

# WING LEADER



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## Aircraft Data Card Creation

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version 2.2

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## WING LEADER ADC CREATION

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### INTRODUCTION

These notes are a guide for creating ADCs to the standard of second edition *Wing Leader*. They are a mixture of hard data, rules of thumb and some arbitrary values. In the second edition we aim to reduce arbitrary rating.

*Wing Leader* is a game of broad brushstrokes. A premise of the rating system is that aircraft can be grouped roughly by generation, and that within generations aircraft were broadly similar. However, enough granularity exists in the palette of game ratings and abilities that each aircraft can feel and perform very differently.

### HEADER STATS

#### Aircraft Model

The selection of model to portray is a key decision. In general, the most numerically important model of an aircraft is chosen. However, an iconic model may also be used. Thus we use the Bf 109E-4 rather than the more common E-7, because it was the iconic type for the Battle of Britain.

Nicknames are given in single quotes. Official names need no quotes. For non-English names try to show diacritic marks, macrons, etc. Allied nicknames for Japanese aircraft are given in parentheses.

#### Aircraft Class

Choose one of the seven classes. Usually, the choice is clear cut. However, multi-role aircraft, such as the Mosquito, may be difficult to classify. In such cases, apply the class appropriate for the most common role for that aircraft. So the Mosquito FB Mk.VI appears as a light bomber, even though it occasionally flew as fighter escort, while the Bf 110C-4 appears as a fighter, even though it could operate in the bomber role.

Heavy bombers are always four-engined types (though some Do 217 variants were classified as 'heavy' by the Germans, we class them as twin-engined Mediums here). The distinction between Light and Medium bomber can be fuzzy. Officially, a Medium bomber can carry a medium bomb load (approx 4,000 lb) to medium range (1,500 miles) but in practice this is a difficult rule to enforce. By the letter of the law, the Mosquito would be a medium bomber. Judgement calls must be made, which is why the Ju 88 is pushed into the Medium category while the SAAB B 18 slides down to light.

#### Victory Points

Assign Victory Points as follows:

- 1 VP     Single-engined fighter or bomber
- 1.5 VP     Multi-engined fighter
- 2 VP     Multi-engined light or medium bomber
- 3 VP     Four-engined heavy bomber

#### Nationality

Apply the nationality of manufacture, not of use. Where an aircraft was built under license, apply the nationality of the country of design origin.

#### Dates

Use the earliest known service date in the format 'Month Year'. (Occasionally this date might not be known, in which case the year of service entry is listed.) In some cases, the earliest known combat date might be substituted.

**Second Edition.** The main goal of the second edition of *Wing Leader* is to unify all the ADCs in the game and enforce consistency across the ecosystem of data cards. Uniformity was lacking in the first edition, in part because the manner in which the system evolved, progressing from a 'form fitting' rating approach towards a data-driven system, but also because notes were scattered across several documents. As a consequence, inconsistencies appeared and there were gaps in the rating process that needed to be plugged.

**Rounding.** Where math is involved, round fractions to the nearest, 0.5 values round up.

**Aircraft Model.** Because the game data is so broad brush, many variants can be encompassed by the main type. (See section on Variants.)

**Aircraft Name.** For reasons of space, we don't list the aircraft manufacturer in the name except where abbreviated (such as Bf 109). The one exception to this is aircraft from the Fokker company.

The seven classes of squadron are:

<b>Fighters</b>	<b>Light Bombers</b>
<b>Dive Bombers</b>	<b>Medium Bombers</b>
<b>Torpedo Bombers</b>	<b>Heavy Bombers</b>
<b>Transports</b>	

Note that the choice of class can affect the data card, because ratings are based on how an aircraft is expected to behave in that role.

**Fighter VP.** For the second edition the VP for multi-engined fighters has been reduced from 2 to 1.5 VP, because in some scenarios having VP equivalent to medium bombers was creating perverse incentives. Note that scenarios featuring these aircraft must account for half VP values in the victory conditions.

## ALTITUDE BANDS

On the ADC, combat, climb and bomb data is divided into bands based on altitude. Defining the bands is a key task.

