedure of using them for the air navigation;

- knowledge of the procedure of sending out request for data from target director posts, for the purpose of position finding or homing to the landing aerodrome;

- ability to use the standard anti-craft defence map;

104. Air navigation by pilots in fighter aviation as distinguished from other branches of aviation, should be supplemented by ground control effected from command posts and target director posts by way of:

- guiding the fighter planes to the enemy target;

- giving friendly fighter planes their location;

- indicating to them the course towards the landing aerodrome.

105. The general preparation of maps for fighter aviation should be carried out in accordance with the rules laid down in chapter 6 of the given Manual. These maps should furthermore contain the center lines of routes in the directions of probable sorties, with a complete course lay-out and no-wind precomputations.

106. The center lines of routes plotted on the maps in advance are used for urgent sorties.

With even a short time available, all necessary flight time and course corrections should be made on the basis of balloon sounding information about the effective wind.

107. In order-up flights, navigation computations should be corrected after take off on the basis of tracks laid out previously and supplemented by knowledge of the area, visual measurement and mental computation.

108. When covering the operations of friendly ground troops and objects on the battlefield, the navigator should figure out the time of sending and changing patrols, allowing for the longest tolerable patrolling time of each shift.

Patrol plane navigation in the objects area should be supported by studying the typical landmarks and by planning manoeuvring in advance taking into consideration solar azimuths.

109. Air squadrons flying out to parry a blow of enemy aircraft should be aware of, or possess data on the course, flight time, altitude and place of encounter.

Success of approach to enemy aircraft depends upon the rapidity and precision of its accomplishment and in exact fulfilment of all pre-computed elements in flight.

110. While escorting, attack planes or transports, the fighter navigation service should ensure:

- a reliable procedure for rendez-vous with the escorted aircraft formations;
- retainment of orientation by escort fighter crews;
- timely return of fighter planes to landing aerodromes.

111. The rendezvous of fighter planes with the escorted bombers or attack planes may take place:

- above the home station of fighters;

- above the typical landmarks within the fighter's local flying area or over the radio navigation post;

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- on the target run;

II2. In solving escort problems, the fighter unit navigators should know:

- route, speed, flight altitude and composition of the escorted aircraft formation and the battle station of fighters;

- the time of passing the check point or the time of arrival to the rendezvous.

II3. The escort fighters carry on independent track control along the flight route of the escorted aircraft formation and should at any moment be ready to continue the flight independently.

The leaders of bomber or attack plane formations duty-bound to inform the fighters about the numbers of check points passed during flight.

II4. For the solution of escort tasks the fighters should know the terrain line or the time after which they should turn back to the landing aerodrome for fear of landing outside the aerodrome on account of fuel shortage.

The range of escorting is determined with relation to the bomber flight speed and the fuel capacity of fighters.

Liaison and Ambulance Aviation

II5. In its navigational preparation the flight personnel engaged in liaison and ambulance service, should pay attention to :

- acquiring excellent knowledge of the flight area up to the smallest typical landmarks, necessary for orientation by visual means at low and zero altitudes (separate

buildings, configuration of forests and fields, individual details of local topography);

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- provision of every flying crew with a prepared large scale map of the entire flight area with the principal routes plotted in advance;

- excellent training of flight personnel in orientation by visual means at low and zero altitudes.

II6. The flight route should be laid along typical (though perhaps small) landmarks, standing not more than 50 km apart, with regard for terrain and camouflaging conditions.

II7. In accordance with the conditions and tasks fulfilled by the liaison and mediacal service aviation, navigation should proceed mainly by aid of magnetic compasses. On curved route sections the flying crew should carry on uninterrupted orientation by visual means, referring to the general compass heading.

II8. In flights over areas deficient in reference points and in dark hours, it is necessary to be guided by landmarks and visual air navigation aids, in order to ensure track control and to find pinpoint targets.

II9. On liaison planes no radio equipped, orientation should be regained by running to some large ground linear reference.

NAVIGATOR'S FORMS 50X1-HUM

I20. As to their purpose navigator service forms may be classified into:

- documents organizing navigation service within staff headquarters;

- documents drawn up to provide navigational service for flights, runs and combat training;

- documents drawn up for navigational service of combat operations;

I2I. Documents organizing navigation service in staff headquarters include:

- documents drawn up in order to prepare material for adopting decisions (reports, operations, diagrams, tables, graphs);

- documents drawn up for the purpose of planning and organizing navigation service (working plans, inspection schedules, etc.);

- record and accounts material (logs, summaries, reports, individual flight records files, individual record cards).

The documents used to organize navigation service work within staff headquarters, should not, as a rule, be sent out of the headquarters.

I22. Among the documents prepared for navigational purposes to be used in flights, runs and combat training are the following:

- instructions designed to prevent the loss of contact in flights within the air unit (or large air force unit) base area;

- instructions concerning the use of target ranges and the safety measures to be observed during drill bombings;

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- directions given to air unit and large air force unit on readying the flight personnel for navigation duty;

- directives on the provision of navigational support of flights (runs);

- instruction concerning cloud breaking and landing with the help of ground approach control systems in heavy meteorological conditions and at night;

- instructions given to the navigator-on-duty at the command post (air traffic control point);

- instructions concerning the use of radio navigation and bombing aids.

All instructions and orders drawn up by the navigation service of flights (runs), should be signed by the chief of staff and navigation officer and are subject to approval by the commander.

The directions concerning navigational indoctrination of flight personnel should be signed by the navigation officer and approved by the commander or chief of staff.

I23. The navigators forms drawn up for combat operations include:

- directives concerning navigation support of combat operations;

- navigator forms;

I24. A directive on navigational support of combat operations provides for:

- organization of air units and large air force units and their rendezvous with escort fighters;

- routes (or routes center line) of air unit and large air force unit flights;

- flight profile and variants thereof, to be used in the event of changing weather conditions; safe altitude of flight;

- bombing approach procedure and heading; time of arrival to target of air units and large air force units; time in the air above target, manoeuvring in target area;

- bombing procedure, brief description of targets and technique reconnoitring; aiming points; variants of bomb loads with regard to targets assigned; bombing methods, alternate targets, and methods of appraising bombing results;

- designation of the main line of resistance, marking of friendly troops' disposition and target designations;

- alternate aerodromes and restricted areas;

- provision of air units and large air force units with meteorological data, including balloon sounding information, before take-off and in flight;

- instructions on use of radio and other ground air navigation aids for join-up purposes, route flights, target approach and return;

- directions for preventing loss of contact and its regaining;

- special directions to flying crews in distress; directions on jettisoning of hung or unreleased bombs;

- procedure for navigational preparation of air units and large air force units for combat missions;

- anti-radar measures;

- organization of navigation control.

I25. The combat navigation support directive may if necessary, be provided with the following supplements:

- join-up procedures (or join-up area) diagrams and air units and large air force units flight routes diagram;

- manoeuvring target chart; 50X1-HUM

- engineering and navigation flight computations (worked out together with the engineer);

- changes and additions to the list of ground air navigation aids.

The directive should be signed by the chief of staff and the navigation officer, with its subsequent confirmation by the commander.

I26. Navigator forms should include:

- flight maps for various scales, necessary to fulfill the flight mission;

- photographic plotting boards and target diagrams;

- flight logs;

- navigational reference tables and charts of join-up procedure, dropping angles, etc.;

- navigational reference books.

I27. The only forms allowed to be taken on board in flight, are those essential for the fulfilment of the mission and flying safety.

In each particular instance the list of navigators flights forms is determined by the commander releasing the flight mission order.

I28. The plotting of alternate aerodromes and ground air navigation aids on maps, should be made only by permission and choice of the commander releasing the mission order to the flying crew, and the only points to be plotted are those he indicates to that crew.

The commander is governed in his choice by the degree of their secrecy and by the necessity of ensuring the successful fulfillment of the flight mission and the safety of flight.

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Chapter 6

NAVIGATIONAL FLIGHT PREPARATION

I29. Navigational preparations for flight begin upon receipt of the flight mission. The purpose of these preparations is to minimize the volume of work in flight, to have everything necessary provided for and prepared prior to take off.

I30. In all flights including combat flights the flight personnel should be allowed sufficient time to ensure the most thorough navigational alertness.

I3I. Navigational flight preparation comprises:

- the selection and planning of the route;
- flight precomputations;
- thorough study of the route;
- the study of meteorological data and of the ground air navigation aids necessary to carry out the flight mission;
- elaboration of the navigational flight plan;
- preflight preparation of the navigation equipment, bombing armament and personal navigators equipment;
- check-up of flight readiness.

