TRANSLATION OF CAPTURED JAPANESE DOCUMENT

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MACHINE GUN WARFARE

IWATA TAI
MG Sec

Outline of AA Warfare for Machine Guns

NAGOYA Aerial Defense TAI
May, 1942

Stamped: Military Secret.

Order of NAGOYA Aerial Defense Unit

NAGOYA Aerial Defense Order No 19

TSURUMAI Park

May 27th.

1. Machine Gun anti-aircraft warfare will be carried out according to this outline.
2. Rifle anti-aircraft warfare will apply with the necessary changes to the spirit of this outline.

Colonel KARIYA,
Aerial Defense Comdr.

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" " No 3. Conversion table of mils.

Outline of Anti-Aircraft Warfare for Machine Guns

Section 1 -General

1. The machine guns of the NAGOYA Aerial Defense TAI will shoot down low altitude hostile planes and perfect the heavy responsibilities of the aerial defense of NAGOYA'S vital areas. The unit will cooperate with the anti-aircraft gun firing if an enemy plane escapes at high altitude, or if it is repulsed and will carry out its combat duties

2. The machine guns must hold and destroy hostile aircraft. On account of this, you must maintain an unceasing observation day and night and keep close liaison with the immediate higher headquarters to which attached.

3. Since the sighting accuracy of a MG is best at about 30° angle of elevation and the fire power is most efficient within 1000 meters direct distance, the machine gun should wait and fire when the enemy plane is at a 30° angle of elevation and within 1000 meters range.

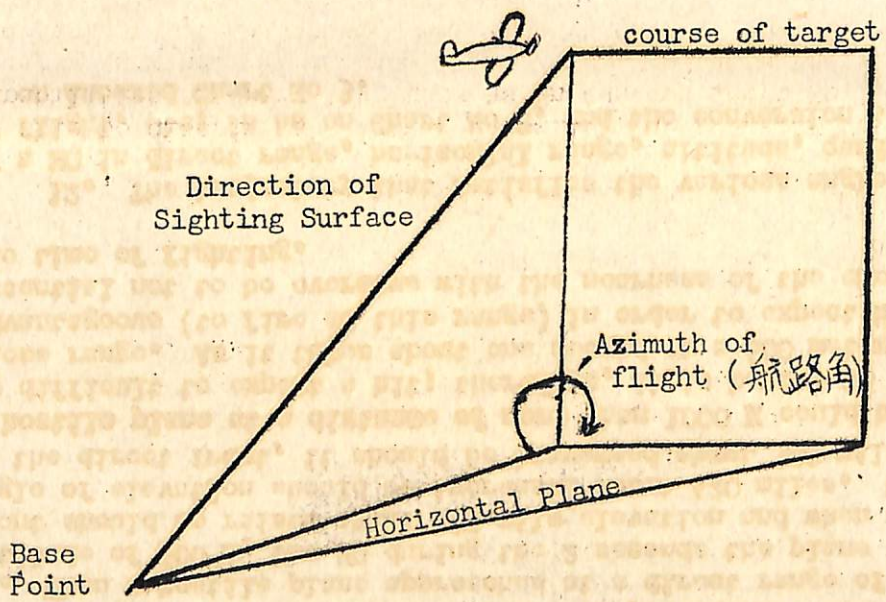
Section 2 - Capabilities of enemy planes.

4. As for a hostile airplane with a cruising radius of more than 2000 km, its construction and functions should be clearly known and you must be able to discriminate with reliability. Especially the names, designs, and capabilities of enemy airplanes as on Annexed Chart No 1, should be kept clearly in mind. It should be noted that as the war progresses the types and designs not only change and improve but the enemy uses their latest types in planning surprise attacks.

5. The flying speed of an airplane is the speed of the target indicated by the time (seconds) required to fly a distance of 500 M or is shown by the distance covered per second (meters/sec). It should be noted that pertaining to the capabilities of enemy planes, in order to make a display, they spread exaggerations of their strength and that by constant modification they have remarkably increased the capabilities. Generally after a plane releases its bombs, the flying speed is greater than before. The conversion table of flying speeds is as per Annexed Table No 2.

6. Even if the hostile plane is flying at a constant altitude, the external appearance will differ with the azimuth of flight (航路角).