### Altitude Levels

For the purposes of ADC rating, each altitude level in the game is 500 metres. Counting from altitude 0, this means that altitude level 1 represents 1,000 metres, altitude 3 is 2,000 metres and so on.

### Number of Bands

As a rule, heavy bombers display two bands, which we call 'bottom' and 'top'. Fighters, light bombers (including dive bombers and torpedo bombers) and medium bombers display three altitude bands, which we will call 'bottom', 'middle' and 'top'.

Rocket aircraft represent a special case and have no altitude banding.

### Heavy Bomber Bands

The bottom band extends from altitude zero up to the aircraft's service ceiling. The top band extends above this.

Climb values are 2 for the bottom band and S for the top band.

### Fighter Bands

The bottom fighter band extends from altitude 0 up to an altitude defined by the aircraft's climb rate, as shown in the sidebar table.

The middle band extends from the bottom band up to the critical altitude at which the aircraft achieves its maximum speed. The best source of data for an aircraft's critical altitude is a doghouse plot from a flight test report. Failing that, most max speed listings will give the critical altitude. The top altitude band extends above this height (though see the sidebar).

Climb values are 1 for the bottom band, 2 for the middle and 3 for the top.

### Light and Medium Bomber Bands

In the second edition the bottom band depends on whether climb data is available. Where it is, use the bottom band table in the sidebar to set the bottom band. Where it is not, apply a bottom band of 0–2 for light bombers, dive bombers and torpedo bombers, and 0–1 for medium bombers. This reflects formation climb rates.

The middle band extends from the bottom band up to the aircraft's service ceiling. The top band extends above this.

Climb values are 1 for the bottom band, 2 for the middle and S for the top.

## SPEED VALUES

Speed is the core value used in air combat. Turn ratings are derived from the speed value.

We use max level speed at the aircraft's critical altitude as the basis for speed in the game, as this is the best reflection of variables such as power-to-weight. Where conflicting sources exist, make a call as to the most credible source data, though it's worth leaning towards the conservative side (i.e. lower rather than higher).

Note that data for some aircraft can be suspect. The Americans would measure speed in terms of speed at emergency power and maximum boost, but the Japanese did not always measure it this way. Similarly, speeds for German fighter speeds tend to reflect maximum with boost.

The formula for speed is:

$$(\text{max level speed in mph}/50) - 2.$$

**Altitude Levels.** Game altitude levels map to real-world heights as follows:

Altitude Level	Metres	Feet
0	500	1,640
1	1,000	3,280
5	3,000	9,840
9	5,000	16,400
13	7,000	22,960
17	9,000	29,527

Note that German bombers in the Battle of Britain would raid at altitudes around 7 to 9 (~13,000 to 16,000 feet), while 8th Air Force heavy bombers would raid around altitude 13 to 15 (~23,000 to 26,000).

Given that *Wing Leader* is an impressionistic game, rather than one that measures movement precisely, please don't get too hung up on exactitude with these heights.

**Bottom Band Table.** Define the altitude range of the bottom band based on climb rate, as follows:

Climb Rate (ft/min)	Bottom Band
Under 1,000	0–1
1,000–2,400	0–2
2,500–2,900	0–3
3,000–3,400	0–4
3,500–3,900	0–5
4,000–4,400	0–6
4,500–4,900	0–7
5,000–5,400	0–8

**Banding Exceptions.** The MiG-3 is an interesting exception. Because it was optimised for peak performance at very high altitude, it was given four bands.

**Fighter Middle Band.** An aircraft's maximum speed is achieved at the critical altitude where the curves for airframe drag and powerplant efficiency converge. Above the critical altitude, speed falls off. To reflect the slow rate of speed fall-off as altitude increases, I sometimes make an arbitrary call to extend the middle band one altitude level above the critical height. For example, if the critical altitude is at 12, I'll rate the middle band up to 13. I generally don't do this where aircraft critical altitudes are 10 or below.

**Bomber Climb Values.** These have been increased for the second edition, to permit faster climbing at low altitudes.

**Speed.** The grand thesis of *Wing Leader* is that victory in air combat usually went to the swiftest. Manoeuvrability turned out to be less important than power and speed. The pre-war biplane fighter advocates lost that argument, though in the right conditions these aircraft proved to be a handful. The division of aircraft into 50 mph bands is crude, but works to define generational improvements. As the war dragged on, leaps in performance tended to be in increments of 25 mph or more.