Selection and Planning of Route

I32. When the route is not definitely specified by the combat or training mission, it should be chosen upon consideration of the following:

- reliability of orientation;
- minimum number of bends on the flight course;
- maximum concealment during flights over the enemy territory;

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Selection and Planning of Route

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- reliability of orientation;
- minimum number of bends on the flight course;
- maximum concealment during flights over the enemy territory;

- the best target approach;

- terrain and meteorological conditions along the route;

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- restricted areas.

During drill flights the route may be planned without consideration of some of these items, but with mandatory accomplishment of all drill and flight elements prescribed for the given exercises.

I33. Route planning includes:

- plotting the track;

- marking the distances, track angles and time of flight;

- marking the legs;

- marking checks points, magnetic declination and terrain configuration.

The route should be plotted in clear, solid lines, figures and symbols, avoiding unnecessary obscuring of the map and check points. The size of figures should be 7-I0 mm. During formation flights all air crews should be provided with maps identical with the leader's.

I34. The track line begins at the point of departure -PD- (ИП М) and ends at the point of terminal -PT- (КПМ).

The departure should be some reliable reference point or radio navigation post (radio beacon, homing station or some radio direction finding station), at a distance ensuring aircraft formation's join-up. In some combat situations, the departure may, by decision of the commander be transferred to some place as far remote from the aerodrome as the front line.

The departure of the return trip -PDT- (ИПОМ) may be the bombing target or some typical landmark in the target

area, a radio navigation post, light beacon or smoke reference located on home territory and near the front line.

No marks from the aerodrome to the departure and from the terminal to the aerodrome should be made on the map during flights over the enemy territory.

135. The magnetic track - MTA- (MTK) should be indicated to the right of the line of flight, further right than the marks showing the distance and flight time, the base of figures directed to the departure (on the return track to the terminal of the return trip). The figures marking magnetic path angles should bear degree signs (°).

The magnetic track angle should be shown:

- at every bend in the course;
- after every 15-20 cm. on straight legs on the map;
- at all changes of magnetic declination exceeding 1°.

During triangular route flights with right-hand turns and small legs, the figures should be written to the left of the flight path.

136. Check points should be chosen:

- from among the most typical reference points, allowing for orientation as to range and heading;
- within the range of visibility from the path line;
- at every 50-150 km. of path, depending upon the tactical navigational situation and the particular branches of aviation.

The chosen check points should be surrounded with circles.

137. When flying without a navigator on board, the pilot should mark the wind symbols on the flight map sideways of the route;

light, or if the flight is made at night - the time of day-
-break.

I38. When the target is barely noticeable, the route should be planned to the reference point nearest to the target from which the flying crew approaches the target.
When the target is situated on a linear reference the route should be plotted with a deliberate deviation from it, in order that the crew, on approach to the linear reference might know in what direction to complete the target change-
-over.

I39. The difference in height between the terrain and the aerodrome of departure should be shown in a rectangle in meters near the target or landing aerodrome. When the height of the terrain exceeds that of the aerodrome of departure, it is marked by the plus sign, if vice versa by the minus sign.

I40. To change over to orientation by visual means on a search for the target, a large scale map of the target area should be prepared. The track from the last check point with distance marking, the track angle and time of flight to the target should be plotted on the map; the elevation difference of the site area and take-off airfield should be indicated near the target.

During flights to unknown aerodromes a large scale map of the landing aerodrome area should also be prepared.

When operations take place at the enemy main line of resistance, it is necessary to use large scale maps, photographic plans and diagrams to search for the target. The maps, photographic plans and diagrams should have plotted on them: the configuration of the terrain, front line, target (marked

by a red cross with a circle around it) and anti-aircraft defence facilities.

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Flight Precomputation

I4I. Flight precomputation should help to determine:

- length of route sections between principal check points;
- total length of route;
- time of flight on separate route sections;
- total endurance;
- spare flight time, depending on the endurance and the fuel capacity;
- time to take off and departure from the point of departure for arrival over the target or the landing aerodrome at the appointed time;
- time of landing;
- time of twilight and day-break;
- safe altitude of flight.

I42. On the basis of balloon sounding information obtained not later than I hour prior to take off, or in accordance with wind forecast data, it is necessary to calculate the ground speed values, as well as the flight time on every straight leg of the route and the total flight time over the entire route. In the absence of a navigator, the compass courses should also be estimated. If no information about the wind is available, the flight time should be calculated on the basis of air speeds.

The time spent on flying from the aerodrome to the point of departure and from the terminal to the aerodrome, as well as the time on take-off, join-up procedure, landing for locating the target, as well as the time spent in the

target area, should be added to the flight time en route. The figure obtained shows the total endurance.

I43. For maximum range flights, estimation of the fuel capacity should be made by the air unit engineer together with the navigator, on the basis of special instructions for range and endurance estimation on aircraft of the given type.

I44. The results of flight recomputation should be entered into the respective columns of the flight log. Flight log forms are provided for each aviation arm (see Appendices 3 and 4).

Route Study

I45. The route should be studied and plotted on the flight map simultaneously covering a strip of from 100 to 200 km, depending upon the particular branch of aviation and the nature of situation.

The flying crew should carefully and thoroughly examine and study the entire route from beginning to end.

As a result of studying the route the flying crew should possess knowledge of:

- the system of linear landmarks and the possibility of using them for orientation;
- the location of aerodromes, landing grounds and restricted areas en route;
- the changes of terrain on the route and the safe flight altitude;
- the reference points defining the front line or the state border;
- the reference points allowing use of radar facilities for orientation;

- the distinguishing features of reference points in the given navigational situation.

I46. The target area should be studied on the basis of large scale maps, plans and photographs.

As a result of studying the target area, the flying crew should know:

- the nature of the target, its dimensions and exact location;

- the system of reference points, ensuring rapid and reliable location of primary and alternate targets;

- a reliable reference point for locating the target in heavy meteorological conditions en route or in the target area;

- the difference in height between the target area and aerodrome of departure and altitude corrections;

- anti-aircraft defence of the target.

I47. The location of aerodromes and landing grounds should be studied by large scale maps, diagrams and air pilots.

Preflight Study of Weather Data and Aids to Air Navigation

I48. As a result of studying the meteorological data and aids to navigation, the flying crew should know:

- the meteorological conditions on all route sections and the trend of weather change during the flight;

- the location, kind and nature of operation of the aids to navigation and the possibility of using them for track track control, target approach and homing.

Navigator's Flight Plan

I49. The navigator's flight plan is a predetermined

plan covering the procedure of the crew in the air as regards navigation and bombing. 50X1-HUM

Depending upon the difficulty of flight and available time, the navigation plan may be:

- memorized;

- written down in the order of consecutive operations of the flying crew;

- made up in the form of a diagram with explanatory notes (see appendix 5).

The navigation plan should be made up for every route flight by air units navigators in case of formation flights, and also by the crews of all arms of aviation in case of individual flights with prescribed itinerary following the instructions of their superior navigation officers or in compliance with basic training (in the case of training flights).

A thoroughly worked out navigator's flight plan ensures successful accomplishment of the flight, prevents hasty decisions without preliminary computation, relieves the flying crew of superfluous discussion in the air, and ensures coordination among the crew.

150. The navigational flight plan should include:

- join-up procedure, as well as approach to the point of departure; beginning from take-off;

- procedures of entering a traffic pattern;

- procedure of track control and heading correction on separate parts of flight line;

- procedure of preparing bombing data, air photography, etc.;

- approach to the target;

- bombing procedure;

- approach to the terminal and landing aerodrome;

- break-up pattern and descent through cloud before landing;

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- method of regaining orientation after becoming disoriented while running for the target and back;

- measures to be taken in the event of drastic weather changes.

Preflight Preparation of Navigational Equipment Bomb-dropping Armament and Personal Navigator's Equipment.

151. The pre-flight preparation of navigation equipment, bombing armament and personal navigator's equipment includes:

- choice and inspection of the navigator's equipment, necessary to fulfil the flight mission;

- checking of the available navigation equipment and bombing armament, loose, as well as stationary, and of their condition; special attention should be paid to the magnetic and radio compasses, time pieces, sights, bombing-up corresponding to the bomb load, setting and timing of bomb fuses;

- arrangement and fastening of loose equipment and navigation equipment within the cockpits.

Control of Readiness for Flight

152. Not a single aeroplane should be cleared out of the local flying area without checking the crew's navigational alertness.

