STATIONS MANNED AND READY

SHIP CONSTRUCTION SYSTEM

CONSTRUCTION ALGORITHMS FOR SHIPS AND AIRCRAFT

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Update History

This new edition of the construction system combines the previous two versions into a single document. It incorporates the examples of construction from both previous documents.

The weapon data tables have been extracted and are to be found as a separate document. See remarks below regarding the weapons data and costs.

A change incorporated in version 2.1 adds a proviso that if either the hull cost or the total weapon cost rounds to 0, it should be treated as 1 in either case. These changes are marked thus:

Version 2.2 has added three SRAA guns that became necessary as the ship database expanded. These items are shaded in the table on page 11.

Weapon Data and Cost Tables

These have undergone a number of changes. The tables have been expanded and the penetration data updated as more source data has become available fore us to use. The data now covers the whole period from 1880 to 1945.

Weapon Costs

One anomaly that came to light while we were undertaking the data revision is that in the previous incarnation the cost of a gun was taken based on its effectiveness over its entire range of up to 5 Range Bands. This led to an inadvertent increase in the cost of certain types of vessel with a potential to attack over 5 bands, but realistically could only attack over 3 or 4. In the case of guns the cost component drops significantly as range increases, so the change in gun cost on many ships is not very much. In the case of Japanese WW2 torpedoes, the cost element is much higher, so you will find that Japanese destroyers (and cruisers) may well be cheaper than before.

The practical effect of this is that the data table now shows a cost for each weapon and range band. This means that a ship that can see 3 RB uses the weapon cost shown for 3RB (assuming it can fire that far), otherwise use the cost for its maximum range.

WARSHIP DATA

Before play can commence a data sheet must be completed for each vessel. We have tried to keep the data required to play to the minimum, and to keep the ship construction system as simple as possible as well. These rules provide you with a selection of vessels for you to start off with.

Players will wish to expand the selection by putting together their own vessels. Data for this purpose can be gathered from various available sources. Various routes are available:

a) Use Jane's Fighting Ships (originals or reprints)

b) Use Conway's All the World's Fighting Ships

c) Use other sources

The choice of which source book is used is left to the players, however it must be noted that you may well arrive at different results if you use different sources. You are advised to avoid mixing sources because there will probably be differences in the data. As a rule we have made use of Conway's as a basic reference source, though during the current revision of SMR we have detected some errors in gun outfit and in ship names. For the Second World War we have also made use of the M J Whitley series of books on warships, which give more reliable data regarding modifications to individual ships. In addition there are translations from the German of Breyer (on battleships), Mickel Jung and Jentschura (on the Japanese Navy) and Gröner (on the German Navy). These are invaluable.

1 – Ship Construction

To put together a ship, you need to equip yourself with the following data:

- Displacement (in tons)
- Length (in feet, waterline if shown)
- Beam (in feet)
- Flight Deck length and width (in feet) if constructing a carrier
- Year the ship was laid down.
- Maximum speed in knots
- Armour protection (see below)
- Number of crew
- Operational capacity for aircraft (for carriers)

Ship construction follows a simple logical sequence, and starts with determining the displacement. This should either be the **Standard** or **Normal** displacement. Whenever the source shows several, use the lowest. The displacement provides the Flotation points (F) and these in turn provide the Structural Points (S).

The structural points receive armour bonus points depending on specific component areas on the vessel (if these are armoured). You will need to jump forward and check the armour section which follows to determine the armour bonus points.

After the values for the ship's hull have been determined, then you calculate the armour classes for specific component areas. The ship's speed is a straight transfer from knots. Finally you must determine the ship's manoeuvre rating, its size and visibility range, Fire Control, Damage Control and Searchlight ratings. After the hull is completed, then the weapons are added, and last of all the points value is calculated. In the following section we will take some sample vessels to show the various stages involved.

2 – Flotation (F)

The first Item to be calculated is the **Flotation**, which is referred to as **F**. This is calculated from the displacement in tons (t) as follows:

$$\left(\frac{t^{0.66}}{29}\right)\times\left(\frac{7.5\times beam\,(feet)}{length\,(feet)}\right)$$

The effect of the flotation calculation is that a long thin ship will tend to have fewer flotation points than a fatter ship of the same length with otherwise a similar displacement. The exact result of this calculation is recorded for the calculation of the structural value (S) in the next stage. The figure is also now rounded to the nearest whole number (0.5 and greater is rounded up) and recorded as the ships Flotation (F) value.

For our First World War examples we will use the German Battleship Kaiser, and Cruiser Scharnhorst, and the British Light Cruiser Bristol and M-Class Destroyer.

For our Second World War examples we will use the German Battleship Bismarck, the American Carrier Yorktown, the Japanese Carrier Kaga and Heavy Cruiser Nachi, the Italian Light Cruiser Giussano and the British Tribal Class Destroyer.

SMS Kaiser displaces 24,330 tons, length 565'7", beam 95'2", giving an F value of 34.16, rounding to 34;

SMS Scharnhorst displaces 12,781 tons, length 474'9", beam 71'0", giving an F value of 19.85, rounding to 20;

HMS Bristol displaces 4,800 tons, length 453'0", beam 47'0", giving an F value of 7.22, rounding to 7;

The M-Class displaces 900 tons, length 273'4", beam 26'8", giving an F value of 2.25, rounding to 2;

Bismarck displaces 41,700 tons, length 792'4", beam 118'1", giving an F value of 43.18, rounding to 43;

Yorktown displaces 19,875 tons, length 770'0", beam 83'2", giving an F value of 19.19, rounding to 19;

Kaga displaces 38,200 tons, length 788'5", beam 106'7", which gives an F value of 36.96, rounding to 37;

Nachi displaces 10,980 tons as built, length 661'1", beam 56'11", giving an F value of 10.34 rounding to 10. She had 13,000 tons as rebuilt in 1940/41, giving an F value of 11.56, rounding to12;

Giussano displaces 5,110 tons, length 525'0", beam 50'10", giving an F value of 7.02, rounding to 7;

The Tribal Class displaces 1,959 tons, length 355'6", beam 36'6", giving an F value of 3.95, rounding to 4.

The unrounded values might vary depending on your calculator or computer.

3 − Structure (S)

The structural value of the vessel is derived from the unrounded Flotation value, calculated above, to which armour and other bonuses are added for the following components on the ship:

- Belt − This takes the thickest listed armour. On older WW1 vintage Protected Cruisers, the deck armour value is applied here (and used again when calculating the deck bonus).
- Deck − This takes the thickest listed armour if there are a number of armoured decks. In the case of carriers, you need to know whether the carrier had an armoured flight deck or not. Quite often the armoured deck is in fact below the level of the hangar, above the engine room.
- Conning Tower − Take the thickest listed armour.
- Main armoured turrets − This covers armoured, fully enclosed turrets. The thickest listed armour is taken. If the main gun is not fully enclosed then this item is ignored.
- All other guns in armoured turrets − This applies to any guns in fully enclosed armoured turrets. It does not apply to casemate guns (even if armoured) nor to any weapon not in a fully enclosed mount.

  Our sample ships carry forward the following structural base values:

  Kaiser 34.16, Scharnhorst 19.85, Bristol 7.22, and the M class 2.25.

  Bismarck 43.18, Yorktown 19.19, Kaga 36.96, Nachi 10.34 or 11.56, Giussano 7.02, and the Tribal class 3.95.

We now add the armour bonus values (if there are any). The first step is to ascertain what modifier is used to convert the armour thickness to a KCE standard, this being based on the date of construction.

The Kaiser class were laid down between 1909 and 1911, so referring to the armour conversion table we see that the best conversion value is 1.02; the Scharnhorst class were laid down in 1904 and 1905, giving a value of 1.04; the Bristol class were all laid down in 1909, giving 1.07; the M-Class has no armour.

The Bismarck was laid down in 1936, so referring to the table overleaf we see that the conversion value is 1.15; the Yorktowns were laid down between 1934 and 1939, giving 1.21; the Kaga was laid down in 1920 giving 1.12; the Nachi class was laid down in 1924 and 1925, also giving 1.12; the Giussano class were all laid down in 1928, giving 1.15; the Tribal Class has no armour.

For the purpose of our illustration, we will now skip forwards to the calculation of the armour class of the various component parts of the ships, this being part of the build routine, and which also determines how many Structural bonus points are accrued.

4 − Armour

To set a starting point for the armour calculations, all armour types are converted to their "Krupp Cemented Equivalent" (KCE), which is really the only complicated part of the calculations. The KCE is then used in the calculations with two formulae, appearing below. Within the game system, the armour fitted to a vessel provides not only the armour class for critical component areas of the vessel, but also a Structural Bonus. The following table shows the modifier which should be used to convert the listed armour thickness in inches to its "Krupp Cemented Equivalent" (KCE).

Note the minimum thickness of armour which is considered in these calculations is 1" of actual armour thickness.

Armour Conversion table	
Condition	***Modifier***
Generic values for all vessels laid down:	
Prior to 1890	0.88
In 1890	0.99
From 1891 to 1894	0.98
From 1895 to 1897	0.97
In 1898 and 1899	0.98
From 1900 to 1918	0.99
From 1919 onwards	1.03
Austrian vessels between 1908 and 1918	1.14
British vessels	
From 1900 to 1904	1.15
From 1905 to 1910	1.07
From 1911 to 1918	1.09
From 1919 to 1925	1.12
From 1926 to 1932	1.21
From 1933 to 1941	1.16
In 1942 (wartime shortages)	1.10
In 1943 (wartime shortages)	1.13
In 1944 and 1945	1.16
German vessels	
From 1894 to 1899	1.07
From 1900 to 1905	1.04
From 1906 to 1918	1.02
From 1919 to 1924	0.97
From 1925 to 1935	1.11
From 1936 to 1945	1.15
Italian vessels	
From 1900 to 1904	1.15
From 1905 to 1910	1.07
From 1911 to 1928	1.15
From 1929 to 1945	1.20
Japanese vessels	
From 1900 to 1914	1.15
From 1915 to 1918	1.09
From 1919 to 1930	1.12
From 1931 to 1936	1.14
In 1937 and 1938	1.10
From 1939 to 1945	1.11
United States vessels	
From 1900 to 1906	1.00
From 1907 to 1909	1.03
In 1910	1.07
In 1911 and 1912	1.10
From 1913 to 1923	1.11
From 1924 to 1929	1.15
From 1930 to 1941	1.21
From 1941 to 1945	1.18

- KCE = Actual armour thickness in inches x modifier (see table below)

  British 10" armour in 1910 has a KCE of 10 x 1.07 = 10.70

  German 12" armour in 1936 has a KCE of 12 x 1.15 = 13.80

Unless data is shown specifically for a nation, then use the generic numbers. The date to be used is that when the ship was laid down.