**Meteor F.3.** Though the Meteor F.3 was a jet, it was significantly slower than the Me 262 and Me 263 in its early incarnation, and so has a speed fixed at the same scale as piston-engined aircraft.

**Low Altitude.** Aircraft fly slower at low altitude than at their critical height, because of air resistance in the thicker air and because the engines are optimised for higher altitudes. However, we don't really measure this in the game--instead assuming that speeds for most aircraft fall off at a similar rate.

**Turn Values.** As the single most arbitrary rating in the game, Turn values need to be set with care. One must be cautious of sources when assessing turn modifiers. There is a tendency for pilots, in memoirs, to insist that their aircraft was exceptionally agile. If we were to take them at face value then every aircraft in the game would get a turn bonus. As a rule I disregard anecdotal accounts and I am *very* conservative when applying bonuses. People creating their own ADCs should try to be objective rather than let their enthusiasm for a favourite aircraft run away with them, otherwise everybody's ADCs will feature super-agile beasts.

**Edge Cases.** Though we generally don't stack turn modifiers, there are edge cases where certain factors stack or cancel out.

*Example 1:* British two-seat single-engined naval fighters were underpowered for their weight, but also had low wing loadings, as befits a naval fighter. So these factors cancel out and no Turn modifier is applied.

*Example 2:* British turret fighters were exceptionally heavy and underpowered, and other than the turret had inadequate armament, making them vulnerable to more agile aircraft. These have been rated as having Turn values lower than their speed.

**Bomber Defence.** The representation of bomber defences in the game is both broad brush and subtle. Most bombers are not downrated for being multi-engined multicrew aircraft, because the penalty is cancelled out by the defence rating bonus. This is a reflection of common tactics and usage rather than the performance of the airframe and engines.

This gives a speed value at 125 mph of 1. Speed values increase by 1 increment for every 50 mph of max level speed. So speed increases to 2 at 175 mph; 3 at 225; 4 at 275; 5 at 325; 6 at 375; 7 at 425; 8 at 475.

### Jets and Rockets

Jets and rockets are special cases, not rated on the same scale, because they break the rating system. So we fix these speeds at 9.

### Edge ▶ Rating

Generally, if an aircraft is just over a speed threshold we rate it that speed. If on or just under (say, within four or five mph) we rate the speed value as the lesser of the two bands but assign an Edge ▶ rating.

### Low Altitude

We do not reduce speed values in the bottom altitude band. However, some aircraft perform particularly well at low altitudes, often because their engines are optimised for combat in that realm.

Where a doghouse plot exists, the general rule is to try and compare sea level speeds with a Bf 109 of an equivalent generation. If speed at sea level is substantially greater, on the order of 20-25 mph, give that aircraft a +1 speed bonus in the bottom altitude band.

In the absence of a doghouse plot, look for other signs that an aircraft is comparatively fast at low altitude. This was a particular feature of Soviet fighters with their inefficient but large capacity engines and lightweight airframes. Low altitude bonuses should not be given out lightly.

### Top Altitude Band

In the top altitude band, take the speed value for the middle altitude band and reduce it by one.

## TURN VALUES

Turn values are derived from the speed value for their altitude band, with a modifier based on known turn or agility characteristics of the aircraft. In general, we apply modifier only when warranted. Rate only if the aircraft clearly demonstrates one of the following characteristics:

**-1 Power inadequate for weight.** Penalize turn by one in the following situations:

*Case 1:* Notably heavy or high wing-loaded single-seat aircraft. *Examples:* P-47, Tempest.

*Case 2:* Single-engined light bombers, including dive and torpedo bombers. *Examples:* IL-2, Ju 87, B5N. Does not apply to very light-weight or biplane bombers such as the D3A1 or Swordfish.

*Case 3:* Multi-engined multicrew aircraft, where the weight of crew, powerplant and equipment affects agility. *Examples:* Bf 110, all medium and heavy bombers.