153. Navigation check-ups of crews cover the following points:

- readiness of the map and knowledge of the route;

- presence of flight computations and navigator's

flight plan and the ability of the crew to recite them by heart;

- presence of flight logs, tables and reference data for navigation and bomb dropping;

- presence of navigation equipment, bombing armament and navigator's personal equipment, all tested out and in good condition;

- correct recording of data on the performance of aids for air navigation;

- knowledge of airspace restricted areas and alternate aerodromes en route.

All faults revealed during checking should be eliminated on the spot before take-off.

154. Navigation alertness control should be carried out by the commanders and their navigation officers clearing out the given aircraft or aircraft formation, namely:

- the commander and navigation officer of a squadron should check the navigational alertness of every crew of their squadron;

- the commander and navigation officer of an air unit should check the navigational alertness of every crew subordinated to squadron commanders, as well as every crew to fly solo;

- the commander and navigation officer of a large air unit should check every crew subordinate to the air unit commanders.

The checkups of crew belonging to other units and engaged in cross-country flights should be made by commanders and navigation officers, to whom this duty is entrusted by order of the garrison commanding officer.

especially responsible and complicated flights made by large units, the chief navigation officer of a large unit should summon to the base aerodrome all the unit navigators for instructions and inspection, allowing them enough time to return to their units within three hours before take-off.

Clearance is granted by an entry in the flight log made by the controlling navigator and in the aeroplane flight report by the commanding officer.

I55. Navigation alertness control in units and squadrons may be carried out in the form of a quiz arranged at the end of preliminary preparation or, in exceptional cases, during pre-flight preparation.

All checking should be finished I5-20 min. before taxying out to the starting line.

I56. It is prohibited to clear planes out of the local flying area, or for runs and operational flights, when:

- the flying crews are not prepared for accomplishment of mission under the given conditions;

- when intending to land within one hour before twilight, excepting cases when night landing is provided for by the commander's decision and ensured by homing and night start aids; if the time in the air is less than one hour, take-off is allowed provided that landing will take place 30 minutes before nightfall;

- without a navigator on board the plane, if such, is authorized by the crew staff list.

Preparation for Flights without Navigators

I57. Flight maps should be folded in such a manner as to be always ready for use, without refolding, for the entire flying area or probable flight sector.

flights made by large units, the chief navigation officer of a large unit should summon to the base aerodrome all the unit navigators for instructions and inspection, allowing them enough time to return to their units within three hours before take-off.

Clearance is granted by an entry in the flight log made by the controlling navigator and in the aeroplane flight report by the commanding officer.

I55. Navigation alertness control in units and squadrons may be carried out in the form of a quiz arranged at the end of preliminary preparation or, in exceptional cases, during pre-flight preparation.

All checking should be finished 15-20 min. before taxying out to the starting line.

I56. It is prohibited to clear planes out of the local flying area, or for runs and operational flights, when:

- the flying crews are not prepared for accomplishment of mission under the given conditions;

- when intending to land within one hour before twilight, excepting cases when night landing is provided for by the commander's decision and ensured by homing and night start aids; if the time in the air is less than one hour, take-off is allowed provided that landing will take place 30 minutes before nightfall;

- without a navigator on board the plane, if such, is authorized by the crew staff list.

Preparation for Flights without Navigators

I57. Flight maps should be folded in such a manner as to be always ready for use, without refolding, for the entire flying area or probable flight sector.

I58. The flight precomputation and the necessary data for flight track control should be register 50X1-HUM pilot in his flight log (Appendix 3), which should be inserted into a special metal knee plotting case, or fastened on the instrument board.

I59. Pilots should memorize all magnetic track angles, distances and times in the air from all stationary reference points and other aids for air navigation as far as the base aerodrome.

Chapter 7

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NAVIGATIONAL FLIGHT RULES

160. The air unit (large unit) navigation officer is duty-bound to ensure that all flight personnel know and observe flight navigation rules. He must clearly realize that neglect of these rules leads to loss of contacts and failure of the flight mission.

161. The flight should be carried out in conformity with the determined navigation plan and flight computations. Rush deviations from the plan usually lead to flight complications.

162. The principal procedure of the air crew in flight comprises the following:

- approach to the point of departure after leaving the aerodrome;
- entry on the true course;
- track control;
- corrections of heading in case of side-slipping;
- manoeuvring with the purpose of arriving at the target at the appointed time;
- preparation of navigation data to ensure accomplishment of the flight mission;
- approach to the target and accomplishment of the flight mission;
- approach to the departure of return trip and the return trip line;
- control and correction of track on return trip;
- approach to the terminal;
- approach to the aerodrome of arrival.

In accordance with Chapter 6 of this Manual, navigational preparation and drawing up of the navigational flight plan

should be carried out in the stages indicated. 50X1-HUM

I63. Approach to the point of departure may be accomplished:

- by compass (the course having been computed before take-off), with simultaneous orientation by visual means;

- by use of aids for air navigation (homing radio-stations, light beacons) installed at the point of departure.

Flight above the point of departure should be accomplished with utmost precision.

Entry upon the Designated Track

I64. The compass course to be followed should be decided and corrected at the moment of approach to the point of departure.

The course of flight is determined by:

- ground precomputations based on balloon sounding information or prognosticated wind data;

- wind measurements taken in flight, prior to passing the point of departure;

- alignment of two reference points, or by a rectilinear check mark lying along the plotted track;

- radio bearings.

The procedure of finding the given flight course should be indicated in the navigation plan.

Track Control and Correction

I65. Control of the track consists in determining the actual line of flight.

Depending upon the situation, track control may be either:

- complete with aircraft position finding;

- by heading (determining the deviation plotted track), or

- by range (determining the position reached).

I66. Complete control is accomplished by:

- ground references;

- marking the moment of passing over the radio-navigation post;

- dead reckoning;

- by plotting of intersecting lines of aircraft position;

- obtaining aircraft position information from ground through inquiry by radio;

- combining several of the above mentioned methods.

I67. Track control by heading may be accomplished by:

- ground references;

- measuring the drift angle;

- a bearing from a radio navigation post falling in line with the track;

- celestial line of position parallel to the track.

I68. Range control may be accomplished by:

- linear ground reference perpendicular to the track line, or by reference points lying abreast of the track;

- dead reckoning;

- a bearing of a radio navigation post lying aside of the track;

I69. The deviations revealed by heading and range control should be taken into consideration during flight computation, or, if necessary, corrected with the aim of:

- recovery of the designated track;

- flight to the next control point;

- flight to the last check point before the target;

- approach to the target;

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- arrival to the target at the appointed time;

- timing the target approach.

I70. Correction of the track heading is accomplished by:

- correcting the previous heading, depending upon the extent of lateral deviation or changing of the drift angle;

- determining the new heading computed on the basis of new navigation data.

I71. Correction of track by range to ensure arrival at the target at the appointed time is accomplished by:

- changing the speed;

- changing the route length;

- combining both methods.

I72. On the control route section the flying crew should define the navigation data (flight speed, altitude, wind), necessary for the fulfilment of the flight mission. Computation of all data needed for the fulfilment of the flight mission, should be finished prior to entering the aiming zone.

I73. Upon completion of the mission, the flying crew, following the navigation flight plan, should run for the initial point of the return trip and fly to the aerodrome, observing all navigation rules.

Formation Flying (Navigation)

I74. The term "aircraft formation" denotes two or more aircraft proceeding in reliable visual contact and fulfilling one common mission.

I75. The flying crew leading an aircraft formation should carry out the flight in accordance with the general rules of air navigation; in addition to that:

- the pilot should avoid drastic evolutions, as well as drastic changes of mode of operation in flight, ensuring thereby the successful navigation of the wingmen;

- the navigator or pilot of a single-seater plane should inform the wingmen about the check points passed and communicate when necessary the magnitudes of navigational and bombing data;

- under heavy meteorological conditions compelling to extend the formation, the leading pilot, apart from giving orders to extend, should inform the wingmen about location.

I76. The navigator of an aircraft formation should be on board the leader. When an aircraft formation consists of single-seaters, the navigator should be a commander or assistant commander of the aircraft formation.

I77. The wingmen are duty-bound to keep constant orientation, dead reackoning and track control, and be ready to begin solo flight at any moment.

I78. The navigators of guided aircraft are always, except in air battles, fully responsible for track control, and dead reckoning, as well as for determining other data necessary for the performance of the mission, and maintain all flight forms.