Where there are many vessels in a class constructed over a long period this will generate a range of modifiers. In such cases always take the best modifier available and apply to the whole class.

The Kaiser has 14" Belt, 4.7" Deck, 14" Conning Tower and 5 main turrets with 12" armour. The Scharnhorst has 4" Belt, 2" Deck, 8" Conning Tower and 2 main turrets with 6" armour. The Bristol has 2" Belt and 2" Deck.

The Bismarck has 12.5" Belt, 4.75" Deck, 14" Conning Tower, 4 main turrets with 14.25" armour and 6 secondary turrets with 4" armour. The Yorktown has 4" Belt, 1.5" Deck, Conning Tower 4", Flight Deck 802' x 86', 96 aircraft. The Kaga has 6" Belt, 1.5" Deck, no Conning Tower armour, Flight Deck 815'6" x 100', 81 aircraft. The Nachi has 3.9" Belt, 1.4" Deck, no Conning Tower armour and 5 main turrets with 1" armour. The Giussano has 1.65" Belt and .787" Deck, 1.57" Conning Tower and 4 main turrets with 1" armour. In the latter case the deck armour is ignored as it is under 1 inch.

Now it is time to get out the calculator… don't be nervous… it is actually quite easy!

Armour Class

The armour class formula is as follows:

- (√(KCE")) x 3.24 – 2.24, rounded to the nearest whole number.

  If we take the previous examples for:

  British 10" armour, the formula is √10.7 *x 3.24 – 2.24, or 8.35832, which rounds to an Armour Class of 8.*

  German 12" armour, the formula is √13.8 *x 3.24 – 2.24, or 9.79607, which rounds to an Armour Class of 10.*

If the armour class results in a value of less than 0, it is treated as 0. It is possible for an armoured vessel to end up with an AC of 0 if the original thickness is not very great.

Structural Bonus

The structural bonus for each component part is calculated as follows and expressed as a percentage.

- Belt: √(KCE") x 16
- Deck: √(KCE") x 6 (incl. Flight deck on carriers)
- Conning tower: √(KCE") x 3
- Main Turret: √(KCE") x 3 x # of turrets.
- Secondary turret: √(KCE") x 1.5 x # of turrets.

Work out each percentage value, total them all, and then apply this to the Base Structural value in one calculation. The examples which follow show this in action. That was not all that scary, was it ?

Ship	*KCE*	*Armour Class*	*Structural Bonus*
Kaiser	(1.02)		
Belt 14"	14.280	10 (10.004)	60.46%
Deck 4.7"	4.794	5 (4.854)	13.13%
CT 14"	14.280	10	11.33%
Turrets 12" x 5	12.240	9 (9.095)	52.47%
			= 137.39%
The Base value of S = 34.16 gets a bonus of 137.39% added (46..93) for a total of 81.09, rounded to an S value of 81.			
Scharnhorst	(1.04)		
Belt 4"	4.16	4 (4.368)	32.63%
Deck 2"	2.08	2 (2.433)	08.65%
CT 8"	8.32	7 (7.106)	08.65%
Turrets 6" x 2	6.24	6 (5.854)	14.98%
			= 64.91%
The Base value of S = 19.85 gets a bonus of 64.91% added (12.88) for a total of 32.73, rounded to an S value of 33			
Bristol	(1.07)		
Belt 2"	2.14	2 (2.499)	23.40%
Deck 2"	2.14	2	08.77%
			= 32.17%
The Base value of S = 7.22 gets a bonus of 32.17% added (2.32) for a total of 9.54, rounded to an S value of 10			
M Class			
Nil	Nil	Nil	Nil
The Base value of S = 2.25 gets no bonus and is therefore rounded giving the ship a S value of 2			
Bismarck	(1.15)		
Belt 12.5"	14.375	10 (10.044)	60.66%
Deck 4.75"	5.4625	5 (5.333)	14.02%
CT 14"	16.100	11 (10.760)	12.03%
Main Turrets			
14.25" x 4	16.3875	11 (10.876)	48.57%
Sec. Turrets			
4" x 6	4.600	5 (4.709)	19.30%
			= 154.58%
The Base value of S = 43.18 gets a bonus of 154.58% added (66.75) for a total of 109.93, rounded to an S value of 110.			
Yorktown	(1.21)		
Belt 4"	4.840	5 (4.888)	35.20%
Deck 1.5"	1.815	2 (2.125)	8.08%
CT 4"	4.840	5 (4.888)	6.60%
			= 49.88%
The Base value of S = 19.19 gets a bonus of 49.88% added (9.57) for a total of 28.76, rounded to an S value of 29.			
Kaga	(1.12)		
Belt 6"	6.720	6 (6.159)	41.47%
Deck 1.5"	1.680	2 (1.959)	7.77%
CT Nil	Nil	Nil	Nil
			= 49.24%
The Base value of S = 36.96 gets a bonus of 49.24% added (18.20) for a total of 55.16, rounded to an S value of 55.			
Nachi	(1.12)		
Belt 3.9"	4.368	5 (4.532)	33.43%
Deck 1.4"	1.568	2 (1.817)	07.51%
CT Nil	Nil	Nil	Nil
Turrets 1" x 5	1.120	1 (1.189)	15.87%
			= 56.81%
The Base value of S = 10.34 gets a bonus of 56.81% added (5.87) for a total of 16.21, rounded to an S value of 16. Alternatively if using the Base S of 11.56 the bonus is 6.57 for as total of 18.13, rounded to an S value of 18.			
Giussano	(1.15)		
Belt 1.65"	1.898	2 (2.224)	22.03%
Deck 0.787"	Nil	Nil	Nil
CT 1.57"	1.8055	2 (2.114)	04.03%
Turrets 1" x 4	1.150	1 (1.235)	12.86%
			= 38.92%
As mentioned before the low deck armour is ignored. The Base value of S = 7.02 gets a bonus of 38.92% added (2.73) for a total of 9.75, rounded to an S value of 10.			
Tribal Class			
Nil	Nil	Nil	Nil
The Base value of S = 3.95 gets no bonus and is therefore rounded giving the ship an S value of 4.			

5 – Maximum Speed

Ships' maximum speeds are converted directly from knots. Remember that while quoted speeds are often taken from trials when the ships were in perfect conditions and the stokers were fresh and prepared for the trial, all things are relative and we are determining a speed for the game.

Kaiser has a top speed of 21 knots; Scharnhorst a speed of 24 knots; Bristol has a speed of 25 knots, and the M-class has a speed of 34 knots.

Bismarck has a top speed of 29 knots; Yorktown has 32.5 knots (rounds to 33); Kaga has 27.5 knots (rounds to 28); Nachi has 35.5 knots (rounds to 36) or 34 knots; Giussano has 36.5 knots (rounds to 37); the Tribal class has 36 knots.

6 – Manoeuvre rating

Different ships of different sizes have different manoeuvre ratings (MVR). In the game a ship can turn up to 45 degrees each time it makes a manoeuvre, after which it moves straight ahead a distance equal to the manoeuvre rating. There are a number of specific conditions regarding manoeuvre which are explained in detail in the Movement section, and are not examined here.

- MVR is calculated by dividing the overall length in feet by 66, then rounding to the nearest whole number.

Kaiser is 566 feet long giving MVR of 8.575 = 9

Scharnhorst is 475 feet long = MVR 7.197 = 7

Bristol is 453 feet long = MVR 6.863 = 7

M-class is 273 feet long = MVR 4.136 = 4

Bismarck is 792.3 feet long giving MVR of 12.005 = 12

Yorktown is 770 feet long giving MVR of 11.666 = 12

Kaga is 788.4 feet long giving an MVR of 11.945 = 12

Nachi is 661 feet long = MVR 10.015 = 10

Giussano is 525 feet long = MVR 7.950 = 8

Tribal class is 355.5 feet long = MVR 5.390 = 5

When you compare the MVR with the speed above, Kaiser, Bismarck, Yorktown and Kaga can make 2 changes of course in a game turn; Scharnhorst, Bristol, Nachi could make up to 3; Giussano can make 4 changes; the Tribal van make 7 changes while the M class Destroyer could make up to 8!

7 – Ship Size and its visibility range.

The relative sizes of ships have an effect on combat. Larger vessels will be easier to hit, while smaller ones will be more difficult. We decided to pre-calculate the ship displacements which would provide the various size classes. The size modifier in the table is used in many places in the rules.

The physical size of a ship (in reality its height above the waterline) determines how far it can actually see. Given that these rules also make use of the concept of range bands, rather than exact distances, we have also calculated the range of displacements which can see up to the maximum possible visibility distance.

The visibility range determines the effectiveness and therefore cost of its weaponry. When you start equipping your ship with guns, you will find cases where the gun may shoot further than the ship can actually see. In such cases the game values you apply to the ship reflect the actual distance over which you can use the weapon and therefore its cost. The details are to be found in the weapon data document (available as a separate download).

The actual displacement used to initially calculate the Flotation value is the determining factor for both size and visibility.

Actual Displacement	*Size Modifier*	*Maximum visibility*
up to 747 tons	− 3	2 Range Bands
up to 1,124 tons		3 Range Bands
up to 3,249 tons	− 2	
up to 3,477 tons	− 1	
up to 9,249 tons		4 Range Bands
up to 16,197 tons	+ 0	
up to 17,249 tons		5 Range Bands
up to 27,249 tons	+ 1	
up to 48, 499 tons	+ 2	
Larger vessels	+ 3	

Kaiser displaces 24,330 tons and has a Size modifier of +1 and can see 5 Range Bands;

Scharnhorst displaces 12,781 tons so it also has a Size modifier of + 0, but can only see 4 RB;

Bristol displaces 4,800 tons, has a Size of modifier of − 1 and can see 4 RB;

The M-class destroyer, displacing 900 tons, has a Size modifier of − 3 and can see 3 RB.

Bismarck displaces 41,700 tons, has a Size modifier of +2 and can see 5 Range Bands;

Yorktown displaces 19,875 tons, has a size modifier of +1 and can see 5 Range Bands.