The azimuth of flight is the angle in mils measured clockwise from the intersection of the vertical plane containing the line of sight and the vertical plane containing the line of flight with a horizontal plane through the base point.



Drawing No 1.

The azimuth of flight is zero mils whenever the target proceeds directly over the battery, 3200 mils when it passes by, 1600 mils if it makes a right angle turn to the left of the plane of the line of sight, and 4800 mils when it makes a right angle turn to the right.

7. For a hostile plane which advances directly at a constant altitude and a zero azimuth, there is no traverse, but the angle of elevation increases as it approaches. For a hostile plane flying horizontal at right angles (TN: To the line of fire) the angle of elevation is usually fixed, but the amount of traverse is great. However, for a plane approaching obliquely, the amount of traverse and the angle of elevation differs according to the size of the azimuth of flight. As long as the altitude and direction is fixed, it is usually easy to estimate the future position of the hostile plane. This is the reason for a machine gun firing fixed fire.

8. The maneuvers of a hostile plane which changes its altitude and azimuth of flight, turning, diving, climbing, changing direction, increasing speed, decreasing speed, etc, changes every moment and makes the prediction of its future position difficult. This is the reason why following fire of the machine gun is necessary.

9. The enemy's long distance reconnaissance planes and bombers are commonly equipped with MGs, and at times with automatic cannon; it is especially so in the case of large type heavy bombers. Moreover, it is essential for machine guns to fire accurately at closest range and shoot down the hostile plane before it has any opportunity for counteraction. However, when a hostile plane approaches and strafes from a long distance, the machine guns must face them quietly and carry out calm and intrepid fires and display the effectiveness of our stable fire power and annihilate the enemy.

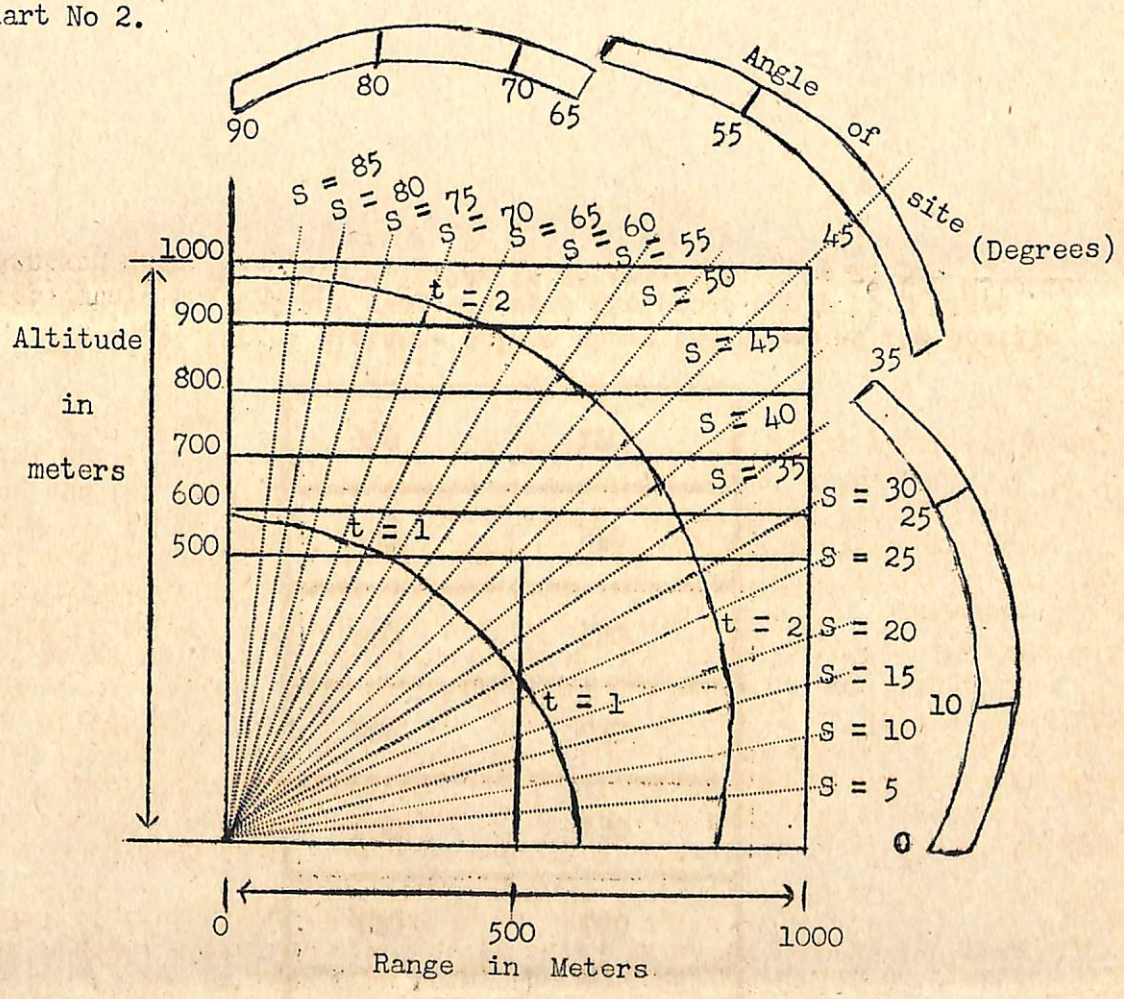
Section 3 - Capabilities of the Machine Gun