I79. Depending upon the type of aircraft and the situation, join-up procedure of an aircraft formation up to air units unclusively, may be arranged:

- in a circling flight (in the local flying area, over a typical landmark or a homing radio-station);

- by turning through 170-180°;

- by turning together to the rated angle (approaching one another in a close sheaf or on parallel courses);

- by circling flight about a linear refer50X1-HUMrom a radio-navigator post.

I80. Join-up procedures of large aircraft formations are carried out depending on the situation:

- by circling along a linear landmark, or from a radio-navigation post;

- en route, while passing check points at the appointed time;

- by use of the homing radio station on board the leader;

- with the help of a ground radar set.

I8I. All variants of join-up procedure should be so organized, as to ensure:

- minimum time loss;

- maximum reliability of rendezvous;

- impossibility of confusion of air squadrons and units.

Work Map and Flight Log Entries

I82. Accurate and rapid map work in flight is one of the prerequisites of successful flight.

The following are plotted on the map during flight:

- aircraft position symbols;

- line of a new true course or track;

- line of aircraft position, by corresponding symbols;

- reconnaissance data (about the enemy, weather, etc.).

Radio bearings and celestial lines of position, as a rule, are plotted on a special map. If necessary, the following data may be transferred from the special map to the flight map: the aircraft position - by a symbol, radio bearing line - by a double-headed arrow, celestial line of position - by

a dash with arrow heads at both ends. 50X1-HUM

In all events the actual time to which the map mark refers should be recorded.

It is allowed to plot on the map:

- estimated time of flying over check point (to the right of the flight line);

- true flight heading;

- actual time of flying over check points (if not coincident with estimated); recorded above the estimated time and underscored.

When actual and estimated time coincide a new entry is not made; it is sufficient to underscore the estimated time.

183. Map plotting is done with lead pencils of medium hardness. All entries should be made legibly, no unnecessary data or figures encumbering the map. When no refolding of the map in the plotting case is needed, the planning and all marks may be made on the opaque celluloid surface of the case.

184. The flight log represents a form on which pre-computations of the actual value of flight elements are recorded at the time of their observation or determination.

Legible and complete entry of all flight elements into the log facilitates air navigation and promotes the successful accomplishment of the flight mission. The log represents also a report document on plane navigation and bombing.

185. In all flight forms the actual values should be e either underscored or entered into a special column. The corrected flight altitude and the true air speed should also be underscored.

True values, regardless of their degree of precision, include all navigation and bombing data, obtained as a result

of track control and referring to the present or past.

All precomputed navigation and bombing [illegible] 50X1-HUM ing to the estimated values.

Chapter 8

FLIGHT SAFETY RULES

I86. Flight safety rules requires the following navigational measures:

- prevention of loss of flight orientation;
- prevention of premises to collisions with terrestrial obstacles, as well as flight collisions;
- prevention of possible penetration into the airspace of restricted areas and unforseen penetration into enemy territory or neighbouring states;
- prevention of possible entry into weather conditions threatening flight safety;
- prevention of casualties from one's own bombs.

Prevention of Orientation Loss

I87. Orientation is considered lost, when the flying crew does not know its flight position and is unable to determine the further heading of flight for the fulfilment of its mission.

I88. Orientation may be lost as a result of:

- poor preparation of the crew for flight (poor knowledge of the flight area, incorrect and negligent preparation of maps, errors made in flight computations, absence of navigational flight plan, defective navigation equipment of aircraft, inability to use ground aids for air navigation or lack of knowledge of the nature and operation data of these aids);
- violation of regulations of air navigation by the flying crew, due to carelessness and lack of discipline (inobservance of the navigational flight plan, disregard of flight courses, lack of track control, gross errors in

determining actual track data, failure to use duplicate navigation instruments when the original ins[redacted] refuse in flight);

- poor supervision of flight operations (the crew being cleared out insufficiently ready for flight under heavy meteorological conditions, failure to provide the flight with ground aids for air navigation, or careless operation of these facilities, irresolute or incorrect action of the flight operations officer during weather deterioration or other changes in the navigational situation);

- involuntary non-observance of the principal navigation rules under emergency conditions or lack of self-control on the part of the flying crew (for instance, during strong counteraction from the enemy).

189. The flying crew actions to regain lost orientation are determinate by this Manual and defined by an order issued in the air unit (large air force unit), containing special instructions for preventing the loss of orientation and by the navigation plan, depending upon the concrete conditions of the air unit's (large air force unit's) disposition, the situation and the nature of the flight.

190. When the loss of orientation is established, the crew should:

- immediately report the loss of orientation to the air unit (large air force unit) command post (air-traffic control point);

- estimate of the situation, determine the residual fuel level, and immediately apply the methods provided for regaining orientation by the instructions and navigation plan, or follow directions received from the air unit (large air force unit) command post (air-traffic control

point);

When orientation is lost in the area of the state border or front line, the flying crew should plan its course to home territory, taking subsequent measures to regain orientation while flying over home territory.

I91. The crew should begin efforts to regain orientation by determining the aircraft position (by plotting on the map or mentally the track travelled down by the plane, by inquiries addressed to a ground radar station or radio-direction finder, by plotting intersecting lines of the aircraft position, determined by flying crew with the air navigation aids at its disposal).

In the event of impossibility to determine the aircraft position, orientation should be regained by flying towards a radio navigation post or some linear (large) typical landmark.

After first resorting to the air navigation aids available for restoring orientation, the crew is also obliged, when ground reference points are visible, to take measures for regaining orientation by visual means, by comparing the map with the terrain.

I92. Orientation being regained, depending upon the nature of the mission on hand, the fuel reserve and the time of day, the flying crew should make its decision as to its further actions, i.e., whether to continue or cease fulfilment of the mission, return or land at the nearest suitable aerodrome.

I93. When it proves impossible to regain orientation, <u>the crew commander should</u> :

- take all possible measures to save the crew and the aircraft, for which, not allowing out-of-fuel, he should land

at the nearest aerodrome or suitable ground; 50X1-HUM

- in night flight, if the fuel capacity is sufficient, remain in mid-air until dawn;

- in the absence of possibility to land even on the fuselage, measures should be taken for the crew bail out.

I94. When orientation is lost during a formation flight, the leader should be governed by the general rules on regaining orientation and in addition to that immediately send out inquiries to the wingmen about location. Upon receipt of the latter, the leader should check his own position, or, if necessary, order one of the wingmen that knows his location, to proceed forward to keep station and duties of leader.

In absence of radio communication in the aircraft formation, the crew which has retained orientation, on receiving the leader's signal showing loss of orientation, should come forward and signal their readiness to lead the formation.

When the crew of any of the guided aircraft has retained orientation but is convinced that the same had been lost by the leader, they should immediately, without awaiting inquiry, report location to the commander, or, when communication is absent, head forward and signal their readiness to lead the formation.

Replacement of an aircraft formation commander, who has lost orientation does not relieve him of responsibility for the final outcome of the flight.

Guided aircraft on becoming disoriented should keep station and report to the aircraft formation commander about the loss of orientation.

I95. When orientation is regained in time during flight and followed by accomplishment of the mission and landing on the home (indicated) aerodrome, but has necessitated a special

it is regarded as temporary loss of orientation.

Orientation not regained in flight or not regained in time, as a result of which the flying crew (or aircraft formation) was forced to abort the mission or to make a forced landing, is regarded as complete loss of orientation

I96. Every case of lost orientation (temporary or complete) should be investigated and analyzed in the presence of the flight personnel, for the purpose of establishing the cause od incident, ascertaining the guilty parties, and preventing the recurrence of such incidents. The results of this inquiry, recorded in due form, should be reported to the senior navigation officer.

I79. Persons guilty of complete loss of orientation owing to carelessness or lack of discipline, should be severely punished, up to being referred for trial.

Temporary loss of orientation, restored as a result of correct measures taken by crew, does not involve punishment.

Prevention of Collisions

I98. No crew flying under conditions of restricted visibility or within a cloud, has the right to descend below the designated safety altitude.

Safety altitude is the altitude which guaranties against collisions with the ground and obstacles during blind flight.

During flight preparations, the commander should on the basis of the navigator's report, determine the safety altitude, taking into account: terrain, the height of possible obstacles and the change of atmospheric pressure en route at the time of flight.

When the conditions do not warrant the fulfilment of the mission, the crew should land at the near[illegible] or return.

Safety Measures During Bomb-Dropping

204. To ensure safety during bombing the following occurences should be avoided:

- bomb damage;
- collision of the plane with a bomb dropped by a plane;
- destruction by one's own bombs, which results from dropping bombs below the minimum altitude designed for the given bombs and fuses;
- destructions by his own bombs during forced landings.