Kaga displaces 38,200 tons, has a size modifier of +2 and can see 5 Range Bands.

Nachi displaces 10,980 or 13,000 tons so in either case it has a Size modifier of + 0, and can only see 4 RB;

Giussano displaces 5,110 tons, has a Size of modifier of − 1 and can see 4 RB;

The Tribal class destroyer, displacing 1,959 tons, has a Size modifier of − 2 and can see 3 RB.

The next part of this document covers the addition of game data such as Fire Control and Damage Control. After this comes "optional" equipment such as scout aircraft and radar. After this comes the addition of main weapons and small weapons.

8 – Fire Control

All combat vessels have a Fire Control value. This is based on the final structural value (S) of the ship, and represents not just systems but also their protection against damage. The number is calculated from:

$\frac{S}{15}+1$ rounded to the nearest whole number

Kaiser has a Structural value of 81 providing a Fire Control Value of 6 (6.40).

Scharnhorst has a Structural value of 33 providing a Fire Control Value of 3 (3.20).

The Bristol has a Structural value of 10 providing a Fire Control Value of 2 (1.67).

The M class has a Structural value of 2 which provides a Fire Control Value of 1 (1.13).

The Bismarck has a Structural value of 110 which provides a Fire Control Value of 8 (8.33).

The Yorktown has a Structural value of 29 providing a Fire Control Value of 3 (2.93).

Kaga has a Structural value of 55 providing a Fire Control Value of 5 (4.667).

The Nachi has Structural values of 16 or 18, but both provide a Fire Control Value of 2 (2.07 or 2.20).

Giussano has a Structural value of 10 providing a Fire Control Value of 2 (1.67).

The Tribal destroyer has a Structural value of 4 providing a Fire Control Value of 1 (1.27).

9 – Damage Control Teams

All combat vessels have Damage Control Teams, the value depending on the size of the Crew, calculated using the formula:

- √(number of crew) ÷ 10, rounded to the nearest whole number.

If there is a choice of a number of crew use the highest number shown, unless it is a value for a specific action.

Kaiser has a crew of 1084 providing 3 damage control teams (3.292).

Scharnhorst crew of 764 provide 3 damage control teams (2.764).

The Bristol's crew of 480 provide 2 damage control teams (2.191).

The crew of 80 on the M class destroyer provide 1 damage control team (0.894).

The crew of 2092 on Bismarck provide 5 damage control teams (4.573).

Yorktown crew of 2175 provide 5 Damage Control Teams (4.664).

The crew on Kaga of 2016 provide 4 Damage Control Teams (4.489).

The crew of 773 on Nachi provide 3 Damage Control teams (2.780).

The Giussano's crew of 520 provide 2 damage control teams (2.280).

The crew of 250 on the Tribal destroyer provide 2 damage control teams (1.581).

10 – Carriers

Handling Capacity

A carrier can handle a number of aircraft in one game turn. This is referred to as handling Capacity (H), and is based on the size of the flight deck and the number of lifts available. The actual value is calculated from:

- the surface area of the flight deck in feet^2 ÷ 6,600, rounded to the nearest whole number.

PLUS

- the number of lifts

The total is further modified by being multiplied by 1.25 if the carrier has a ventilated hangar. This is normally only to be found in US Fleet Carriers of Yorktown, Essex and Midway classes. The advantage of a ventilated hangar is that the aircraft can be warmed up below decks and then moved to the flight deck and launched that bit faster than would be the case of the warm-up has to occur on the flight deck.

Yorktown has a Flight Deck area of 68,972 square feet, three lifts, 2 catapults and a ventilated hangar, which provides a handling capacity of 17 ([10.45 + 3] x 1.25 = 16.813).

Kaga has a flight deck of 81,550 square feet and also three lifts, but no catapults, providing a handling capacity of 15 (12.356 + 3).

The number of aircraft which a carrier can safely launch OR recover OR provide in support to its CAP (assuming fighters are available) in a turn is equal to H.

Yorktown can launch or recover or support 17 aircraft.

Kaga can only launch or recover or support 12 aircraft.

The safe limit can be exceeded, at a risk, and there is a benefit if the carrier has catapults. Note that these figures are dynamic, so as the turn progresses the available number will fall as aircraft are launched and recovered.

You must remember that the cost of the carrier does not include any aircraft. These must be purchased separately.

The basic data for the hull of the ship is now complete.

The next part of this document covers the addition of "optional" equipment such as scout aircraft and radar. After this comes the addition of main weapons and small weapons.

11 – Scout and Float Planes

Scout aircraft started to be carried on towed lighters in about 1915/16, then on turret-top flying-off platforms towards the end of the First World War. They were carried more extensively (mainly by cruisers) until the middle of the Second World War, when carriers gained the upper hand. While the intended role of these aircraft was as gunnery spotters, this was usually restricted to shore bombardment. In these rules aircraft are restricted to a scouting function.

These assets are used in the game to try to gain the tactical advantage before the game starts. No more aircraft can be carried on a ship than it did historically. In the First World War, when ships did carry aircraft this was usually limited to one, perhaps two, per ship. If using aircraft on lighters, then you may have one per lighter, and the lighter must have a suitable towing vessel, such as a light cruiser.

Each aircraft carried adds a fixed equipment charge to the final cost of the vessel. Note that this extra charge is optional, so if you choose not to use aircraft for scouting in your game you may if players agree forego the extra cost. None of the ship data tables include aircraft costs.

Bismarck carries 4 scout planes

Nachi carried 3 scout planes

Giussano carried 2 scout planes

12 – Radar

Radar is introduced in World War Two, and comes in two types within the scope of these rules: Detection and Gunnery Direction. The types of radar available, to whom, and from which date, are shown in the table below. 'D' denotes the detection range in Range Bands, 'G' denotes the range at which radar can be used to support gunnery attacks, again in Range Bands. The target type against which the radar set is effective is shown, and some are effective against two types.

- Detection radar may help to gain the tactical initiative at the start of the game. If fitted with radar, the effective visibility range of a ship is doubled when calculating the scout points for tactical initiative (though it cannot be greater than the actual radar range).
- Gunnery radar will benefit individual ships by overcoming adverse visibility conditions, getting better information about fall of shot, and getting better damage through more effective fire. Some types of radar also provide "to hit" bonuses in AA fire.

All radar capability is lost when the Fire Control value = 0 and cannot be repaired.

Radar is ineffective if there is a land mass within 2 RB of the ship or air target, and behind it, when viewed from the shooting ship.

It is permitted to fit more than one radar set onto a ship, of different types, if desired. This is only really of value if you have an anti-aircraft set which has inferior surface gunnery ability.

Radar Types

Nationality & date		*Type*	*Use: Range*	*Cost*
Germany	pre-war	FuMo 21, 23, 26	D: 5 (ship)	250
	pre-war	FuMo 24, 25	D: 4 (ship)	200
	1940	FuMo 27	D: 5 (ship)	250
Great Britain	1940	Type 284	D: 5/ G: 3 (ship)	400
	1941	Type 284M	D: 7/ G: 4 (ship)	550
		Type 285, 285MP	D: 4/ G: 1 (a/c)	250
	1942	Type 274	D: 7/ G: 5 (ship)	600
	1944	Type 275	D: 6/ G: 1 (a/c)	350
Japan	1942	Type 21	D: 5 (a/c)	250
	1943	Type 2	D: 5 (ship)	250
	1944	Type 13	D: 5 (a/c)	250
United States	1942	Mk 3 FC	D: 8/ G: 4 (ship)	600
		Mk 4 FC	D: 8/ G: 1 (a/c)	750
		...	D: 6 (ship)	
	1943	Mk 8, 13 FC	D: 8/ G: 5 (ship)	650
	1944	Mk 12	D: 9/ G: 1 (a/c)	900
		...	D: 8 (ship)	

Interpretation of Radar data and effects

The radar game effects we have provided here is our interpretation of data we have been able to find, in the nautical setting. Some radar sets actually had a gunnery value greater than 5 but for game purposes these sets are treated as having a Gunnery value of 5. The detection ranges against aircraft are an average value, as the target may be at low level, in which case it may not be detected until too late, or at high level when the aircraft could be detected much farther away. You may feel that nations without radar are at a serious disadvantage. If you want to experiment with an alternate reality by giving other nations radar ability, you may do so.

- The maximum permitted Detection range is 9. The maximum permitted Gunnery range for radar is 5, and in any case, the Gunnery range for radar must be at least 2 lower than the Detection range.
- The maximum AA Gunnery range for radar is 1 Range Band.
- Dual purpose radar must have a lower Detection range against ships than that against aircraft.

Costs

The costs of radar sets are shown in the table and is based on the sum of the detection and gunnery values, multiplied by 50. This value is added to the final cost of the ship (after applying other cost modifiers and crew quality).

The next steps cover the addition of main weapons and small defensive weapons such as quick firers and anti aircraft guns.

13 – Adding Armament

These rules incorporate guns with a calibre down to 3.9". Smaller guns are used in the close defence of a vessel as described later. The guns and torpedoes to be fitted can be found in the weapon data document. Standard reference works as mentioned in the introduction will provide you with the details of which guns were fitted on which ships. Research on the internet will often provide data to fill in the inevitable gaps.

Weapon data documentation

These revised Weapon Data and Cost tables show details of naval weapons sorted by calibre and barrel length. These are further sorted by nationality and date. Usually the nationality is the that of the nation that designed the gun. The weapon now shows a simpler [numerical identifier], instead of a detailed gun description by type. This allows some more flexibility in interpretation. The identifier may not follow in numerical order due to the earlier sort parameters. While playing a game you just need the game data, not the absolute data showing that it is a Mark 17 gun. For this reason weapons are simply identified by calibre, length and numerical identifier.

The new table groups weapons in some cases, so that you may find details of many nations and ship classes using the "same" gun. In some ships we have had to make decisions on which gun to fit where data is sketchy. In such cases we have used weapons from either the nation where the ship was constructed in the case of minor navies, or of nations that were known to have supplied the minor nation with its guns.

The data is then completed with details of the IP value of the shell or warhead, and the maximum game range in range bands (RB). Following this is a section which shows the penetration or to hit modifier over distances up to 5 range bands. Under this row is the cost of the weapon if it is capable of being used at up to each of these range bands. This is dependent on the vessel concerned. If your ship has a weapon that can shoot 5 RB but the vessel can only see 3 RB, then the game date for the first three RB is used, and the cost shown under the 3rd RB is the cost of each of those weapons.