10. The anti-aircraft sighting instrument of a machine gun has the greatest accuracy when at an altitude of about 30 degrees. When the angle of fire is greater or less than this, the accuracy gradually decreases. For this reason, firing carried out at an angle of 30 degrees is, from the standpoint of firing accuracy, the most effective.

11. A MG projectile requires about 2 seconds in time of flight to go 1000 meters. During this period, a hostile plane flying at a speed of 150 meters per second will travel 200 to 300 meters before our shell reaches it. When a hostile plane approaches at a direct range of 1000 M and at an altitude of 500 M, the MG during the 2 seconds the plane is in its immediate front should be raised about 160 mils elevation and when departing, the angle of elevation should be increased about 420 miles. When going crosswise on the direct front, it should be traversed about 300 mils. Moreover, a hostile plane at a distance of more than 1000 M could be fired at but it is difficult to expect a hit; therefore, it is better to open fire at a close range. As it takes about one second at a 600 meter range, it is advantageous (to fire at this range) in order to expect hits. But, it is essential not to be overcome with the nearness of the enemy plane and lose the time of fighting.

12. The trajectory that satisfies the various angles of elevation of a MG in direct range, horizontal range, altitude, quadrant angle, time of flight, etc; is as on Chart No 2, and the conversion table for mils is as on Annexed Chart No 3.

Chart No 2.



Machine Gun Trajectory Chart (less than 1000 meters)

13. The time required to fire a strip (30 rds) with a MG is less than 4 seconds. When the gunner has time to fire several strips, he must be proficient in the loading process and make full use of the firing time, and display his maximum ability against aircraft.

14. If the machine gun must meet a hostile plane at a quadrant angle of more than 30°, it must fire at a range of less than 1000 meters. Even though the actual range may exceed 1000 meters the sight range must be ruled not to exceed 1000 meters whenever waiting to open fixed fire.

15. The distances of a straight flying plane, parallel to the ground at a quadrant angle of between 30 and 75 degrees, and at a direct distance of between 100 and 1000 meters, are as follows:

(a) When the hostile plan flies directly over the MGs. (the upper half)

Altitude in meters	Target distance in meters
100	150
200	290
300	440
400	600
500	730
600	620
700	530
800	380
900	170

The right target distance column shows the range of the hostile plane approaching the machine gun; the same distances apply to a plane leaving the machine gun. Its relation is as shown on chart No 3.