205. The preparation of bombs and bombing armament for the flight, so as to ensure safety of the crew, is the responsibility of engineering personnel.

The duties of the flying crew are:

- to check the proper preparation of bombs and bombing armament on the ground;
- to obey orders, directions and instructions concerning bombing and operation of bombing armament, as well as the handling of ammunition in flight.

206. In formation bombing at low altitudes, when using bombs with delay fuses, the commander should so arrange the combat formation, that the aircraft and aircraft formations flying behind, should not be hit by the bombs dropped by the aircraft in front.

For this purpose the distance between aircraft formations should be determined with relation to:

- depth of the aircraft formation;

I99. While performing flight along a large linear reference or airway the crew should make sure 50X1-HUM of the right of it.

In flying under heavy meteorological conditions and by night on airways the flying crew is obliged to maintain the altitude fixed for the given airline and given echelon.

Prevention of Encounter with Dangerous Flying Conditions.

200. Flying conditions that are dangerous to flight safety and lead to become disoriented and failure of mission, may be:

- fog;
- restricted visibility;
- overcast below the safe altitude of flight;
- thunder clouds, as well as squalls, spouts, etc.;
- ice-formation.

201. Traffic control clearance is given under various weather conditions by the air unit commander in accordance with Air Force Flight Operations Regulations.

202. A crew in flight is duty-bound to carry on constant observation of weather changes, especially the development of conditions dangerous to flight, and to report them to the commander, inquiring about the weather conditions en route, alternate aerodromes and at the terminal.

203. In encountering dangerous weather conditions unforseen by the weather forecast, the decision regarding the possibility of fulfilling the mission, as far as navigation is concerned, should be based on the skill of the crew and the ground navigation aids for fulfilling the mission under the given conditions.

- fuse delay;
- splinter spray radius;
- plane speed;
- length of bombing train.

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207. To avoid collisions with bombs dropped from other aircraft (or aircraft formations) it is necessary to observe definite time intervals between aircraft or aircraft formations.

208. During dive bombing, in order to avoid collision of a dropped bomb with an aircraft, the diving turn should be made directly after releasing the bombs.

209. In case of forced landing on an unprepared areas, on home territory, the flying crew should release the bombs, having set them in the "safe" position. Precision bombing should be carried on, with a view to the safety of local population and structures.

210. The safety measures for human beings and structures to be exercised during bombing drills, are determined by the Target Ground Service Manual.

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- splinter spray radius;

- plane speed;

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Appendix I

ABBREVIATIONS AND SYMBOLS USED 50X1-HUM
NAVIGATION SERVICE.

I. Points and Lines

D	(ИПМ)	- Departure
T	(КПМ)	- Terminal
TPR	(ППМ)	- Turning Point of Route
IPRR	(ИПОМ)	- Initial Point of Return Route
Ap	(МС)	- Airplane Position
TD	(ПБР)	- Tactical Divergence Point
CP	(КО)	- Check Point
CLP	(АЛП)	- Celestial Line of Position
DP	(КПП)	- Departure Point
MCP	(ГКП)	- Main Control Point
TDP	(ПЦН)	- Target Director Post
RNP	(РНТ)	- Radio Navigation Post(homing radio-station, radio-direction finder, radio beacon, etc.)
NLM	(СНТ)	- Navigational Light Markers (beacon search-lights, etc.)
BS	(ШВРС)	- Broadcast Station
RDF	(РСОН)	- Radio Direction and Finding

2. Angles and Bearings

N	(С)	- North
E	(В)	- East
S	(Ю)	- South
W	(З)	- West
TTA	(ИПУ)	- True Track Angle
MTA	(МПУ)	- Magnetic Track Angle
DTTA	(ЗИПУ)	- Designated True Track Angle
DTA	(ЗМПУ)	- Designated Track Angle

AMTA	(ФИПУ)	- Actual Magnetic Track Angle
ATTA	(ФМПУ)	- Actual True Track Angle 50X1-HUM
DA	(УС)	- Draft of Angle
TC	(ИК)	- True Course
MC	(МК)	- Magnetic Course
CC	(КК)	- Compass Course
D	($^{\Delta}$К)	- Deviation
	$^{\Delta}$ М	- Magnetic Declination
	Δ	- Variation
	($\Delta_{Р}$)	- Radio Deviation
	δ	- Wind Direction
WFA	(УВ)	- Wind-Fire Angle
CAW	(КУВ)	- Course Angle of Wind
CARP	(КУО)	- Course Angle of Reference Point
CARNA	(КУР)	- Course Angle of Radio Navigation Aid
RCR	(ОРК)	- Radio Compass Reading
PCA	($КУР_{опред}$)	- Precomputed Course Angle
TBRP	(ИПО)	- True Bearing of Reference Point
MBRP	(МПО)	- Magnetic Bearing of Reference Point
CBRP	(КПО)	- Compass Bearing of Reference Point
TBRNA	(ИПР)	- True Bearing of Radio Navigation Aid
MBRNP	(МПР)	- Magnetic Bearing of Radio Navigation Aid
TAB	(ИПС)	- True Aircraft Bearing (by reference point or Radio-Navigation Post)
MAB	(МПС)	- Magnetic Aircraft Bearing (by reference point or Radio Navigation Post)
LD	(БУ)	- Lateral Deviation (in degree)
ACRD	(ДП)	- Additional Correction for Remaining Distance
CC	(ПК)	- Course Correction
	$\mathfrak{G}$	- Correction of Grid Declination (on conic charts)
	$\mathfrak{E}$	- Loxodromic Correction (on orthographic charts)

ψ - Station Angle

VA (BY) - Vertical Angle

AT (YP) - Angle of Turn

β - Angle of Bank

ATA (YYP) - Angle of Turning Allowing

3. Speeds, Distances and Altitudes.

V_{tr}($V_{ист}$) - True Air Speed

V_{ind}($V_{пр}$) - Indicated Air Speed

V_{cl}($V_{наб}$) - Air Climbing Speed

V_v($V_в$) - Vertical Speed

ΔV_a - Aerodynamic Correction of Air-Speed Indicator

ΔV_{ind}($\Delta V_{пр}$) - Instrument Correction of Air-Speed Indicator

W - Ground Speed

U - Wind Speed

S - Range

B(Б) - Base (distance between radio navigation posts)

LLD (ЛБУ) - Linear Lateral Deviation

CL (КЭ) - Control Leg

H_t($H_{ист}$) - True Altitude

H_p($H_{бар}$) - Pressure Altitude

H_{rel}($H_{отн}$) - Relative Altitude

H_{abs}($H_{абс}$) - Absolute Altitude

H_i ($H_{пр}$) - Indicated Altitude

H_b ($H_б$) - Bombing Altitude

ΔH_{bp} ($\Delta H_{пр}$) - Correction Barometric Pressure

ΔH_{bar} ($\Delta H_{бар}$) - Altitude Correction for Changing Pressure

ΔH_p - Correction for Topographic Variation

R - Turning Radius

LTR (ЛУР) - Linear Turning Allowance

4. Astronomical Designation

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A	- Azimuth of Celestial Body
$h_c (h_B)$	- Computed Height of Celestial Body
$H_s (h_и)$	- Sextant Altitude
h	- Rectified Altitude
Δh	- Altitude Difference ($h_b - h$)
δ	- Star Declination
Z	- Zenith Distance
t	- Hour Angle
tgr ($t_{гр}$)	- Greenwich Hour Angle
α	- Straight Ascent of Celestial Body
r	- Star Refraction Correction
P	- Lunar Parallax Correction
S (C)	- Sextant Altitude Correction
q	- Correction for Earth Rotation
D	- Correction for Aircraft Displacement
A_{str} (K)	- Astrodome Refraction Correction
n	- Dip Correction
$\Delta \varphi$	- Polaris Correction

5. Elements of Time

t	- Time Interval
T	- Moment of Time
Tc ($T_м$)	- Local Civil Time
T_{st} ($T_п$)	- Standard Time
T_{gr} ($T_{гр}$)	- Greenwich Time
T'	- Time Reading
u	- Chronometer
ω	- Change Over a Day (chronometer)
N	- Number of Standard Time Zone
$t_\odot$	- Apparent Time

η - Equation of Time

S - Sidereal Time

S_{gr} (S_{rp}) - Greenwich Sidereal Time

6. Weather Data

P_o - Ground Pressure

P_H - Altitude Pressure

t_o - Ground Temperature

t_H - Altitude Temperature

t_m (t_{cp}) - Mean Temperature

t_{gr} (t_{rp}) - Vertical Temperature Gradient

7. Bombing Symbols

T - Time of Fall of the Bomb

θ - Characteristic Time of Bomb Drop (time of bomb dropping from altitude of 2000 m., at air-speed of 40 m/sec.)