The data is then rounded off with details if the nation that built the weapon, its exact designation and type, and the classes of vessel that used the weapon. If there is common data for a whole range of weapons, then they will often be all placed together in one data set.

For game record keeping you will need to know the weapons, their IP value and range, the penetration or to hit modifier at each range band and also how and where they are mounted on the ship. It is recommended that you only enter the data for the ranges that the ship can fire over, to avoid mistakes in the game, and our revised ship data tables take account of this.

Weapon Mounts

The type of mount that carries the weapon is significant when it comes to applying critical hits. To get the correct type requires reference to a plan or photo of the ship. There are cases where the same guns may be mounted differently on the same ship. We have chosen to use the abbreviations the following table. The annotation *n* is used to denote the number of guns in the mount. The mount type is followed by a colon (:) then the arc into which the weapon mounts fire, then the number of such mounts in parenthesis (x n^1). The armament in the examples can be referenced from the weapon data tables.

Mount type	*Abbreviation*
Armoured turret	AT*n*
Unarmoured turret; fully enclosed weapon mount	UT*n*
Weapon with splinter shield	S*n*
Open, unprotected weapon mount	O*n*
Casemate	C*n*
Torpedo mount	TT*n*
Torpedo Reload (Japanese WW2 only)	TR*n*

Arcs of fire

Arcs of fire are an important part of these rules. The placement of the weapons on the model will usually enable players to work out where they can fire. Knowing which arcs of fire are covered by your weapons is very important.

We have tried to make this part of the rules as simple as we can by classifying the various arcs of fire, following study of different ship designs. By this means we can say that a ship has a certain type of gun battery, and how it is laid out. When you are making an assessment of which arcs the gun can fire into, study of reference books or the model is recommended. Bear in mind that in most cases a turret mounted on the side of a ship is unlikely to be able to fire to the Bow or Stern, because its blast is going to damage the superstructure. Such guns would be limited to a broadside arc. Guns with a quarter arc (allowing restricted fire along the length of the ship) are going to cost more, as explained later.

There are some cases where a battery is split and conforms to two different layouts, in which case we show the number of guns in each layout. Arcs of fire are delineated by angles of 45° or 90°. The arcs shown in the table are most common. The angles shown are centred in the direction shown, unless otherwise indicated.

Note under cost calculations that arcs in excess of 90° cost an additional 10% for each extra 45° or part thereof. The cost supplements are shown in the table overleaf as indicators. Some guns on the bow or stern may have limited arcs of fire, so it is important to check this when constructing the ship.

It is also possible (especially in World War 1) that a certain calibre of gun might be fitted both in turrets and other mounts, bearing into overlapping or identical arcs. In such cases you should note on your game record that these guns can all be combined into one salvo when used against one target.

The diagrams on the next page depict the various arcs used in the game, and the supporting table describes them and the cost effect.

Weapon costs

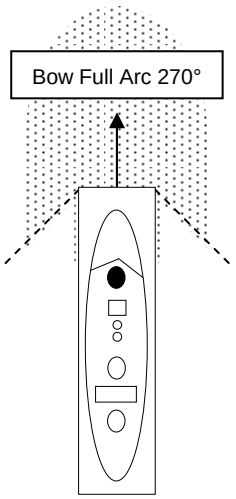
The cost of a mount is the value for its weapon at its maximum range (based on the carrying ship's visibility), multiplied by the number of weapons and the modifier for the arc into which the mount can fire.

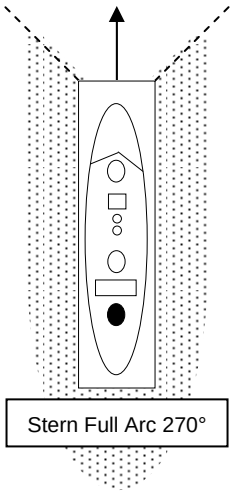
If a vessel has poor magazine safety then the cost for some mounts is reduced by 10%. This effect is only applied if the guns in the battery are in an armoured turret, and only on certain categories of vessel.

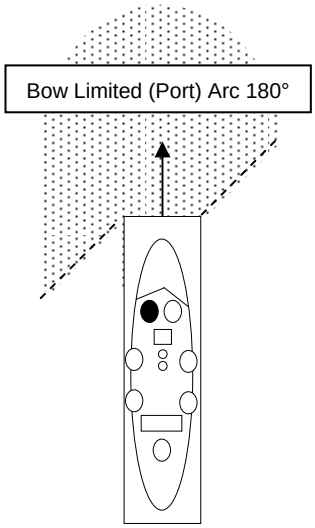
The total for all weapon mounts is added together and the final total is rounded.

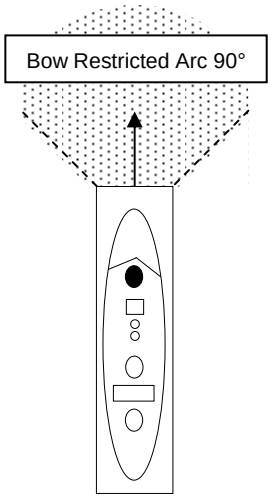
If the combined figure for the weapons in the main batteries rounds to 0, it should be treated as a value of 1. This will tend to only happen with small pre-dreadnought torpedo boats armed with inferior torpedoes.

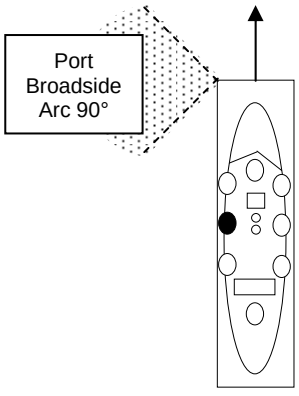
Arc	*Abbreviation*	*Definition*
Bow or Stern Full arc	B S	Weapons are mounted on the bow or stern of the ship, covering an arc of 270° centred in those directions, consisting of the Bow or Stern plus BOTH Broadside arcs. Arc B or S: mount cost +40%
Bow or Stern Limited arc	BLP BLS SLP SLS	Weapons are mounted side by side on the bow or stern of the ship, covering an arc of 180° consisting of the Bow or Stern plus ONE Broadside arc. '...LP or ...LS" arcs: mount cost +20%
Bow or Stern Restricted arc	BR SR	Weapons are mounted on the bow or stern of the ship, covering an arc of 90° centred in those directions, effectively only firing ahead or astern. This arrangement is rare. Arc B or S: normal mount cost
Broadside Port Starboard Centreline	PB SB CB	Weapons are mounted on either side of the ship, and fire in an arc covering 90° in the direction shown. Centreline turrets can fire to either side. Arc PB or SB: mount cost +0% Arc CB: mount cost +20%
Quarter Port Starboard plus... Foreward Aft	PFQ SFQ PAQ SAQ	Weapons are mounted into the relevant broadside, but also to a limited extent ahead or astern. In this case, the broadside arc is supplemented by an additional widening of the arc by 45° foreward or aft so that its limit is defined by the axis of the ship. For practical purposes the port arc is limited in the starboard direction by an extension of the starboard base edge and vv. All '...Q' arcs: mount cost +10%

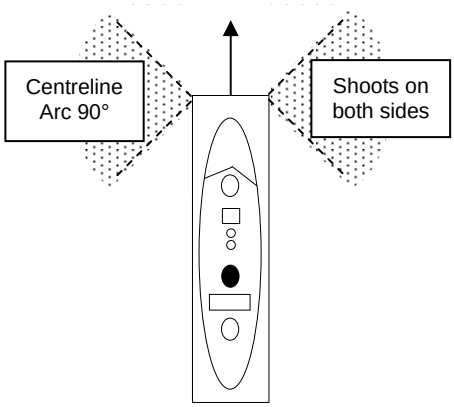


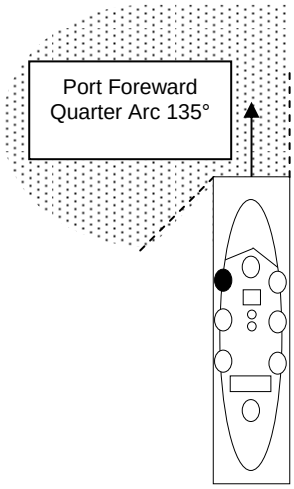












13.1 – Quick Firer Guns

For use with SMR 1

These weapons cover guns of approximately 20mm (usually 40mm) or over and less than 3.9" calibre. The usual size for the smallest quickfirer for the game is often termed a "1 pounder". These guns are regarded as Quick Firers (QF) in the rules. These may be fired against ships, with a relatively low effect.

For game purposes they are calculated as a factor by totalling the number of gun barrels that fall in this calibre range and entering them in the following calculation:

- √ (# of barrels) rounded to the nearest whole number.

13.2 – Anti Aircraft weapons

For use with SMR 2

These weapons are prominent during the Second World War and replace Quick Firers that are used in WW1. They come in two types, Dual Purpose and Short Range Anti Aircraft Weapons.

13.3 – Dual Purpose

The calibres which are considered for this purpose are from 3.9" to 5.3", serving also as Anti Aircraft weapons. A factor is calculated for these weapons, by entering the relevant figures in the formula below.

- √(# barrels x IP) rounded to the nearest whole number

Each factor of DP weapons costs 10 points.

These weapons have an anti-aircraft range equal to half the normal range (rounded up to the higher range band). Each time a DP gun mount is lost due to Critical Damage, the DPAA factor is reduced by 1, regardless of the number of guns in the mount. If the DP mounts are all lost then the DPAA factor is automatically set to 0.

Effect of VT fuses on DP AA guns.

Many Allied AA guns of between 5.25" and 4" can be equipped with VT fused shells with effect from the start of 1943. These have advantages in AA fire. The cost per factor of DP weapons if equipped with these shells is increased by 50% to 15.

13.4 – Short Range AA Weapons

These weapons cover all guns below 3.9" calibre down to and including 20mm. To derive the short range AA factor for the ship you must total the number of points derived from the Table of Short Range AA points, multiplying the number of guns by the values shown. The final factor is derived from:

- √(total points) rounded to the nearest whole number

The cost of each factor is 10 points.

These weapons can only be used against aircraft attacking their ship at a range of 0 RB.