Field of Fire Chart

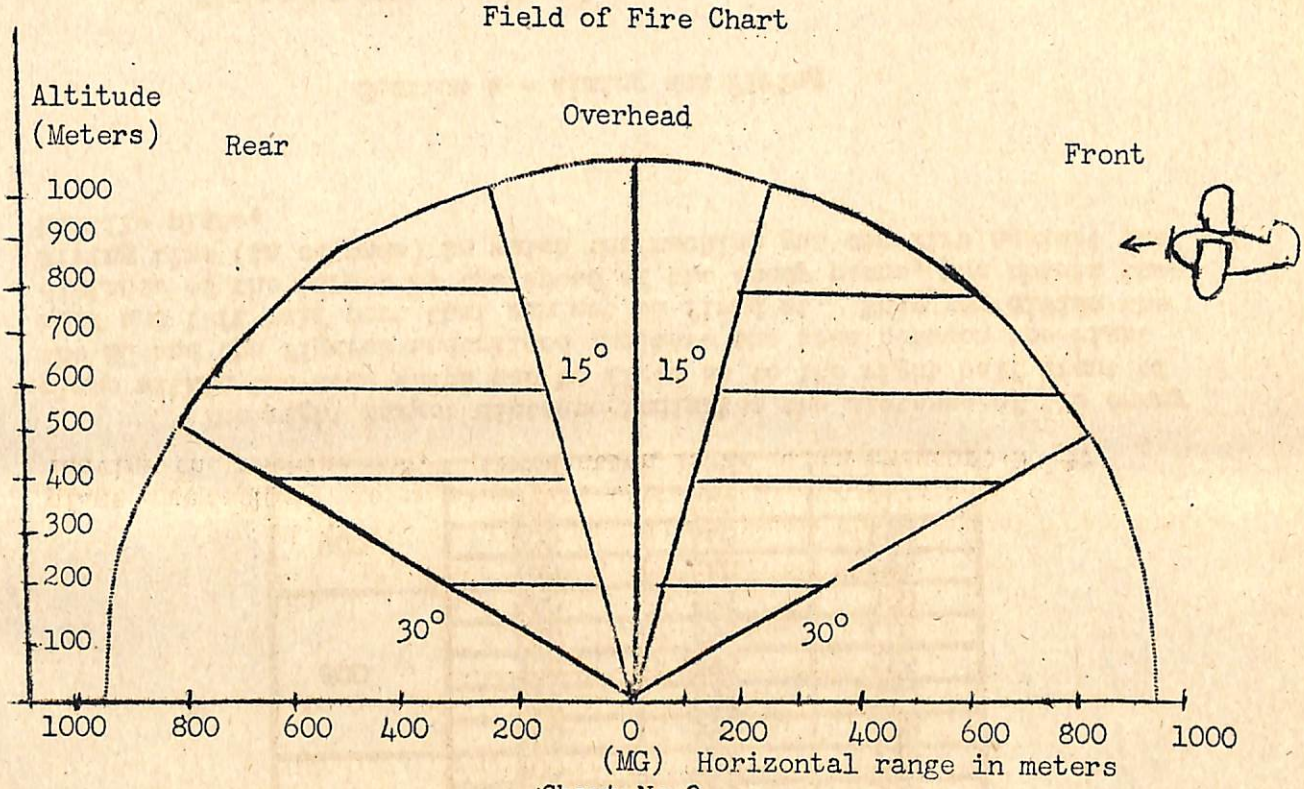


Chart No 3.

(b) When an enemy plane crosses (right half) in front of the MG within 500 meters.

Altitude	Nearest distance in meters	Furthest distance in meters	Target Distance (M)
100	100	170	140
200	100	330	320
	200	330	270
	300	330	150
300	100	520	490
	200	520	460
	300	520	400
	400	520	310
	500	520	120
400	100	680	670
	200	680	630
	300	680	580
	400	680	530
	500	680	440
	600	680	310
500	100	840	730
	200	840	820
	300	840	790
	400	840	740
	500	840	690

	600	840	600
	700	840	480
	800	840	290

When beyond 600 meters

Altitude in Meters	Nearest Distance in Meters	Furthest Distance in Meters	Target Distance in Meters
600	100	820	650
	200	820	780
	300	820	730
	400	820	690
	500	820	620
	600	820	530
	700	820	370
	800	820	150
700	100	715	530
	200	715	680
	300	715	640
	400	715	590
	500	715	500
	600	715	380
	700	715	130
800	100	595	380
	200	595	510
	300	595	515
	400	595	440
	500	595	330
900	100	440	195
	200	440	290
	300	440	315
	400	440	180

The right target distance indicates the distance of the enemy plane within the area which can be fired at to the right half front of the MG and the figures underlined indicate the area between the right half and left half part that can not be fired at. When you divide the distance of the target by the speed of the enemy plane, you obtain the firing time (in seconds) in which the machine gun can fire against the hostile plane.