A - Deviation of the Bomb

Δ - Trail Distance

γ - Angle of Trail

φ - Dropping Angle

S - Plane Trajectory During Bomb Dropping

∂ - Cross Trail of Bomb

D_t (Γ_4) - Depth of Target

W_t (δ_4) - Width of Target

φ_δ - Sighting Plane Tilt Angle

V_u (V_4) - Target Speed

l - Length of Bomb Train

t_c - Time of Train Drop

t_i - Time Distance Between Bombs in Train

i - Linear Distance Between Bombs in Train

n - Number of Bombs in Train

n' - Number of Bombs in Plane

D (Г)	- Depth of Combat Formation
B	- Width of Combat Formation
d	- Distance Between Planes in Combat Formation
l	- Interval Between Planes in Combat Formation
IPCP (НБП)	- Initial Point of Combat Path
CP (БП)	- Combat Path
CCM (С К)	- Course of Combat Mission
CSA (БУРП)	- Combat Sight Angle (relative to plane centre-line)
YC (УСД)	- Drift Angle on Combat Track
MR (ГД)	- Map Range
SR (НД)	- Slant Range
t_{lf} ($t_{гД}$)	- Level Flight Time
T_a ($T_ц$)	- Time of Arrival to Target
r_l (r_c)	- Light Radius
TL (ВВ)	- Time Lag
V_D($V_{СН}$)	- Rate of Descent
t_{burn} ($t_{гор}$)	- Luminous Bomb Burning Time
T_{FS} ($t_{тр}$)	- Fuse Time Setting
H_{DB} ($H_{ВВ}$)	- Dive Beginning Altitude
H_{BR} ($H_{сбр}$)	- Bomb Release Altitude
(ΔH)	- Loss of Altitude Between Beginning of Engage in Diving and Instant of Bomb Release
φ'	- Angle of Aligning - the angle between the vertical and sight line at the moment of going into dive
X	- Horizontal Projection of Plane Track from Beginning of Dive to Bomb Release
λ	- Angle of Dive Between Tangent to Plane Trajectory (relative to air and the level plane)
φ	- Aiming Allowance - the distance from the point of bomb burst to the intersection of tangent to plane trajectory (at the moment of bomb releasing) with the target horizontal

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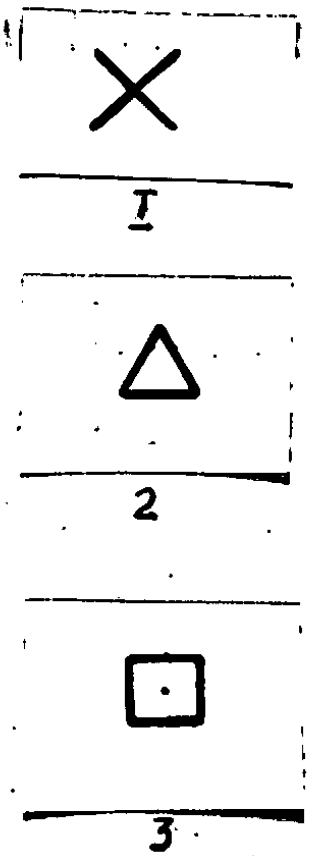

Ls (лп) - Line of Sight - line connecting bomb release point with point of impact

Ψ - Drift Correction Angle - angle between the direction of aircraft's longitudinal axis at moment of bomb release and line of sight

Ψ_δ - Lateral Drift Correction

$\Delta\varphi$ - Angle Between Plane Centre Line and Direction of Air-Speed Vector, at Bomb Release During Diving

f_δ - Standard Effect of Bomb Hit

$t_{man}(t_{МАН})$ - Manoeuvring time - from dive beginning to bomb release

$T_{dive}(t_{пик})$ - Diving Time on Straight Leg of Flight Path

Wind values of φ', A, ψ, φ, X, are marked with a "zero" index (φ_o', A_o, ψ_o, φ_o, X_o).

Symbols

1 - Sign of plane position determined on passing a reference point or a 30C (ground marker) (either visually or with the aid of navigational facilities)

2 - Sign of plane position obtained by plotting and cpmputation of track made good.

3 - Sign of plane position obtained by request from ground.

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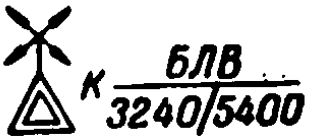

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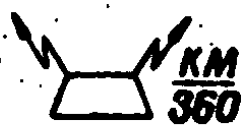

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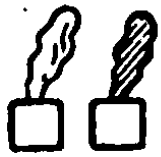

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a chart (the arrows show the way the fix is obtained).

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5 - Check point (ИПМ, ПП М, ПБР, ИП ОМ, КПМ).

6 - Target

7 - Stationary homing radio beacon.

8 - Mobile homing radio beacon.

9 - Automobile liaison radio station.

IO - Stationary liaison radio station.

II - Stationary radio direction finder. Letter C (K) (on the left side) stands for - command; L (Б) - lateral; O - separate; the numerator is the call signal; the denominator - frequency in KC. P.S. (aircraft/ground).

I2 - Mobile radio direction finder.

I2a- Falcon

I3 - Radio beacon.

I4 - Mobile radio beacon.

I5 - Radio direction and finding station.

I6 - Screening post (designated by the colour of screen).

4 - Sign of plane position obtained by plotting a fix on a chart (the arrows show the way the fix is obtained).

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5 - Check point (ИПМ, ПП М, ПБР, ПРОМ, КПМ).

6 - Target

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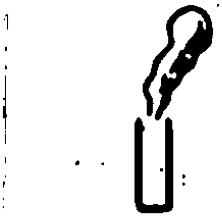

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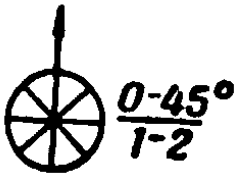

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I7 - Pyrotechnic candle.

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I8 - Ground of navigation Reference Symbols.

I9 - Code light beacon (transmits code signals KP).

20 - Rotating light beacon (rotation speed 6 rpm, time of operation - I min., interval - 2 min.).

2I - Light beacon, oscillating vertically (angle of rise 0-45°, operation - I min., interval - 2 min.).

22 - Light beacon, oscillating horizontally, oscillation angle - 60° between 240° and 300°, operation - I.5 min., interval - 3 min., angle of rise - 3°.

23 - Magnetic declination (with its corresponding plus (+) or minus (-) sign).

24 - Main altitude points of the area.

25 - Difference in height between target area terrain and aerodrome of arrival.

26 - Rendez-vous of aircraft formation over RNS (PHT) (radio-navigation station) (left-hand circuit, time of rendez-vous 6.00, altitude - 3000 m.).

27 - Bearing from reference point towards plane (time II.02)

28 - Bearing from radio navigation point to plane.

29 - Straightline of equal altitudes (celestial line of position).

30 - S 46 t 6.20 - Control leg of 46 km. to be covered in 6 min. 20 sec.

t 45° 4.I8 - Base at 45° sight angle in 4 min. I8 sec.

CC (KK) 2I5 - Compass Course 2I5°, angle of drift 50X1-HUM

H 7500 - Altitude 7500 m.
V 540 - Air Speed 585 km/hr.
W 585 - Ground Speed 585 km/hr.

8500 - Climb from 4000 to 8500
↑
4000

II.000 - Descent from II000 to 7000 m.
↓
7.000

I2.3I - Actual Time of Passing Reference Point.

I2.34 - Estimated Time of Passing Reference Point.

Appendix 2
/form/

50X1-HUM

T A B L E
of
Natural Light

Month of I95 .....
/ Name of Point /

Date	Time of Dawn	Sun-rise	Sunset	Dark-ness	Light hours	Dark Hours	Moon		
							Moon-rise	Moon-set	Phase

Appendix 3
50X1-HUM

Alert Status of ----------
/signature/

June I5, I95 .....

PILOT'S FLIGHT LOG

Dawn at 4.32 AM
Darkness at 8.IOP.M.