If you are uncertain about the 20mm or 40mm gun type in question when you are calculating the numbers, use the shaded rows as a default.

Table of Short Range AA Points

Nationality	*Gun*	*Cal in mm*	*Factor*
France	3.54"	90	1.6
Italy	3.54"	90	5.2
Germany		88	2.3
USSR		85	2.8
Jugo	Skoda	83	2.7
GB	3" L/40 12 pdr	76.2	1.5
GB	3" L/45	76.2	2.0
Italy	3" L/40	76.2	1.7
Japan	3" L/40	76.2	2.0
Japan	3" L/60 (Agano)	76.2	2.5
Norway	Bofors 3" L/50	76.2	1.9
USA	3" L/23	76.2	1.5
USA	3" L/50	76.2	1.8
USA and Russian	3" L/55	76.2	2.0
France	2.95" L/50	75	1.5
France	2.95" L/55	75	2.0
USSR	45mm	45	0.7
GB	Vickers 2pdr "pompom"	40	1.4
GB	Vickers 40mm	40	1.5
Germany and Allied forces	Bofors 40mm	40	1.8
France		37	0.5
Germany	FlakM42	37	1.8
Germany	FlakM43	37	2.6
Germany	SKC30	37	0.4
Italy		37	1.7
USSR		37	2.0
USA	M9 Aero cannon	37	1.3
USA	Mk 16 1pdr	37	1.2
USA	1.1"	28	1.1
Japan		25	0.5
Germany	Flak 30	20	0.6
Germany	Flak 38	20	1.0
Italy	Breda	20	0.5
Italy	Scotti	20	0.5
Switzerland	Oerlikon	20	1.0

On the following pages you will find how armament is added to our example ships.

Kaiser

The Kaiser is armed with 10 x 12" SKL/50 (L/47) guns, mounted in 5 armoured turrets, each with two guns. These are located with one at the bow, one on each broadside, and two at the stern. There are 14 x 5.9" SKL/45 (L/42), mounted in casemates, 7 guns on each broadside (these guns have improved values after the end of 1915).

If you refer to the Weapon Data and Cost tables for the calibre and barrel length you will find one entry for the 12" L/47 and four entries for the 5.9" L/42 (the first two being applicable to the Kaiser). The game annotations for the main weapons are as follows. The [identifier in square brackets] is not strictly necessary, but it does serve as a point of reference when looking at the weapon tables.

10x12" (L/47) – [01]: AT2: B.PB.SB.S (x2)

14x5.9" (L/42) – [01]: C1: PB (x7).SB (x7)

In addition there are 12 guns of the Quick Firer type, providing a QF value of 3. (√12 = 3.464)

Scharnhorst

The Scharnhorst is armed with 8 x 8.2" SKL/40 (L/37) mounted in two armoured turrets, each with two guns. These are located at the bow and stern. The other 4 guns are mounted 2 on each side of the ship in casemates, 2 on each side of the vessel. These have the additional capability of firing ahead or astern, into quarter arcs. Note that these guns have lower game values than the turret weapons. She also carries 6 x 5.9" SKL/40 (L/37), in normal casemates, 3 on each side of the ship.

There are two entries for the 8.2" (L/37), both of which will be used, and one entry only for the 5.9" (L/37). The annotations for the main weapons are:

4x8.2" (L/37) – [01]: AT2: B.S

4x8.2" (L/37) – [02]: C1: PFQ.PAQ.SFQ.SAQ

6x5.9" (L/37) – [01]: C1: PB (x3).SB (x3)

There are 18 guns of the Quick Firer type, providing a QF value of 4. (√18 = 4.242)

Bristol

*The Bristol is armed with 2 x 6" Mk XI (L/50), mounted behind shields, one each to the bow and stern. There are 10 x 4" Mk VIII*** (L/50), mounted behind shields with 5 on each broadside.*

There are 12 entries for a 6" (L/50) and the Mk XI is the third. There is only one entry for the 4" (L/50). The annotations for the main weapons are:

2x6" (L/50) – [03]: S1: B.S

10x4" (L/50) – [01]: S1: PB(x5).SB(x5)

In addition there are 4 guns of the Quick Firer type, providing a QF value of 2. (√4 = 2)

M Class Destroyer

The M-Class destroyer is armed with 3 x 4" Mk IV (L/45), mounted behind shields, one on the bow, one amidships (firing to either broadside) and one to the stern. The torpedo armament is two twin 21" torpedo tubes on the centre line, firing to either side of the ship. These could be Mk II or Mk IV, depending on the date of the battle.

There are 6 entries for 4" (L/45) guns and the one we want is the first. When you look at the 21" torpedoes there are a very large number (31 in all). As they are sorted by nationality you will find the British torpedoes together and we need two of them, numbers [11] and [17]. The annotations for the main weapons are:

3x4" (L/40) – [01]: S1: B.CB.S

4x21" Torpedo – [11] (or [17]): TT2: CB (x2)

There are no Quick Firers.

Bismarck

The Bismarck is armed with eight 15" SKC/34 (L/48) guns, mounted in 4 armoured turrets, each with two guns. These are located with two at the bow and two at the stern. There are twelve 5.9" SKC/28 (L/52), mounted in 6 armoured turrets, with 3 on each broadside. There are sixteen 4.1" SKC/33 (L/60) dual purpose guns. These are in 8 shielded mounts, 4 on each broadside.

There is only one entry for 15" (L/48) guns, so that is straightforward. Similarly the 5.9" (L/52) and 4.1" (L/60) guns each only have one entry. The annotations for the main weapons are:

8x15" (L/48) – [01]: AT2: B(x2).S(x2)

12x5.9" (L/52) – [01]: AT2: PB(x3).SB(x3)

16x4.1" (L/60) DP – [01]: S2: PB(x4). SB(x4)

The dual purpose guns give a DP anti-aircraft factor of 6 (√(16xIP2) = 5.656). Short Range AA guns comprised 16x37mm SKC30 at 0.4 plus 12x20mm Flak 30 at 0.6, providing an SRAA factor of 4 (√(6.4+7.2) = 3.688).

Yorktown

The Yorktown's weapons are restricted to eight 5" Mk 12 (L/38) Dual Purpose guns, mounted in single open mounts, four on each broadside.

There are a number of 5" (L/38) guns with slightly different ratings. The guns on the Yorktown have the identifier [03]. The annotation for the weapons is:

8x5" (L/38) DP^ – [03]: O1: PB(x4).SB(x4)

The ^ symbol denotes the fact that this weapon can use VT ammunition later in the war (at an additional cost of 25 points).

The dual purpose guns provide a DP anti-aircraft factor of 5 (√(8xIP3) = 4.9). The Short Range AA outfit varied considerably during the war in the class. Initially they were all equipped with 16x1.1" guns at 1.1 giving 4 (√17.6 = 4.195). The Hornet received an additional 30x20mm by October 1942 so her value was increased to 7 (√(17.6+30) = 6.899) when she was sunk. By the end of the war the Enterprise carried 44x40mm at 1.8 and 32x20mm at 1.0 giving a total value of 11 (√(79.2+32) = 10.545).

Kaga

The Kaga is armed with ten 8" Type I 3rd year (L/50) guns, mounted in single casemates, five on each broadside. There are also sixteen 5" Type 89 (L/40) Dual Purpose guns in six twin shielded mounts, four to port and two to starboard and two unarmoured turrets (to starboard, astern of the funnel).

There are nine entries for 8" (L/50) guns, of which three are Japanese. The one with designation [05] was carried by the Kaga. There are two 5" (L/40) guns, one being the one we want with designation [02]. The annotations for the weapons are:

10x8" (L/50) – [05]: C1: PB(x5).SB(x5)

16x5" (L/40) DP – [02]: S2: PB(x4).SB(x2); UT2: SB(x2)

The dual purpose guns provide a DP anti-aircraft factor of 6 (√(16xIP2) = 5.65). Short Range AA guns comprised 22x25mm at 0.5, giving a factor of 3 (√11 = 3.317).

Nachi

The Nachi is armed with ten 8" Type II, 3rd year (L/50) mounted in five armoured turrets, each with two guns. These are located with 3 at the bow (one of which only fires to either broadside) and 2 at the stern. As built she carried six 4.7" 10th year (L/46) dual purpose guns. These are in 6 shielded single mounts, 3 on each broadside. These were changed during the first refit in 1934 to eight 5" Type 89 (L/40) dual purpose guns in 4 twin shielded mounts, two on each broadside. Torpedoes were carried, initially there were twelve 24" Type 8 Torpedoes in 4 sets of 3 launchers, two on each broadside. In the 1934 refit these were changed to eight 24" Type 93m1 "Long Lance" carried in two quadruple mounts, one on each broadside. After the 1940/41 reconstruction the number of mounts was doubled. There is no record of this class having carried quick reload systems.

We go back to our entries for 8" (L/50) guns and find that the correct guns for the Nachi are designated [09]. There are two types of 4.7" (L/46) guns, [01] being the one required here. The 5" guns are the same as those on the Kaga, designation [02]. There are three possible torpedoes we can carry on this ship. Initially the designation [02], then the [04] and possibly from 1944 the [05]*. The asterisk denotes that there are special rules regarding ships carrying this weapon. The annotations for the main weapons are:*

10x8" (L/50) – [09]: AT2: B (x2).CB.S (x2)

6x4.7" (L/46) DP – [02]: S1: PB (x3).SB (x3) OR

8x5" (L/40) DP – [02]: S2: PB (x2).SB (x2)

12x24" Torpedo – [02]: TT3: PB(x2).SB(x2) OR

8x24" Torpedo – [04]: TT4: PB.SB OR*

16x24" Torpedo – [04] or [05]*: TT4: PB (x2).SB (x2)*

The 4.7" guns provide a DP anti-aircraft factor of 2 (√ (6xIP1) = 2.449). The 5" guns provide a DP anti-aircraft factor of 4 (√(8xIP2) = 4). As built there was no SRAA outfit. After the 1940/41 rebuild she gained 8x25mm guns at 0.5 giving a factor of 2 (√4 = 2). In May 1944 these increased to 24x25mm, a factor of 3 (√12 = 3.464); in July 1944 they were further increased to 52x25mm, a factor of 5 (√26 = 5.099).

Giussano

The Giussano is armed with eight 6" Ansaldo 1926 (L/53), mounted in armoured turrets with 2 guns each, two turrets each to the bow and stern. There are six 3.9" OTO1928 (L/47), in twin mounts behind shields with one on each broadside and one on the centreline. Four 21" torpedoes are carried in two twin mounts, one per broadside.

