SCRAMBLE !

CALCULATION ALGORITHMS FOR
SCRAMBLE
WARGAMES RULES FOR AERIAL COMBAT
1935 – 1945

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Update History

The original file was created in 2003.

Version 1.1 has been slightly altered to reorder items in the list of calculations. The formulae have been simplified slightly and new guidelines introduced.

In addition, the formulae for the Aerobatic Modifiers were missing, these have been added. Sorry for missing these out.

GAME ALGORITHMS

For those of a technical mind who wish to work out Stats for aircraft not included in the tables, these algorithms determine the game data. Feet and inches, and minutes and seconds are always converted to decimal values of feet and minutes. All results are rounded to nearest whole number. 0.5 rounds upwards to 1. We use the formula '*Integer (result +0.5)*'. **In cases of negative results round away from 0 in cases where this is specifically noted.**

Algorithms

1. Damage (Hit Points):
   Empty Weight Lbs x 0.003

2. Airspeed:
   Max Speed mph x 0.04

3. Stall Speed:
   Max Speed mph x 0.04 x 0.3

- If you have something unmanned use the Airspeed

4. Some numbers must now be defined for the later calculations.

   CLEAN Weight is calculated as follows:
   Empty Weight (if aircraft is not a Glider add 20% + 2.5% per Engine of empty weight) + 200lb per Crew man + Cargo (if loaded) + Payload (underwing guns) + Warhead weight (if fitted with such).

   LOADED Weight is calculated as follows:
   Clean Weight plus Bomb, Torpedo, Rocket weight in lbs

5. DV Clean:
   (# Engines x HP per engine (x 0.7 if a jet or 0.35 if a rocket)) ÷ Clean weight lbs x 80

6. DV Loaded:
   (# Engines x HP per engine (x 0.7 if a jet or 0.35 if a rocket)) ÷ Loaded weight lbs x 80

- The DV of an unpowered Aircraft such as a glider, or an unmanned aircraft, is the same as the current Airspeed.

7. MV Clean:
   Clean weight lbs ÷ (10 x wing area in sqr feet) x √(wing span in feet ÷ 40)

8. MV Loaded:
   Loaded weight lbs ÷ (10 x wing area in sqr feet) x √(wing span in feet ÷ 40)

- The MV of an unmanned aircraft is 0.

9. Climb:
   4000 ÷ (Climb Rate in Feet ÷ Climb time minutes)

- If this value is equal to or less than 0.5, then redo calculation:
   40000 ÷ (Climb Rate in Feet ÷ Climb time minutes) x 0.1, which gives you the value between 0.5 and 0.1

10. Operational Ceiling:
    (Ceiling (feet) ÷ 1000) – (Airspeed – Stall Speed)

11. Shallow Dive Limit: (½ ST)
    Max Speed mph x 0.04 x 0.3 x 0.5

12. Steep Dive Limit: (ST)
    Max Speed mph x 0.04 x 0.3

13. Power Dive Limit: (ST + ½ AS) ÷ 2
    ((Max Speed mph x 0.04 x 0.3) + (Max Speed mph x 0.04 x 0.5)) ÷ 2

14. Vertical Dive Limit: (½ AS)
    Max Speed mph x 0.04 x 0.5

15. Aerobatic Modifier Clean
    (Max Speed mph x 0.04 x 0.3) – (Clean Weight lbs ÷ (10 x Wing Area in sqr feet) x √(wing span in feet ÷ 40)).
    Round to nearest whole number, with negative results rounded away from 0.

16. Aerobatic Modifier Loaded
    (Max Speed mph x 0.04 x 0.3) - (Loaded Weight lbs ÷ (10 x Wing Area in sqr feet) x √(wing span in feet ÷ 40))
    Round to nearest whole number, with negative results rounded away from 0.

17. Bomb Value:
    Bomb weight lbs ÷ 500

18. Torpedo Value:
    Torpedo weight lbs ÷ 500

19. Cargo value:
    Cargo weight lbs ÷ 500

20. Warhead Value:
    Warhead weight lbs ÷ 500

21. Gun/Rocket Value:
    Each gun mount has a number of D6s that will be rolled for damage if it hits. These are shown in the weapons tables. If a gun is not shown then damage is rated at 3D6 plus 1D6 per 5mm calibre in excess of 20mm.

    A machine gun mount has 1D6 damage and a gun value of 1.

    A Spitfire with 4 twin machine guns has a Gun Value of 4.

    A Hellcat with 6 Heavy machine guns (at 2D6 per gun) has a Gun Value of 6.

    A Lancaster Bomber only has a gun value of 4.

    A B17G Flying Fortress has a Gun Value of 18, even though many of the guns are single HMGs with a lower to hit chance.

    Similarly each salvo of rockets carried will do a number of damage dice. These are shown in the weapons table.

    Air to ground rockets get 1D6 damage per 25lb of total warhead weight for the first pair in a salvo, and 1D6 per 50lb total warhead weight for each subsequent pair fired.

22. Points value:
    (Damage x (Speed + DV Loaded + Bomb value + Torpedo value + Cargo value + Warhead value + Gun/Rocket value) ÷ (10 + MV Loaded))

Weapon Fit

Normally this is straight forward. The area of difficulty is where you have three guns of the same calibre firing effectively into the same area, such as on some Bf 109s. In such a case if the majority of the guns are in the wings, treat the mount as a whole as being wing mounted so converging the guns is optional. On the other hand a fighter such a Blenheim with 4 machine guns under the nose and one in the wing root is treated as having all in the nose so they must be converged if the rules are in use.

When in doubt look at the way we have put our data together.

Weapon Weights

Some weapons such as missiles and under-wing anti-tank guns have a payload weight which will effect the aircraft's peformance and these weights have to be allowed in the Loaded Weight calculation.

The weights of Bombs, torpedoes and cargo carried both internally and externally are easy to find from reference sources.

The weights of Anti Tank guns and Missiles are shown in the Table below.

Great Britain

40mm Vickers S gun	400lb
25lb RP	75lb
60lb RP	110lb

Germany

37mm BK 37	750lb
55mm R4M	40lb
80mm PzB1	25lb
210mm WfrFr 21	240lb
X-4	300lb

USA

5" HVAR	135lb

USSR

75mm RS75	50lb
82mm RS82	55lb
132mm RS132	95lb