**-1 Overpowered Airframe.** Applies to aircraft near the limits of their design 'stretch'. *Examples:* Fw 190D, Bf 109K.

**+1 Lightweight Aircraft.** Very low wing-loaded aircraft, or ones that demonstrated a notable horizontal fighting advantage compared to its peers. *Example:* Merlin-engined Spitfires.

**+2 Very Lightweight Aircraft.** This is limited to biplanes, or extreme examples of low wing-loaded models such as the early Zero and Ki-43. Note that the Zero and Ki-43 only get this bonus in their early incarnations. It falls off in later, heavier variants.

**+1 Bomber Class with Defence Rating.** Bombers with a defence rating that fly in mutually supporting formations get this bonus. Note that this can stack with other modifiers.

In general, modifiers don't stack except where indicated (i.e. the bomber class defence stacks with other modifiers).

### Low Altitude

In the bottom altitude band, the turn rate will generally track the speed in the same band. Which is to say that if the speed is increased by one in the bottom band, then the turn will be increased too. However, the Turn cannot be increased to a value greater than 7 by this method.

### Top Altitude Band

In the top altitude band, take the turn value for the middle altitude band and reduce it by one.

## FIREPOWER VALUES

Firepower values are derived from Williams and Gustin's *Flying Guns World War II* (Airlife 2003). In Appendix 6 they lay out their formulae for calculating gun power. I have taken their gun values and used these to create gun power totals for each aircraft's gun battery. I have then derived a firepower value from this total. (See sidebar.)

### Fighters and Light Bombers

Calculate the firepower of fighters, light bombers, dive bombers and torpedo bombers by totalling the gun power of the aircraft's forward fixed gun battery. (Do *not* add the value of flexible guns.) Check the gun power total against the firepower column on the sidebar table to derive the firepower.

Large calibre armament designed for bomber-killing is dealt with separately, as a Heavy Gun ability (see Abilities, below).

### Medium and Heavy Bombers

The firepower of medium and heavy bombers is 0 if all defensive guns are below 20mm calibre. If they have defensive guns of 20mm calibre or greater, the firepower is 1.

If the bomber is a gunship, with a forward fixed gun battery for strafing, in addition to defensive guns, the firepower is represented as two numbers separated by a slash like so: 1/0. The first firepower value is for strafing and the second for defensive guns (see rule 3.3).

The strafing value before the slash is based on gun power, as calculated for fighters. However, if the aircraft has large calibre guns that fire HE rounds (not AP), treat these as the Heavy Gun ability.

Large calibre guns that fire AP rounds are dealt with as the AT Gun ability (see Abilities, below).

### Edge Cases

Batteries with gun values close to a boundary between firepower values can be nudged up or down, as seems appropriate. For example, a battery of 12 x 0.50 calibre guns has a gun power of 696. This can be nudged upwards to give a strafing firepower of 3.

Bomber aircraft with no fixed armament, but which have defensive armament, can have a firepower value of U/0, meaning that they are unarmed for the purposes of attack and strafing, but have a firepower of 0 when defending in air combat. Generally, we assign U/0 ratings only where the defensive armament cannot be used for strafing.

## PROTECTION

Protection differs for single-engined and multi-engined aircraft. The default protection for all aircraft assumes some form of pilot armour and fuel protection (such as self-sealing tanks or an inert gas system).

**Comparing Turn Values.** Turn is calculated relative to an aircraft's speed, not relative to other aircraft. Because speed is not just a measure of straight line speed, but is our measure of engine power, a fast aircraft like the P-51D has more opportunities to get out of trouble through applying throttle than a nimble aircraft like the A6M Zero does. Most importantly, that power can be applied in turning situations to offset induced drag. This is the secret sauce that speed and engine power represent--it assists in ways that agility and light wing loadings do not.

So this is why the P-51D will outclass the under-powered Zero, even in a turning fight. The lesson here is that the Zero's manoeuvrability still keeps it somewhat competitive where conditions are favourable, such as in an extended melee.