There are two types of 6" (L/53) in the tables, and we need that with identifier [02]. There are two 3.9" (L/47) guns, both Italian, and we need the AA version which is [01]. As previously there are a lot of 21" torpedoes. For WW2 the most appropriate one will be the latest available for Italy, which is [26]. The annotations for the main weapons are:

8x6" (L/53) – [02]: AT2: B (x2).S (x2)

6x3.9" (L/47) DP – [01]: S2: PB.CB.SB

4x21" Torpedo – [26]: TT2: PB.SB

The 3.9" guns provide a DP AA factor of 2 (√(6xIP 1) = 2.449). Short Range AA guns comprised 8x37mm at 1.7, giving a factor of 4 (√13.6 = 3.688).

Tribal class

The Tribal Class destroyer is armed with eight 4.7" Mk IX (L/45), in twin shielded mounts, two each at the bow and the stern. The torpedo armament is one quad set of 21" torpedo tubes on the centre line, firing to either side of the ship. These could be Mk IX, IX, or IX**, depending on the date of the battle. Some vessels had one mount replaced with a twin 4" Mk XVI gun which served as an AA weapon.*

There are nine 4.7" (L/45) entries, of which three are British, and we need the one designated [08]. There are six 4" (L/45) guns, four are British and the one we need is that marked as a DP gun with VT capability, that marked [06]. Of the nine possible British 21 torpedoes, the ones we want are designated [27] or [30], the latter being used after 1943 with a Torpex warhead. The annotations for the main weapons are:

either

8x4.7" (L/45) – [08]: S2: B (x2).S (x2)

or

6x4.7" (L/45) – [08]: S2: B (x2).S

2x4" (L/45) DP^ – [06]: S2: S

plus

4x21" Torpedo – [27] or [30]: TT4: CB

The ^ symbol denotes the fact that the 4" DP guns can use VT ammunition later in the war (at an additional cost of 10 points). These guns provide a DPAA factor of 2 (√(2xIP2) = 2). Short Range AA guns comprised 4 x 40mm at 1.4, giving a factor of 2 (√5.6 = 2.366). This was later increased to 2x40mm at 1.8 and 12x20mm at 1.0, making a factor of 4 (√(3.6+12) = 3.95). Some vessels carried an SRAA value of 5.

We have now added the armament data to the ships, though in the above examples we have left out the penetration values for reasons of space.

14 – Points Values

While we know that points values are anathema to some naval wargamers, we prefer to include these so that some sort of evaluation can be made of the results of an action. Points values for a ship with Crew Quality 0 are calculated from:

Hull Cost PLUS Weapon Cost

14.1 – Hull cost

The value of the hull is calculated taking:

- (Structure S plus Flotation F) x Speed ÷ MVR.
- If a ship has poor underwater protection, then its HULL COST is reduced by 10%. Such vessels are counted as being merchant vessels converted to military use, such as armed merchant cruisers and some carriers; First World War vintage Pre-dreadnought Battleships and Armoured Cruisers.
- Round the final figure to the nearest whole number. If this figure should round to less than 1, then it is treated as 1.

14.2 – Weapon cost

- The value of weapons is taken from the weapons tables x the number of guns or torpedoes. In addition, there is a cost for the gun or torpedo mount itself, which is based on the extent of its firing arc. All weapons get a 90° of fire for free, and then each additional 45° or part thereof adds 10% to the cost of a mount. Calculate the cost for each mount based on the number of guns and arc of fire and total the figure for the equipment concerned. Retain all decimal points in these calculations, and only round to the nearest whole number when all the weapons have been calculated and added together.
- Some vessels may be regarded as having poor magazine safety, either due to weak protection or poor handling facilities. On such vessels the cost of the specific battery concerned is reduced by 10%. Note that this effect is only applicable to vessels that have the guns in a given battery mounted in an armoured turret. Typical vessels falling into this category are First World War vintage Pre-dreadnought Battleships and Armoured Cruisers (WW1); British First World War Battle Cruisers.
- Many Japanese vessels in World War 2 were equipped with special torpedo reload systems. If these systems are fitted, then the cost of reloads is an additional 50% added to the cost of the torpedo mount they serve.
- If the combined figure for the weapons in the main batteries rounds to 0, it should be treated as a value of 1. This will tend to only happen with small pre-dreadnought torpedo boats armed with inferior torpedoes.
- The additional cost of a QF factor is 1 per factor. This only applies to ships being used in games using SMR part I.
- The cost per DP factor is 10. This increases to 15 if the ship can use VT fuses. This only applies to ships being used in games using SMR parts II and III.
- The cost per SRAA factor is also 10. This only applies to ships being used in games using SMR parts II and III.
- Fire Control and Damage Control are a function of the size of the vessel, so these are deemed to be included in the basic hull value.
- Carrier Handling Capacity is treated similarly to the main battery of a large warship such as a battleship in that it also has a cost, calculated from:
  - H x 10 for most carriers
  - H x 9 if the carrier has poor safety measures to prevent leaks of aviation fuel and resultant combustion, and the vessel will be susceptible to more devastation when it suffers a critical hit. Typical carriers in this category are most WW2 Japanese Carriers, though some were retrofitted with concrete "cladding" after Midway. Converted merchants will all be subject to this effect as well.
  - If the carrier has any catapults, these cost 10 points each.

14.3 – Crew Quality Modifier

The cost of any ship or base may be modified by Crew Quality using the modifier of between + 20% and – 20% if you are using CQ values other than +0.

14.4 – Other equipment

Other additional equipment is fitted at a cost of:

- 50 points per float plane/scout
- cost of radar.

14.5 – Carrier Victory Point Bonus

Aircraft carriers are especially valuable assets and in order that players take the right steps to protect them, if they are lost due to sinking or failing morale, the enemy gains a victory point bonus of 1% per operational aircraft capacity, added to the cost of the carrier, including any modification for crew quality but not radar.

Yorktown with a cost of 484 points, and capacity of 96 aircraft would give the enemy a VP bonus of 465 points. Kaga with a cost of 769 points and 81 aircraft gives a bonus of 623 points. Both assume Crew Quality 0.

On the following pages we will calculate the actual costs of the example ships.

Ship			*Costs*
(S plus F) x Speed / MVR			
Kaiser			
(81+34) x 21 ÷ 9 =		268.33	268
12": 75.7 x (6 x 1.4 + 4 x 1.0) =	938.68		
5.9": 7.9 x (14 x 1.0) =	110.60		
QF x 3 =	3.00	1052.28	1052
Total			1320
Improved 5.9" used later changes the costs to:			
5.9": 8.3 x (14 x 1.0) =	116.20		
which increases weapons cost to 1058 (1057.88) points and the total to 1326, an increase of 6 points			
Scharnhorst			
(33+20) x 24 ÷ 7 =		181.71	
Less 10% for poor underwater protection		-18.17	
		163.54	164
8.2" Turrets: 21.2 x (4 x 1.4) =	118.72		
Less 10% for poor magazines	-11.87		
8.2" Casemates: 19.9 x (4 x 1.1) =	87.56		
5.9": 6.7 x (6 x 1.0) =	40.20		
QF x 4 =	4.00	238.61	239
Total			403
Bristol			
(10+7) x 25 ÷ 7 =		60.71	61
6": 8.3 x (2 x 1.4) =	23.24		
4": 2.2 x (10 x 1.0) =	22.00		
QF x 2 =	2.00	47.24	47
Total			108
M Class			
(2+2) x 34 ÷ 4 =		34.00	34
4": 3.7 x (2 x 1.4 + 1 x 1.2) =	14.80		
21"TT: 3.7 x (4 x 1.2) =	17.76	32.56	33
Total			61
The alternative torpedo type costs:			
5.0 x (4 x 1.2) =	24.00		
this increases the total weapons cost to 39 (38.80) giving an increase of 6 points to the total ship cost			
Bismarck			
(110+43) x 29 ÷ 12 =		369.75	370
15": 185.3 x (8 x 1.4) =	2075.36		
5.9": 12.8 x (12 x 1.0) =	153.60		
4.1": 5.7 x (16 x 1.0) =	91.20		
DP x 6 =	60.00		
SRAA x 4 =	40.00		
		2420.16	2420
Total			2790
Yorktown			
(29+19) x 33 ÷ 12 =		132.00	132
5": 9.0 x (8 x 1.0) =	72.00		
DP x 5 =	50.00		
SRAA x 4 =	40.00		
		162.00	162
Handling 17 x 10 =	170.00		
Catapults 2 x 10 =	20.00		
		190.00	190
Total			484
(This excludes costs of aircraft)			
Victory point bonus is 484 x 96% = 465 (464.64)			
If equipped with VT fuses the DPAA outfit will cost 75 points increasing the overall value by 25 points to 509, which would make the bonus value 489 (488.64)			