Computation Data: $\frac{S}{t}$ M Y $\frac{n}{P_k}$ CC(KK) MC(MK)	Route	Actual Data: Time	Actual Data: CC (KK)	Liaison facilities and 30C
$\frac{2350}{I200}$	Take-off	8.IO	260	λ = I96 m HP = 350 kg
$\frac{65}{I2}$ 90 $\frac{2200}{860}$ 95	D (M)	8.20	95	KM = 385 kg AH = 4IO kg
$\frac{30}{6}$ I37 $\frac{I900}{640}$ I30	Krupnoyc	8.3I	I30	
$\frac{70}{I3}$ 200 $\frac{I900}{640}$ 205	Ostrov	8.37	205	
$\frac{92}{I7}$ 265 $\frac{I800}{620}$ 270	Goluboye	8.50	270	
	Terminal (K M)	9.07		
	Landing	9.20		

Total duration of Flight I h. IO min.

Fuel Store for 0 h. 40 min.

Safe Altitude of Blind Flight - 800 m.

Signature

50X1-HUM

Appendix 4

CC(KK)	MC(MK)	DA(YO)	MPA(MTY)	V	W	H	Reconnaissance and other data
310							
299	298	-4	294				$\Delta V_{ind}(\Delta V_{пр}) = 0$
301	300	-5	295	315	365	3800	S = 60; t = 9.50
290	290			320		5000	LD(ДБУ) = 5; CC(ПК) = I
304	303	-3	300	403	380	5300	S = 38; t = 6.00
				320			δ = I60; U = 35
305	304	-3	301	320	380	5250	$\Delta H_{ind}(\Delta H_{пр}) = 0$
233	229	-4	225	403/320	410	5000	
I30			320			5200	
I25						4800	
III	I07	+2	I09	325	435	4500	S = 87; t = I2.00

86a

Alert Status of

Date " " I9

Precomputation of

Route	MPA MTY	MC MK	H	V
Departure				
Kamennoye	295	292	4000	400
Resnoye	301	303	5000	400
Ostrov	301	303	5000	400
Target	225	229	5000	400
IPRT(ИПО)	I29	I27	5000	400
Kramnoye	I23	I2I	5000	400
Terminal (КПМ)	III	I07	3000	400
Total				

Overall flight en
- 2 h. I0 min.

Fuel capacity - f

Safe flight altit
800 m.

H_b(Нб) 5000m.100м

K_b(Wб)-407km. CSA
p.h.

λ = λ = φ =

RNP and light bea

Call signal BH-40

Call signal ДЕ-36

Call signal МЧ-52

Dark I7 h. 58 min

Dawn 8 h. I6 min.

Po=760mm at (
U = k

t_o = -I0° H=300
U=30

t_H = -30° H=500

50X1-HUM

...nix 4

...ssance and ...ata

$V_{пр}$) = 0

0; t = 9.50

= 5;00(ПК)= I

3; t = 6.00

50; U = 35

$H_{пр}$) = 0

57; t = I2.00,

86a

Alert Status of ——————
/Signature/.

Date " " I9

NAVIGATOR'S FLIGHT LOG

Precomputation of Flight

Route	МТА МТУ	МС МК	H	V	W	S	t
Departure							
Kamennoye	295	292	4000	400	374	I30	20
Resnoye	30I	303	5000	400	373	38	6
Ostrov	30I	303	5000	400	373	78	I2
Target	225	229	5000	400	407	30	5
IPRT(ИПОМ)	I29	I27	5000	400	430	I8	3
Krasnoye	I23	I2I	5000	400	428	95	I3
Terminal (КПМ)	II0	I07	3000	400	423	I60	23
Total						549	I h. 22m.

Overall flight endurance - - 2 h. I0 min.

Fuel capacity - for 2 h. 20 min

Safe flight altitude, indic., 800 m.

H_0 (Нг) 5000m. ПОМ(К) - 229°

W_0 (Wг)-407km. p.h. | СБА(УР)- 4°

i = λ = | φ = 34° ψ =

RNP and light beacons

Call signal ВН-400 kc | №

Call signal ЛК-365 kc | №

Call signal МН-520 kc | №

Dark I7 h. 58 min. | Moonrise h.min.

Dawn 8 h. I6 min. | Moonset h.min

Po=760mm | at ground level δ = °; U = km.p.h.

t_0 = -I0° | H=3000 m. δ= I45° U=30 km.p.h.

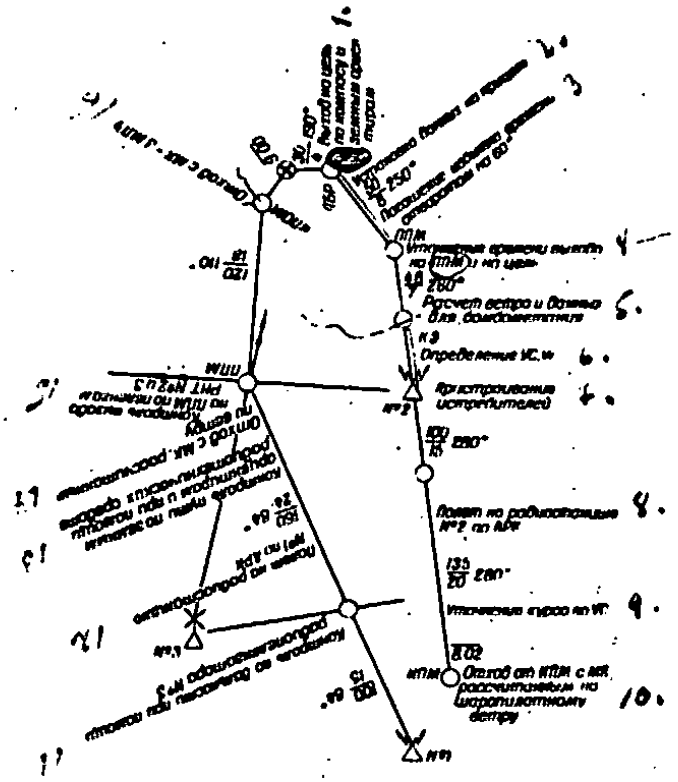
=30° | H=5000 m. = I50°

Name of Place	Time Comp.	Time Actual
Take-off	I3.30	I3.30
Departure (ИПМ)	I3.58	I3.58
Choice of MC on DA (УС)		I4.00
Zelenoye	I4.09	I4.08
(Wind defining)	I4.20	I4.I9
Kamennoye		
Resnoye	I4.25	I4.25
Ostrov	I4.37	I4.38
Target	I4.43	I4.43
IPRT (ИПОМ)	I4.47	I4.47
Krasnoye		I4.57
Terminal (КПМ)	I5.20	I5.20
Landing		I5.35

Flight endurance 2 h. 05 min.

50X1-HUM

NAVIGATIONAL FLIGHT PLAN



I. Approx _____ Reference Points

2. Range Setting ($\frac{50}{8}$ 250°).

3. Cancellation of Surplus Time by Turning to 60°

4. TPR (ПП М) - Determination of Time for Passing TPR (ПП М) and Target ($\frac{46}{7}$ 280°)

5. Computation of wind drift and bombing data CP (КЭ)

6. Determination of Drift Angle DA.W(YC.W)

7. Fighters Form next to Bombers ($\frac{100}{15}$ 280°)

8. Radio-range Flying towards Radiobeacon №2 on RC(АРК) (radio compass) $\frac{135}{20}$ 280°

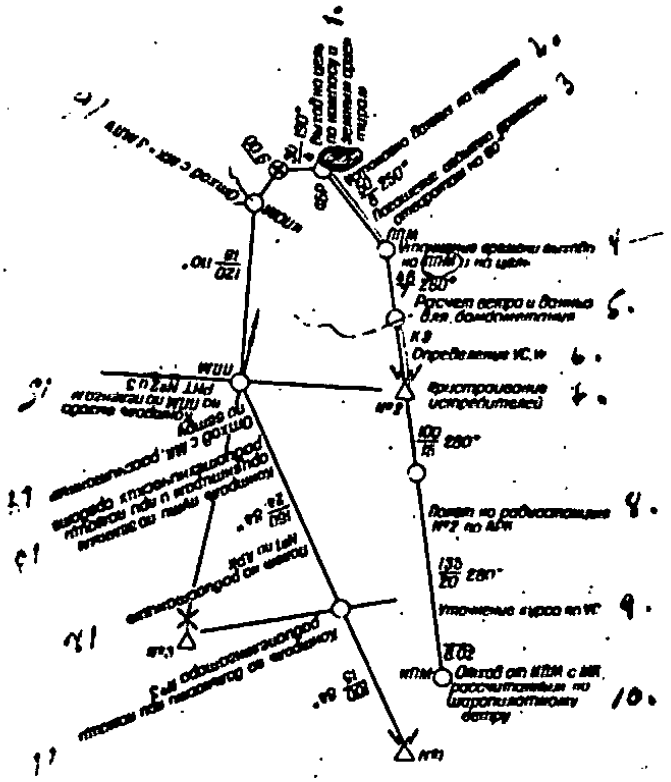
9. Definition of Course by YC (Drift Angle) 8.02