**Firepower.** Determine the gun power total of the aircraft's gun battery and then look up the aircraft's Firepower at the right:

Total Gun Power	Firepower
0–100	0
100–300	1
300–700	2
700–1,500	3
1,500–2,500	4

**Fixed Gun Batteries.** In the second edition we assume that light bombers, dive bombers and torpedo bombers are nimble enough to bring the firepower of these batteries to bear in air combat. We do not extend this to medium and heavy bombers, which is why we split firepower for gunships.

**Gun Power.** This table lists the gun power of individual guns used in WW2. This data is copied from Williams and Gustin, *Flying Guns World War II* (Airlife, 2003):

Gun	Cartridge	Gun Power
MG 17	7.92 x 57	21
Browning	7.7 x 56R	21
MG 131	13 x 64B	45
Breda	12.7 x 81SR	36
Scotti	12.7 x 81SR	36
Ho-103	12.7 x 81SR	45
0.50 M2	12.7 x 99	58
12.7 UB	12.7 x 108	78–102
MG 151	15 x 96	84
Type 99-1	20 x 72RB	96
MG-FF	20 x 80RB	120
Ho-5	20 x 94	140
MG 151	20 x 82	204
Type 99-2	20 x 101RB	120
ShVAK	20 x 99R	169
B-20	20 x 99R	169
Hispano II	20 x 110	200
Hispano V	20 x 110	240
Ho 1/3	20 x 125	126
VYa	23 x 152B	234
MK 108	30 x 90RB	580
MK 103	30 x 184B	693
M4	37 x 145R	160
NS-37	37 x 195	424

**Protection.** The structural strength of aircraft has little to do with protection. Aircraft were most likely to be lost due to a hit on a critical system, such as pilot, engine, oil system, fuel system or hydraulics. The entire aircraft could not be armoured, but these vulnerable parts could be protected with plate or self-sealing coverings. Multi-engined aircraft benefitted from redundant systems (i.e. the extra engines) and were more likely to survive as a consequence.

**Armour.** It is hard to quantify levels of protection, and numbers can be misleading. The 250+ lb armour of a P-39D sounds impressive, compared to the 152 lb of the Spitfire Mk.VB, but this is considerably less than the ~800 lb armour (possibly 1,000 lb) of the Fw 190F.

Data on armour plate might not include all protection features. For example, the F6F Hellcat carried 456 lbs of protection only when you included toughened glass and self-sealing material for fuel tanks. A lack of granularity in the rating system complicates things, so be judicious in handing out increases in protection.

**Fuel Tanks.** Some long-ranged fighters such as the F4U-1 Corsair and Yak-9D had a mix of protected and unprotected fuel tankage. We don't bother to figure these into the protection ratings, since the intent was that the unprotected tanks would be drained before the aircraft entered combat. If there's a situation where such aircraft are in combat with filled unprotected tanks, handle this with a scenario special rule that modifies protection.

**Bomber Defence.** Defence values are very 'flat' in the game with little distinction between aircraft with one defensive weapon, several and many. This was a deliberate design choice, because even modest bonuses for defence can have a major effect on combat given the 2d6 combat system. Only heavy bombers and late-model B-25s, which were bristling with guns, really benefit from this. However, the defensive capability is also represented through the defence rating bonus to turn values.

**AAR.** Generally, we only mark fighters with AARs if they were fitted specifically for anti-bomber duty. Some aircraft tried to use air-to-ground rockets in the air-to-air role. For example, in Mongolia the Soviets tried using RS-82 rockets air-to-air. However, it's better to handle these ad hoc loadouts as scenario special rules.

There is scope for modifying these values in special circumstances, but it is recommended to err on the conservative side.

### Single-Engined Protection

Rate single-engined aircraft as follows:

- 3 Aircraft has no armour or fuel protection
- 3-4 Aircraft has partial armour or fuel protection
- 4 Default protection
- 4-5 Aircraft is known for being exceptionally tough, or armoured at critical points (cockpit, engine, oil system)
- 5 Aircraft is heavily-armoured (e.g. IL-2 or Fw 190 'Sturmbock')

### Multi-Engined Protection

Rate multi-engined aircraft as follows:

- 3-4 Two or three-engined aircraft has no armour or fuel protection
- 4 Two or three-engined aircraft has partial armour or fuel protection
- 4-5 Default protection for two or three-engined aircraft
- 5 Four-engined aircraft has compromised protection
- 5-6 Default protection for four-engined aircraft

Bombers that are armoured but lack frontal crew protection get an 'h' rating. If this is fixed with armoured crew compartments or armoured glass, remove the 'h'.