Section 4 - Aiming and Firing

16. Firing against hostile planes is carried out by aiming directly

at the target by fixed or following fires. (see Part 3, Chapt 1, Sec 1, para 1, art 3 of Soldiers Firing Manual) Fixed firing is that done when aiming momentarily at one point of the enemy plane and carrying out steady fixed firing. Following firing is that which follows the movement of the enemy plane by always aiming at the plane and firing continuously.

17. Fixed fire is a method of firing carried out by laying down a barrage on the predicted future position of the enemy plane. When carrying out fixed firing, the MG must lay down a barrage in the path where the hostile airplane is certain to meet it. For example, against an enemy plane flying at a speed of 150 M, if you merely add a correction of 150 meters when aiming, the bullet according to the time of firing will finally just meet the enemy plane or will reach the point after the plane has passed. If you do as stated above, it is difficult to expect hits. For this reason; in the first correction add the necessary adjustment which is suitable to the skill in aiming and firing of the gunner and control the firing definitely on one point in front of the enemy airplane. If you do this you can expect to shoot down the enemy plane without fail. During this time, lay down an accurate barrage on the point where the hostile plane is expected to be shot down and continue this fire until it has been hit.

18. In following fire, the hostile plane is the aiming point; and the method of following fire is to adjust the firing direction and range of the MG and concentrate the cone of fire on the target according to the time of flight of our projectile and the amount of movement of the target. In executing following fire, the particular requirements are the clear decisions of the leader and the physical strength of the gunner. And when following fire is executed, it must not fall into fixed fire movements. Even though expecting to use following fire, when it appears difficult to follow the enemy plane because of its rapid movements, it is advantageous for the machine gun to carry out fixed fire from the beginning. And even though expecting to use fixed fire, when the movements of the enemy plane are unsteady, it is advantageous for the machine gun to carry out following fire. When the area in which you are able to fire is extremely limited and if you carried out following fire against the hostile plane, the firing time would be insufficient and the percentage of hits would decrease. If you carried out fixed fire when you had the opportunity, you can expect good results. Even though the time in which you can fire is limited, the officers and men of the machine gun units must be proficient in accurate firing and when there is opportunity to fire, must be able to obtain hits by fixed fire.

19. When executing fire against hostile planes, the MG plat leader will clearly indicate beforehand to his subordinates, while the target is out of range, the target, speed, method of fire, and range and cause them to open fire when it is necessary. When executing fixed fire, the platoon leader gives the following command. For example:

Target	Enemy heavy bomber from the South
Speed	150
Fixed fire	
600	
Commence firing	

In carrying out following fire, the orders are according to the previous list, and if necessary, the number of rounds is given. For example:

Target	Enemy airplane on the left
Speed	100
Following fire	
500	
2 strips	
Commence firing	

Section 5 - Conduct of Combat Operations

20. Against enemy aircraft, each ranking MG leader and subordinate must be especially self-possessed and recognize friendly and hostile planes; and all of the fire power of the platoon (小隊) must be concentrated on one enemy plane and must shoot it down. When a hostile plane enters our effective field of fire, the firing must commence, but when it is a fixed fire, commence firing before the hostile plane enters the effective firing area and definitely stop its entry.

21. It is necessary for each platoon position to have a sufficient field of fire and a firing area in which they can expect to shoot down enemy planes. However, it is advantageous if each platoon cooperating with its neighbors can concentrate the firepower of two or more platoons or as many as possible, on the desired enemy plane. However, everyone delaying the opening of fire at the same time and hiding under the name of concentrated fire or postponing the opportunity to fire is not suitable.

22. The MG TAI Comdr must station AA lookouts from headquarters and each platoon, and securely maintain liaison and close watch with Bn Hqs. The stationing of AA lookouts by the platoon leader also follows the above. In stationing AA lookouts, it is necessary not to be deficient in maintaining long term preparedness and to display sufficient observation capacity when it is required. However, it is prohibited to use as an excuse for the discontinuance of AA observation the maintenance of capacity for preparedness.