10. M - Departure from ИПМ (point of departure) with МК (magnetic course) calculated by the balloon sounding wind information. №I $\frac{106}{15}$ 84°

Appendix 5

50X1-HUM

NAVIGATIONAL FLIGHT PLAN



I. Approx[illegible] Reference Points

2. Range Setting ($\frac{50}{8}$ 250°)

3. Cancellation of Surplus Time by Turning to 60°

4. TPR (ППМ) - Determination of Time for Passing TPR (ППМ) and Target ($\frac{46}{7}$ 280°)

5. Computation of wind drift and bombing data CP (КЭ)

6. Determination of Drift Angle DA.W(УС.W)

7. Fighters Form next to Bombers ($\frac{100}{15}$ 280°)

8. Radio-range Flying towards Radiobeacon №2 on RC(АРК) (radio compass) $\frac{135}{20}$ 280°

9. Definition of Course by УС (Drift Angle) 8.02

10. M - Departure from ИПМ (point of departure) with МК (magnetic course) calculated by the balloon sounding wind information. №1 $\frac{106}{15}$ 84°

I3. Track Control by Terrestrial Reference Points and with the help of navigation Facilities. 50X1-HUM

I4. Departure from MC (MK) computed mentally

I5. Control of TPR (ППМ) Passing by Radio Bearing

$$\frac{\text{РНТ №2 and 3}}{\text{ППМ}}$$

$$\frac{120}{18}\ 110^{\circ}$$

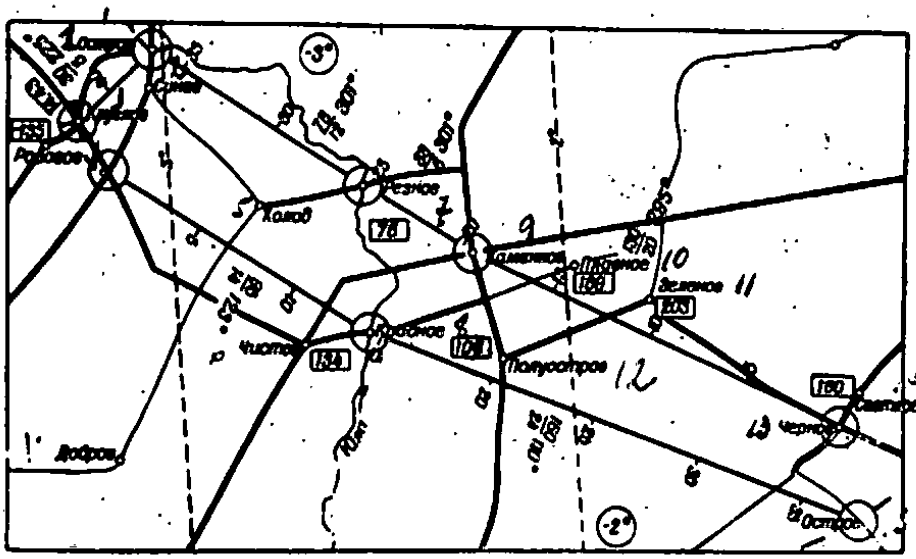
I6. D (ИПОМ) - Departure from MC (MK) = ЗИПУ

9.00

$$\frac{30}{4}\ 190^{\circ}$$

Appendix 6
50X1-HUM

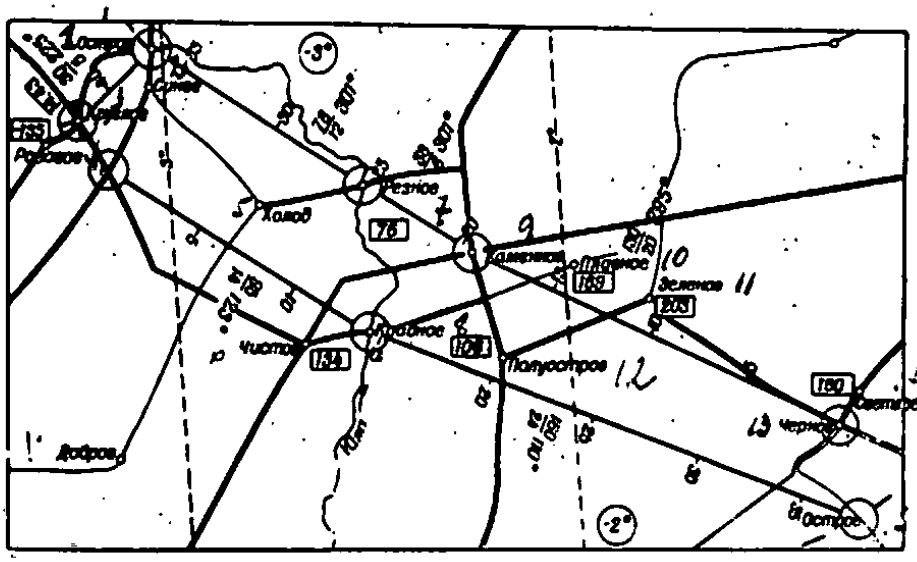
PREPARATION OF FLIGHT MAP



1. Ostrov; 2. Goluboye; 3. Krugloye; 4. Rosovoye; 5. Kholod; 6. Chistoye; 7. Resnoye; 8. Krasnoye; 9. Kamennoye; 10. Plavnoye; 11. Zelenoye; 12. Poluostrov; 13. Chernoye; 14. Svetloye; 15. Ostrov; 16. Dobroye.

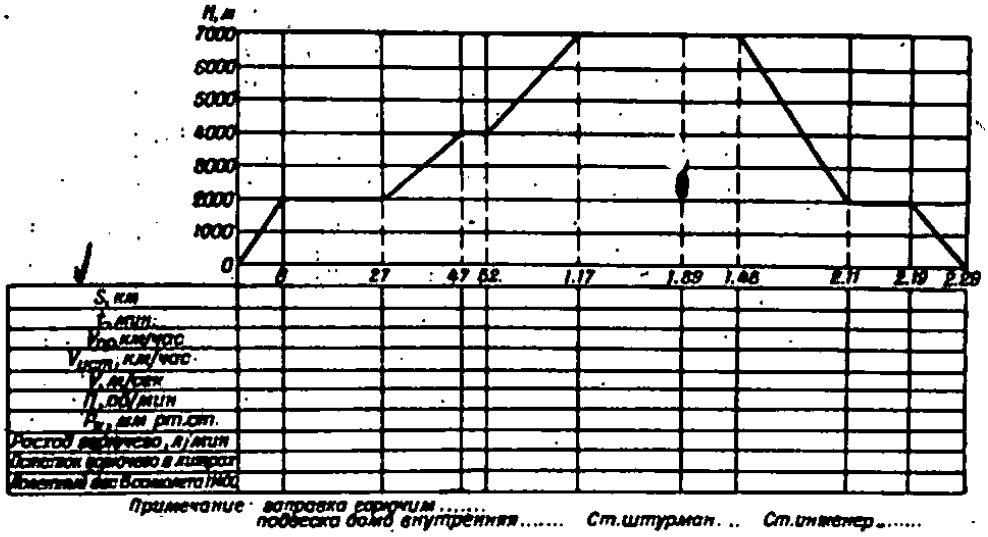
Appendix 6
50X1-HUM

PREPARATION OF FLIGHT MAP



1. Ostrov; 2. Goluboye; 3. Krugloye; 4. Rosovoye; 5. Kholod; 6. Chistoye; 7. Resnoye; 8. Krasnoye; 9. Kamennoye; 10. Plavnoye; 11. Zelenoye; 12. Poluostrov; 13. Chernoye; 14. Svetloye; 15. Ostrov; 16. Dobroye.

ENGINEERING AND NAVIGATIONAL FLIGHT COMPUTATION



S, Km

t_i min

V_{ind} ($V_{пр}$) Km p.h.

V_H ($V_{ист}$) Km p.h.

n - rpm.

P_K mm. m. c.

Fuel Consumption, I p.m.

Fuel Residual, I

Gross Weight G, II400

Note: Re-fuelling

Bomb inspection - internal

Senior Navigation Officer.....

Senior Officer .....

CONTENTS:

50X1-HUM

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