Ship			*Costs*
(S plus F) x Speed ÷ MVR			
Kaga			
(55+37) x 28 ÷ 12 =		214.67	215
8": 24.9 x (10 x 1.0) =	249.00		
5": 5.0 x (16 x 1.0) =	80.00		
DP x 6 =	60.00		
SRAA x 3 =	30.00		
		419.00	419
Handling 15 x 9 *=		135.00	135
Total			769
(This excludes costs of aircraft)			
* Carrier has poor safety measures			
Victory point bonus is 769 x 81% = 623 (622.89)			
Nachi (1929)			
(16+10) x 36 ÷ 10 =		93.60	94
8": 24.2 x (8 x 1.4 + 2 x 1.2) =	329.12 (+)		
4.7": 2.9 x (6 x 1.0) =	17.40		
24" TT: 9.1 x (12 x 1.0) =	109.20		
DP x 2 =	20.00		
		475.72	476
Total			570
(+) In this case the weapon can fire 5RB but the ship can see only 4RB, so the cost of 24.2 is taken, that which applied to these guns shooting to 4RB in the Weapon Data and Cost tables.			
Nachi as refitted 1934			
(16+10) x 36 ÷ 10 =		93.60	94
8": 24.2 x (8 x 1.4 + 2 x 1.2) =	329.12		
5": 5.0 x (8 x 1.0) =	40.00		
24" TT: 14.7 x (8 x 1.0) =	117.60 (+)		
DP x 4 =	40.00		
		526.72	527
Total			621
(+) In this case the weapon can fire 5RB but the ship can see only 4RB, so the cost of 14.7 is taken, that which applied to these torpedoes shooting to 4RB in the Weapon Data and Cost tables.			
Nachi as rebuilt 1941			
(18+12) x 34 ÷ 10 =		102.00	102
8": 24.2 x (8 x 1.4 + 2 x 1.2) =	329.12		
5": 5.0 x (8 x 1.0) =	40.00		
24" TT: 14.7 x (16 x 1.0) =	235.20		
DP x 4 =	40.00		
SRAA x 2 =	20.00		
		664.32	664
Total			766
The later SRAA increases to 3 and 5 in 1944 increase the costs by a further 10 or 30 points.			
If the improved Long Lance torpedo is used from 1944, this would cost 18 points over the engagement range of 4RB. This means that the torpedo outfit could cost 288 points increasing the weapons costs to 717 (717.12) and the total to 819, an increase of 53 points (not taking into account the increased cost of SRAA).			
Giussano			
(10+7) x 37 ÷ 8 =		78.63	79
6": 8.7 x (8 x 1.4) =	97.44 (+)		
3.9": 2.5 x (4 x 1.0 + 2 x 1.2) =	16.00		
21" TT: 5.4 x (4 x 1.0) =	21.60		
DP x 4 =	20.00		
SRAA x 4 =	40.00		
		195.04	195
Total			274
(+) In this case the weapon can fire 5RB but the ship can see only 4RB, so the cost of 8.7 is taken, that which applied to these guns shooting to 4RB in the Weapon Data and Cost tables.			

Ship			*Costs*
(S plus F) x Speed ÷ MVR			
Tribal Class (1937 as built)			
(4+4) x 36 ÷ 5 =		57.60	58
4.7": 5.6 x (8 x 1.4) =	62.72		
21"TT: 5.8 x (4 x 1.2) =	27.84		
SRAA x 2 =	20.00		
		110.56	111
Total			169
Tribal Class (1941 refit)			
(4+4) x 36 ÷ 5 =		57.60	58
4.7": 5.6 x (6 x 1.4) =	47.04		
4": 5 x (2 x 1.4) =	14.00		
21"TT: 5.8 x (4 x 1.2) =	27.84		
DP x 2 =	20.00		
SRAA x 2 =	20.00		
		128.88	129
Total			187
Alternative Torpex torpedo carried after 1943 costs:			
9.3 x (4 x 1.2) =	44.64		
this increases the total weapons cost to 146 (145.68) giving an increase of 17 points to the total ship cost to 204 points.			

14.6 – Equipping Carriers (and Air Bases)

During some games you will have the opportunity to refuel and rearm your aircraft. If you wish to do this you must purchase batches of attacks and put them with your carriers or air bases, An air base may also need to have suitable arms for carrier based aircraft that have to land there if necessary.

To do this you decide how many aircraft you wish to be able to rearm during the game – any number between the minimum and 24 (or fewer if the carrier carries fewer of that aircraft type). This is a decision by the player which will come from experience.

The cost of providing payload is determined by multiplying the number bought by the attack cost for each type of ordnance purchased. These costs are totalled, and modified by the Crew Quality of the carrier or base concerned. This figure is then rounded to the nearest whole number.

Our USS Yorktown will be equipped with 12 x D13 for the Dauntless strike bombers, 12 x D5 for the Dauntless scout bombers and 12 x T1 for the Devastators. D2's will not be bought for the rearming cycle so the scouts cannot be rearmed with this additional attack. This player is not planning to build up big stands, but 12 does allow for a reasonable hope of launching stands with an acceptable number of aircraft. the costs are:

12 x D13 (9.6) = 115.20

12 x D5 (4.8) = 57.60

12 x T1 (8.0) = 96.00

The total is 268.80. If USS Yorktown has a Crew Quality of +1, then this figure is multiplied by 1.10 making a total of 296 (295.68). This figure is added to the cost of buying USS Yorktown.

AIR BASES AND FORTS

Air Bases

Air bases are created in a similar way to carriers:

- The operational capacity (H) is derived from the surface area of the runway initially using the carrier formula, for each runway. It is usually possible to make a rough estimate of the length of a runway from plans. In all cases, use a width of 200 feet to determine the surface area.
- Having determined a start value, you then take the square root of the result. Finally, total this value and then round to the nearest whole number.

  Midway Island in 1942 had three runways, length approx 5,250, 4,500 and 3,188 feet. This gives you values of:

  √(5250x200 ÷ 6600) = 12.613

  √(4500x200 ÷ 6600) = 11.677

  √(3188x200 ÷ 6600) = 9.829

  Total value of H is 34 (34.119)
- The air base has an "S" damage value equal to 5 x H. It has no "F" value.

  Midway has an S value of 5 x 34 = 170.
- Air bases automatically have a size calculated from: (√ H) minus 2.5, rounded to nearest whole number.

  Midway has a size of √34 –2.5 = +3 (3.331)
- They can be armed with anti aircraft guns, and derive their factors exactly like ships.

  Midway had in total 24 x 3" AA guns, 8 x 37mm and 18 x 20mm AA guns. The value for the USMC 37mm AA weapon does not appear in the table shown earlier. These provide an SRAA defence of:

  24 x 1.5 + 8 x 1.25 x 18 x 1.00 = 64; √ 64 = 8
- They have a Fire Control value derived from their S value like a ship.

  Midway's FC value is (170 ÷ 15) +1 = 12 (12.333)
- They have damage control teams calculated from: √ (number of aircraft on the base), rounded to nearest whole number.

  For the purposes of the calculation, at the time of the battle Midway Island had 105 aircraft based there, which gives a value of 10 (10.247)
- They can be armed with surface defence guns, using appropriate data (which may date from WW1 vintage). Surface guns are always assumed to be able to fire into any arc and are costed at x2 for this reason.

  Midway had surface defence guns of 6 x 5" Mk 7 L/51 with a range of 4RB and 4 x 7" MK 2 L/45 guns with a range of 3RB, both of WW1 vintage. All are in open single mounts
- The points value is calculated from:

  S x 10 plus equipment, modified by Crew Quality.

  Midway has a value of

  Midway Island: S x 10 = 1700.00

  Air Handling capacity 34 = 340.00

  Surface Weapons:

  6 x 7.1 x 2.0 = 85.20

  4 x 14.3 x 2.0 = 114.40

  SRAA value 8 x 10 = 80.00

  The total value excluding aircraft and aircraft payload is 2320 (2319.60)

Forts and gun batteries

Forts are calculated in similar fashion.

- They have an "S" damage value equal to the sum of each calibre of gun (in inches) times the number thereof. Total the figures for all including fractions.
- Forts get an additional bonus depending on their construction:

Earth	+ 10%
Earth and wood	+ 15% (such as a Japanese bunker)
Brick	+ 20%
Stone	+ 25%
Concrete	+ 30%

- They have a size based on the number of guns in the fort.

1 gun	– 2
2 or 3 guns	– 1
4 to 8 guns	+ 0
9 to 15 guns	+ 1
16 to 24 guns	+ 2
over 24 guns	+ 3

- Fire Control is derived from the S value like ships.
- Damage Control is derived from √ (total number of guns)
- Points value is derived from S x 10 plus equipment, modified by Crew Quality.

AIRCRAFT DATA

Aircraft size is implicit in how they are handled in the game and any modifiers have been included in their combat rules. Aircraft have a visibility range of 1 better than the prevailing visibility, up to a maximum of 6 Range Bands.

1 – Scout Planes

These have a flat cost of 50 points per plane carried. These are typically carrier borne scouts or float planes on World War 2 cruisers, etc.

2 – Combat Planes

The most effective combat aircraft in use in the game are fighters, fighter-bombers, low level, dive and torpedo bombers. In addition special aircraft with specific attack types are also permitted, these being equipped either with a stand-off weapon or being used in a Kamikaze attack.

3 – Aircraft Stands

Aircraft are represented by stands, each of which can only represent one aircraft type. We recommend that stands are represented by a card counter 30mm square. A stand can represent any number of aircraft between the minimum, which depends on the Tactical Doctrine Table below, which varies by date and nationality, and a maximum of 24.

Aircraft Tactical Doctrine for Fighter-type aircraft		
Nationality	***Date***	***Number***
China	1940/1941	2
Finland	1940 1944	2 4
France	1940	5
Germany	up to 1938 1939 onwards	3 4
Great Britain (European Theatre) Great Britain (N. Africa) Great Britain (Far East)	up to 1940 1941 1942 onwards up to 1942 1943 onwards up to 1943 1944 onwards	3 3 or 4 4 3 4 3 4
Italy	–	3
Japan	–	3
USA	1940 1942 (Navy) 1943/44 (Other)	3 4 4
Russia	up to 1943 from 1944	4 2
Others	–	3
Aircraft Tactical Doctrine for Bomber-type aircraft		
Italy	–	5
All others	–	3

"On table assets" will operate in squadron strength formed up at bases or on carriers. Off-table air groups are likely to be composed of formations that have grouped together en route to form a larger strike.

A record must be kept of the number of aircraft remaining on the stand, along with their game statistics. (This can actually be on the card counter if desired). It is left up to the player whether he puts a large number of aircraft into one stand, or splits his forces up into a large number of stands.

4 – Aircraft Movement

Speed is calculated from:

- √(½ x Speed in MPH) x 5, rounded to the nearest whole 5 cm.

This allows us to take into account historical cruising speeds, the amount of time spent by aircraft climbing, diving and making other necessary manoeuvres, while having a simple set of speed data, which is also reasonable for game play as well. (Altitude is ignored for game purposes).

Aircraft have a Manoeuvre Rating of 0, which means they can be moved in any direction and facing.

5 – Aircraft Hit Points

Aircraft have varying numbers of hit points, calculated as follows:

- ((empty weight of one aircraft in lbs) $^{0.66}$) ÷ 100, rounded to the nearest whole number.

An aircraft is lost every time the accumulated damage inflicted matches the hit point value. It is also possible to lose "whole" aircraft as part of the combat routine.

6 – Aircraft Size

Like ships, aircraft have a size, which gives a modifier. This modifier also reflects the manoeuvrability of the target. It is calculated as follows:

- (Speed in MPH) ÷ (Empty weight ÷ 33) rounded to the nearest number.