23. When a hostile plane comes attacking within the field of fire, the MG TAI should immediately, without any specific orders, begin the battle. As for opening fire in this case, although there is a difference according to the relation of the position of the BUTAI, especially in the effective fire area, and the movements of the enemy in the firing area where hits are definitely expected, in case you are able to make sufficient operational preparations, carry out accurate firing. Even though opening fire at a long distance, when spare time for firing preparation is lacking, strive to cause the enemy plane to climb or drive it away.

24. The determination of the MG TAI Comdr and platoon leader in respect to firing must be precise and firm. A MG which is unable to fire even one

round when the hostile plane makes a raid, is an inactive and inefficient specimen. Therefore, in fighting operations, the commander will be burdened with grave responsibilities.

25. In indicating the target, it is necessary to be clear and simple. For this reason, the platoon leader must indicate beforehand the base direction, or position, and if necessary must indicate the azimuths. In the Aerial Defense Tai, the names of the lookout areas which are established in order to search out enemy information must be well known to all soldiers in the machine gun TAI, and also, meanings of the orders and data which are necessary for the firing of the AA battery must be deeply understood. It is essential that the MG TAI Comdr announces the necessary information to his subordinate platoons prior to the appearance of the hostile plane and facilitates the discovery and indication of the target by the platoon leader.

26. Rapid and accurate judgement of speed and range is an important requisite not to be lacking in order to shoot down enemy planes. The MG TAI Comdr and platoon leaders must be well accustomed to estimating the range, speed and azimuth of the target so that they can open fire without any hinderance when the enemy makes a surprise air attack. The determination and announcement of data of the approaching enemy by the AA Gun Bn will be vital informational material for the MG TAI.

27. For a night-flying, low altitude hostile plane, the MG will fire at the silhouette of the plane or its lights as the target. As night is the most likely period for the enemy to attack vital areas, the security measures and fighting preparations of the MG TAI must not be neglected.

28. "Don't rely on their not coming, but let them come!", is the traditional characteristic of our Aerial Defense Tai. The machine gun TAI should not be bound by the former old customs but taking up the heavy duties of aerial defense, quickly grasping the essentials of aerial defense operations, even the matters shown in this outline, it should be able to exalt the fighting power with clear decisions and resolve.

ANNEXED CHART NO 1.

	Kind of Plane	Design	Characteristics		
			Speed in Kph " "(Sec) " "(M/Sec)	Range	Armament
DB-3	Heavy Bomber	Low-wing monoplane with slight dihedral angle. Fuselage rather large, straight leading edge, wing span 20 M.	450 (4) (125)	2300-3500	3 MG Bomb load 1,300 kgs

DB-7	Heavy Bomber	Mid-wing monoplane Retractable landing gears Wing span 40 M	400 (4.5) (125)	4000	1 or 2 HMG
(TN: ?) ARK 3	Patrol Bomber Flying Boat	High-wing monoplane with tandem engines and wing-tip floats Wing span 26 M.	270 (6.5) (75)	3000	2-3 MGs Bomb load 800 kgs
Consolidated PBY-1	Patrol Bomber Flying Boat	High-wing monoplane, twin engine, and showing a peculiar type of wing-tip, Wing span 32 M.	300 (6) (85)	4500	2 MGs Bomb load 100 kgs.
Curtis Hawk 75	Fighter	Low-wing monoplane, with dihedral wings and rounded tail-plane. Aircooled Wing span 22.37 M.	450 (4) (125)	2480	2 MGs Bomb load 136 kgs.
Brewster F2A-1 F2A-2	Fighter	Mid-wing monoplane with dihedral wings. Antenna pole is forward. Retractable landing gear. Tail plane, round and large. Wing span 22.4 M	530 (3.4) (150)	4000	6 MGs
Bell (Airacuda) XFM-1	Heavy fighter	Mid-wing, twin pusher engined plane, swept back wings, the tail rudder protrudes beyond the horizontal rudder. A fixed machine cannon is mounted in forward end of the engines.	530 (3.4) (150)	4000	4 MGs 2 Machine cannon