### BOMBSIGHT

Bombsight values are as based on the description in the rulebook:

- T Telescopic sights and fighter gunsights
- V Vector sights and unstabilised tachymetric sights  
*EXAMPLE: early Lotfernrohr sights; British Mk.XI*
- G Gyrostabilised tachymetric bombsights  
*EXAMPLE: Norden sight; SABS; Lotfernrohr 7C*

### DEFENCE

Defence values are only given where an aircraft has defensive guns.

The default defence value is 0.

Aircraft with substantial numbers of defensive guns, such as B-17, B-24, B-25J can have a defence value of 1.

### ABILITIES

Add abilities as seems appropriate.

**AAR.** Add if the aircraft was equipped with air-to-air rockets.

**ATGR (value).** Add if the aircraft commonly carried air to ground rockets. The rating value is described below in the bombs section.

**AT Gun (value).** Add if the aircraft was equipped with a large calibre anti-tank gun (30mm or greater, with armour-piercing ammunition). The rating value is described below in the bombs section.

**AT Pod.** Add if the aircraft could carry an AT Pod.

**Dive Brakes.** Apply only to fighters, dive bombers or torpedo bombers with specialist dive brakes. Light and medium bombers with air-brakes use the *Speed Brakes* ability instead.

**Drop Tanks.** Apply to fighters if they carried drop tanks.

**Edge** ▶ Apply to a fighter if it has the Edge ▶ ability. (See the section on Speed, above.)

**Gun Pod.** Add to fighters that could carry gun pods for air combat.

**Gyro.** Add to fighters if they were equipped with gyroscopic gun-sights at any point in their careers.

**Heavy Gun (value).** Add this ability if the aircraft has a heavy calibre gun for bomber-killing. Also if it has a heavy calibre weapon firing HE rounds for strafing. The value is the calibre of the weapon, divided by 10.

**Jet.** The aircraft qualifies for jet movement rates (generally, speeds at or above 500 mph).

**Low Drag.** Bombers with internal bomb stowage can qualify for the Low Drag ability. This is handed out judiciously, and generally to high-speed bomber types, so that it applies to the Pe-2 and Mosquito, but not to the He 111H.

One exception to this is the Hs 129, where the bomb load was so light relative to power that it was ruled to be Low Drag.

**Max Load (value).** Bomb values are based on typical bomb loads (see Bombs section, below). Bombers that could sometimes carry much greater payloads into combat may be given a Max Load bombs value as a guide for scenario designers.

**Rear View.** Apply this to fighters where they benefit from a bubble canopy or a substantially cut down rear fuselage. Two seat fighters with a rear-facing crewmember get this benefit also.

**Rocket.** Apply to rocket aircraft only.

**Speed Brakes.** Where light bombers and larger have airbrakes, they are given the **Speed Brake** ability rather than **Dive Brakes**.

**Torpedo (Value).** Apply where a bomber can carry torpedoes. The default value is +1. However, apply a -1 value if the torpedoes do not have air tails and other retardation devices. Early US torpedoes suffer this problem. The designation **Slow** is applied when either the torpedo does not have retardation devices, or the delivery aircraft is a very slow aeroplane, like the Swordfish.

## BOMBS

Bomb-carrying aircraft have a bomb value listed in the bottom and middle altitude bands (i.e. up to their service ceiling or critical altitude).

### Bomb Values

Bomb values are calculated as follows (round to nearest whole value):

$$\text{SQRT (bomb payload in pounds)/3.5}$$

The bomb payload is based on the typical mission load for that aircraft, not its maximum. If you want to list maximum loads, add a **Max Load (value)** ability to the data card.