The result is then multiplied by – 1, and then + 2 is added. The resulting range is between +2 and – 2. Should for any reason the result fall outside this range, these figures are used as the maximum and minimum values.

7 – Air Combat Factors

Aircraft Combat Factors (ACF) are based on the guns carried and used for air combat. They are calculated by totalling the number of points for the various guns carried, then applying the formula:

- √(Gun Points) for fighters and fighter bombers
- √(Gun Points) ÷ 2 for other aircraft incl. all Kamikazes even if not carrying a bomb or other type of payload.

The result is then rounded to the nearest whole number.

The Air Combat factors are treated as an IP in combat resolution.

Gun type	*Points*
Machine gun up to 8mm	1
Heavy machine gun up to 15mm	2
Cannon up to 20mm	3
Cannon up to 25mm	4
Cannon up to 30mm	5
Cannon up to 35mm	6
Cannon up to 40mm	7

8 – Aircraft payload

Typical aircraft payloads are bombs, torpedoes, and other weapons. Payloads have IPs based on the equipment carried by ONE aircraft of the type in the flight. Payload may be of more than one type, such as torpedoes or bombs plus rockets. If an aircraft carried two types of bombs then each is counted, so it may have 'sticks' of 500lb and 1000lb bombs.

The IPs, penetration and costs of the payload types carried by aircraft that appear in Part III are shown in the tables in the rules. A complete table is shown here, though it is unlikely that many of the combinations are going to be used.

The Bomb table requires some explanation. The base cost for an attack with a single bomb of a given weight is shown for each attack type.

If you attack with more bombs you get the following to hit bonuses:

No of Bombs	*To hit bonus*
2 or 3	+1
4 to 8	+2
9 or more	+3

The additional costs for each of the bonuses are shown for each bomb weight, and should be added to the base costs shown.

The attack codes are grouped in 4's, so a +2 attack with a base code of 5 has a code of 7.

9 – Aircraft Costs

The cost of an individual aircraft is determined using the formula:

- (Speed in cm ÷ 10 x Hit Points) + ACF.
- The size of the aircraft increases or decreases the final cost as follows:

Aircraft Size Cost modifier					
Size:	***– 2***	***– 1***	***+ 0***	***+ 1***	***+ 2***
Modifier	x 1.650	x 1.575	x 1.500	x 1.425	x 1.350

- The final cost of an individual aircraft is then rounded to the nearest 0.10.

  A Douglas Dauntless SBD-2 with speed 55, 3 hit points, Size +1, 1 ACF and one bomb of 1000 lbs derives its costs as follows. The base cost is (55 ÷ 10 x 3) + 1 = 17.5

  This is then multiplied by the size cost modifier of 1.425 making 24.938, which rounds off to 24.90.

- The payload costs are added to this figure, arrived at by adding the weapons cost for each bomb, torpedo or other weapon attack carried.

  The above Dauntless gets an attack code of D13, and the bomb costs 9.6. An alternate payload is 1x500 lbs and 2 x 100 lbs. These have codes D5 for 1 x 500lbs (costing 4.8) and D2 for 2 x 100 lbs with a to hit of +1 (costing 2.4+0.2 = 2.6). The payload cost in this case would be 7.4.

The cost of a stand of aircraft is derived from the aircraft cost plus payload, multiplied by the number of aircraft in the stand. The result is then modified for Crew Quality (see '*Command and Crew*') then rounded to the nearest whole number.

Nine Dauntless will cost 9 x (24.9+9.6) = 311 (310.5) or 9 x (24.9+7.4) = 291 (290.7) depending on payload.

Remember that tactical doctrine stipulates the minimum number of aircraft in a stand, and that the maximum is 24.

An air group is made up of a number of stands of aircraft. The total cost for the air group is the sum of the costs of the stands. Finally the cost of the commander (see *'Command and Crew'*) is added to the cost.

10 – Kamikaze Aircraft

Kamikaze aircraft are a special case, in that their attack expends the aircraft, and the IP is derived from both the airframe and payload (if any). The aircraft and its base cost are derived using the routines for aircraft shown above.

The IP for the attack is calculated from

- (empty weight of one aircraft in lbs PLUS any payload it carries in lbs) $^{0.66}$) ÷ 100

The PEN for the attack is the result of the above calculation divided in half.

The IP and PEN are then rounded to the nearest whole number. It is possible that the PEN may not be half the IP when the result is rounded.

The cost of the kamikaze attack is added to the base cost of the aircraft. The attack cost is:

- IP x 10.6

Aircraft Ordnance Table (Bombs)						
Attack		*IP*	*PEN*	*Type and cost*		
Code	*Bomb weight*			*D*	*F*	*L*
1	Up to 362lbs	1	1	2.4	2.0	1.2
2-4	+1 attack costs +0.2, +2 attack costs +0.4, +3 attack costs +0.6					
5	363 to 639lbs	2	2	4.8	4.0	2.4
6-8	+1 attack costs +0.4, +2 attack costs +0.8, +3 attack costs +1.2					
9	640 to 928lbs	3	3	7.2	6.0	3.6
10-12	+1 attack costs +0.6, +2 attack costs +1.2, +3 attack costs +1.8					
13	929 to 1227lbs	4	4	9.6	8.0	4.8
14-16	+1 attack costs +0.8, +2 attack costs +1.6, +3 attack costs +2.4					
17	1228 to 1534lbs	5	5	12.0	10.0	6.0
18-20	+1 attack costs +1.0, +2 attack costs +2.0, +3 attack costs +3.0					
21	1533 to 1847lbs	6	6	14.4	12.0	7.2
22-24	+1 attack costs +1.2, +2 attack costs +2.4, +3 attack costs +3.6					
25	1848 to 2165lbs	7	7	16.8	14.0	8.4
26-28	+1 attack costs +1.4, +2 attack costs +2.8, +3 attack costs +4.2					
29	2166 to 2489lbs	8	8	19.2	16.0	9.6
30-32	+1 attack costs +1.6, +2 attack costs +3.2, +3 attack costs +4.8					
33	2490 to 2816lbs	9	9	21.6	18.0	10.8
34-36	+1 attack costs +1.8, +2 attack costs +3.6, +3 attack costs +5.4					
37	2817 to 3147lbs	10	10	24.0	20.0	12.0
38-40	+1 attack costs +2.0, +2 attack costs +4.0, +3 attack costs +6.0					
41	3148 to 3482lbs	11	11	26.4	22.0	13.2
42-44	+1 attack costs +2.2, +2 attack costs +4.4, +3 attack costs +6.6					
45	3483 to 3820lbs	12	12	28.8	24.0	14.4
46-48	+1 attack costs +2.4, +2 attack costs +4.8, +3 attack costs +7.2					
49	3820 to 4161lbs	13	13	31.2	26.0	15.6
50-52	+1 attack costs +2.6, +2 attack costs +5.2, +3 attack costs +7.8					

* The ordnance tables show values in some cases for attacks with single weapons, tough in service these were not carried thus. Players may wish to use these in "what if" games if they wish.

*Aircraft Ordnance Table (Stand Off)**				
Attack Code	*To Hit Mod*	*IP*	*PEN*	*Cost*
S1 (Fritz X x 1) *	+0	11	11	26.4
S2 (Fritz X x 2)	+1	11	11	29.7
S3 (Hs 293 x 1) *	+0	9	5	54.0
S4 (Hs 293 x 2 or 3)	+1	9	5	63.9
S5 (Ohka)	+0	15	8	87.0

Aircraft Ordnance Table (Gun attack)				
Attack Code	*To Hit Mod*	*IP*	*PEN*	*Cost*
G1 (US 75mm T13E1)	+0	1	4	2.0
G2 (GB 57mm Molins)	+4	1	4	2.8

*Aircraft Ordnance Table (Rockets)**				
Attack Code	*To Hit Mod*	*IP*	*PEN*	*Cost*
R1 (4 or 6x3.5")	+0	1	1d6	1.8
R2 (8 or 10x3.5")	+0	2	1d6	3.6
R3 (4x5")	+0	2	1d6	3.6
R4 (6x5")	+0	3	1d6	5.4
R5 (8 x 5")	+0	4	1d6	7.2
R6 (10 x 5")	+0	5	1d6	9.0
R7 (8x60lb)	+0	3	1d6	5.4
R8 (16x60lb)	+0	5	1d6	9.0
R9 (Tiny Tim x 1) *	+0	5	5	10.0
R10 (Tiny Tim x 2)	+1	5	5	11.0

Aircraft Ordnance Table (Torpedoes)					
Attack Code	*To Hit Mod*	*IP*	*Cost*	*Description*	
T1	+0	4	8.0	Germany Great Britain United States	17.7" F5 (x1) 18" Mks VII; VIII (1920's) (x1) 22.4" Mk 13 (1935)
T2	+1	4	8.8	France Germany Great Britain Italy Japan Russia	15.75" 26DA St Tropez (x1) 17.7" F5 (x2) or 17.7" F5b (Light, 1941) (x1) 18" Mks IX (1936); XII (1937); XIV (1938) (x1) 17.7" F 200/450x5.46; Si 200/450x5.36; W 120/500x2.6 (pre-1941) (x1) 17.7" Type 91 Mod 1 (1933); Mod2 (1941) (x1) 17.7" 45-36AN; AV-A (x1)
T3	+2	4	9.6	Germany Italy	17.7" F5b (Light, 1941) (x2) 17.7" F 200/450x5.46; Si 200/450x5.36; W 120/500x2.6 (pre-1941) (x2 or x3)
T4	+0	5	10.0	—	—
T5	+1	5	11.0	Germany Italy Japan	17.7" F5b (Heavy, 1941) (x1) 17.7" F 200/450x5.46; Si 200/450x5.36; W 120/500x2.6 (1941) (x1) 17.7" Type 91 Mod 3 all types (1942-1944); Type 4 Mk 2 (1944) (x1)
T6	+2	5	12.0	Germany Italy	17.7" F5b (Heavy, 1941) (x2) 17.7" F 200/450x5.46; Si 200/450x5.36; W 120/500x2.6 (1941) (x2 or 3)
T7	+0	6	12.0	United States	22.4" Mk 13 (1943) (x1)
T8	+1	6	13.2	Great Britain Japan	18" Mks XV (1943); XVII (1945) [Torpex Warhead] (x1) 17.7" Type 4 Mk 4 (1945) (x1)
T9	+2	6	14.4	—	—