Vultee VII	Attack	Low-wing monoplane dihedral wings, air cooled engine Wing span 15.25 M.	370 (3.4) (150)	3930	6 MGs Bomb load 270 kgs.
Vultee V12-A	Attack Bomber	Projecting nose fuselage, large, long enclosed cock-pit	421 (4.3) (120)	2690	2 MG 2 Machine cannon Bomb load 1360 kgs
Douglas 8A - 3P	Pursuit plane	Resembling the type 97 light bomber the wheels can hard-ly be seen. Large rudder, on the under side of the fuselage there is a lower wing for landing use Wing span 15 M.	386 (4.7) (105)	3300	2 MGs
North American B-25	Bomber	Twin-engine, high-wing monoplane Dihedral wings and with retractable tricycle landing gears. Transparent areas in nose of fuselage. Twin tail planes, gun mounts in tail-end and on top. Wing span 20 M	520 (3.4) (150)	2800	Machine cannon
Martin 167	Rcn Bomb-er Attack plane	Mid-wing, air-cooled twin engined mono-plane. The fuselage is like a fish with a swollen stomach. Retractable landing gear. Wing span 19 M.	500 (3.7) (135)	4000	6 MGs Bomb load 567 kgs.

Boeing B-173	Bomber "Flying Fortress"	Four-engined with gun ports projecting on both sides and the bottom of the fuselage. Wing span 32 M	420 (4.3) (120)	6030	5 MGs Bomb load 1000 - 3000 kgs
Douglas B-18	Bomber	Mid-wing, air cooled twin-engine mono-plane. The face section of the fuse-lage is in 2 steps. The rear of the fuselage retracts upward. There are (TN: Illegible) gun mounts. Wing span 27.4 M.	460 (4) (130)	3200	3 MGs Bomb load 2000 kgs
Douglas B-19	Bomber	Gigantic plane, mid-wing, four air-cool-ed engines, triangul-ar shaped main wings Spherical gun turret in tail-end. Wing span 65 M.	336 (5.5) (95)	12000	Bomb load 1800 kgs
Consolid-ated B-24	Bomber	Mid-wing, four air-cooled engines. Twin tail. No dihedral. Retract-able landing gears. Wing span 33.5 M.	536 (3.4) (150)	4800	Bomb load 4000 kgs
Consolid-ated PBY-2	Patrol Bomber flying boat	High-wing monoplane with twin air-cooled engines mounted on wing. Gap between the two engines is narrow. The rising tail section is constructed at the rear of the hull.	330 (5.5) (95)	6400	Bomb load 1800 kgs

Consolidated XPB2Y-1	Patrol Bomber flying boat	High-wing with four air-cooled engines, has rectangular wings and the hull extends out in front of the engines The head section is in two steps.	352 (5) (100)	8300	Has MGs.
Martin 162	Patrol Bomber flying boat	High wing with twin air-cooled engines. The rear of hull slants upward. Twin tail planes.	400 (4.5) (110)	6400	Bomb load 3000 kgs
Boeing 314	Patrol Bomber flying boat	Dihedraled high wing four air-cooled engines, twin tail planes and in the end of the hull there is a vertical tail fin. On both sides of the hull numberous windows.	304 (6) (85)	4960	--
Bristol Blenheim	Bomber	Twin engined, air-cooled mid-wing monoplane. Dihedral, Gun mount projects out of top-center of fuselage. Wing span 17.16 M.	475 (4) (85)	3060	Bomb load 900 kg.
Vickers Wellington	Long range Bomber	Rectangular mid-wing, twin air-cooled engines. Long fuselage. Gun mount in tail. 2 antenna poles. Wing span 26.25 M.	430 (4.3) (120)	5150	3 MGs Bomb load 1400 kgs.

Armstrong Whitworth WWhitley"	Bomber	Rectangular mid-wing, twin air-cooled engines. Twin tail planes, long slim fuselage. Gun position in blunt tail. 2-step nose. Wing span 25.6 M.	392 (4.5) (115)	2880	---
Albatross	Transport	Torpedo-like, stream lined, low-wing, four engines. Twin tail planes. Engines project. Wing span 32 M.	400 (4.5) (115)	6400	---

CHART FOR CONVERTING FLYING SPEED

Seconds	M/per sec	KM/per hr
18	28	100
16	31	112
14	36	129
12	42	150
10	50	180
9.5	53	190
9	56	200
8.5	59	212
8	63	225
7.5	67	240
7	71	257
6.5	77	277
6	83	300
5.5	91	327
5	100	360
4.5	111	400
4	125	450
3.5	143	514
3	167	600
2.5	200	720

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