### Rockets

Values for ATGR depend on the type of rocket or size of battery. The most common mixes of rockets are listed here:

#### ATGR

Value	Payload	Examples
4	6 x RS-82	LaGG-3
5	8 x RS-82	IL-2
6	6 x HVAR; 2 x BR-21	F6F, P-51D; Fw 190F
7	8 x HVAR; 4 x BR-21	F4U, TBF; Bf 110G
8	10 x HVAR; 8 x RP-3	P-47D, P-38L; Typhoon, Mosquito

**Heavy Gun Values.** The heavy gun calculation is based on the notion that the heaviest anti-bomber gun in service was the German 50mm, though the Japanese used 37mm field guns in their bomber destroyers and the Dutch-made Fokker T.V had a bomber-hunting sniper weapon as small as 20mm. That sets our spread of values between 2 and 5.

In the exceptional case where a tank gun with HE ammunition was mounted for strafing work on the B-25, we get an outlier value of 7.

**Max Loads.** We do not need to assign a Max Load ability to every aircraft. Only heavy bombers and those where the scenario potential for a maxed-out aircraft is high.

**Bomb Values.** Re-rating the bomb values is *the* major change to the second edition ADCs. Whereas the original game based bomb values on a linear scale, this is now calculated on a square root curve. Note that the value of 1,000 lbs of bombs remains the same in both systems—a bombs value of 9.

**Bomb Loads.** This table is not comprehensive, but lists some typical bomb load values and the aircraft they apply to:

Payload (lbs)	Bomb Value	Aircraft
220	4	F4F Wildcat
550	7	D3A1 Val
1,000	9	SBD, Ju 87B
2,000	13	P-47D
3,250	16	B-25C/D
4,000	18	He 111H
4,500	19	B-17 long-range mission

**Rocket Values.** The rocket values listed are somewhat arbitrary but have been fitted to potential targets. They average 5 or more so that a 100% hit will heavily damage a Tank unit, but are capped at 8 so that a 100% hit cannot fatally damage an infantry unit or destroyer.

**Soviet Rockets.** Soviet aircraft could carry a smaller number of large-calibre RS-132 rockets in place of RS-82s. An assumption here is that both types of load perform much the same.

**AT Guns.** The default rating for AT Guns is 5, which is the same as the damage rating for Tank targets, meaning that a 100% hit would heavily damage such a target. The 4 value covers weapons such as the 30mm anti-tank gun aboard the Hs 129, which was known to have difficulty penetrating Soviet T-34 tanks. The 7 rating handles obscenely large weapons such as the 75mm *Bordkanone 7,5*.

Note that special heavy rocket loads, such as the 11.75-inch ‘Tiny Tim’, are not listed here. If you wanted to include these in the game you may need to develop bespoke special rules. For example, you could create a special rule so that an F6F with a load of two Tiny Tims might have an ATGR rating of 8, but a reduced attack modifier +2 instead of +3—to represent the inaccuracy of the weapon.

#### AT Guns

AT gun values are used where dedicated anti-tank guns are being employed aboard an aircraft. AT gun ratings work differently than for heavy guns because AT guns use armour piercing rather than high explosive and so are based more on factors such as muzzle velocity and penetration than on calibre. The values are:

4 = gun calibre less than 37mm

5 = gun calibre between 37mm and 57mm

7 = gun calibre greater than 57mm

#### DESCRIPTION

The flavour description on the back of the ADC is not a brief history of the aircraft *per se*. Rather, it is designed to provide context for an aircraft, how it fits into the wider picture of the war, and to indicate its importance to the war.

Key information to be included should be the aircraft manufacturer and also whether the aircraft is sibling to others. If part of a family of aircraft it should be positioned within the bloodline (i.e., as the original service version or an improvement).

#### VARIANTS

The broad brush strokes of the game’s rating system mean that many variants of the aircraft model can be listed as the same aircraft. In other words, the differences are too small to show up at this scale, so we lump them together.

Often, variants can be distinguished by a change in abilities, bomb value or some other rating, like protection or firepower.

Where aircraft performance differs by a major degree, and can’t be handled by adding an Edge ▶ ability, don’t add a variant to an ADC but instead break it out as a separate card.

Where possible, try to list service dates for variants.

Where possible, try to list alternative names or designations for an aircraft or variant.

All information for description and variants needs to be edited to fit on the back of the card. An aircraft with a lot of variants will cut into the word count of the flavour description.