STATIONS MANNED AND READY

PART 2 – WORLD WAR TWO

CONSTRUCTION ALGORITHMS FOR SHIPS
1920 TO 1945

BY ANDREW FINCH AND ALAN BUTLER

EDITION 1.12

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Update History

Version 1.9 incorporated all the changes following adjustment of the costs of ship weapons. These are marked with marginal type for changes:

and for deletions:

These changes are summarised as follows:

The weapons costs were revised following closer examination of the calculation we had used for torpedoes. We uncovered the failing that the calculation did not adequately take into account the chance of hitting at any given range. This error has been corrected now, and the results vary slightly from the original figures used. Having uncovered one anomaly, we immediately realised that the gun costing also failed to take account of the chances of delivery of the damage at the various ranges. This has now also been corrected.

The Carrier construction costs have also been revised and finalised such that they are now cheaper, reflecting the fact that you must still buy their main weapons (the aircraft) separately.

Land bases and forts are still subject to some alteration, more in the lines of adding extra features rather than changing the calculation.

New in Version 1.10

Version 1.10 has some errors corrected in the dimensions of Kaga Flight Deck, where the original (600 feet) rather than reconstructed length (815.5 feet) crept in.

Marginals are marked thus for changes:

In addition there are some additional changes that come from the use of aircraft, which became apparent when we were working out the final methods of air attack and air defence.

AA Fire

Firstly, the original concept we used to determine the number of AA factors (based on what we used to generate the Quickfirers for WW1) is completely changed so that the relative effectiveness of an AA weapon is part of the calculation. For this purpose there is now a table of medium and light AA guns and the values they contribute to the calculations. In addition the calculation for the factors provided by Dual Purpose guns has also been changed.

Cost of AA weapons.

These were originally costed at a very low value at 1 per point. This is clearly not a valid contribution, so after some deliberation, the cost to be added for each factor of AA weapons is increased to 10.

Use of VT Fuses for Allied AA guns.

In cases where a weapon is able to make use of a VT fuse, the cost per factor of AA for that weapon group is increased to 15. This makes it easy to show on the ship data tables, so that those ships that can carry VT ammunition have an additional points cost bonus shown in the notes.

Carrier Aircraft

Clarification that the number of aircraft used to determine the VP Bonus for a Carrier is the operational capacity. You have to check that some of the numbers do not include crated aircraft (carried on most Japanese and American carriers constructed between the wars). Reference works often also indicate a reduction in capacity as aircraft got larger.

Aircraft ACF

The calculation of the Air Combat Factor has been corrected (part of the text got missed out).

Aircraft Costs

The aircraft cost calculations have been altered to take account of aircraft sizes, changes in the air attack combat and anti surface attack rules, and also for purpose of game balance.

Aircraft Weapons

There are some significant changes in how aircraft attacks work, and it was necessary to revise the costs of weapons. The final revised costs are now presented in a table. The table shows more data than appears in SMR3, where the data shown is restricted to the payloads attached to the aircraft in use in the game.

New in Version 1.11

One minor correction to the weapon data for the USA removing the DP effect of one type of 5”/38.

Marginals are marked thus for changes:

There has been a minor adjustment to the calculation of the costs of an air group. The change means that you buy an airframe, put on payload, multiply by the number of aircraft, modify the result by the Crew Quality, then round to the nearest whole number.

This takes account of the method used in the rules to determine the cost of an Air Group when playing in larger games with the added option of refuelling and rearming aircraft during the game. This will require calculation during play.

A new section has been added giving you ideas about equipping carriers and bases with the ability to refuel and rearm during bigger games.

Some sections have been moved around and numbering has been amended and corrected where necessary.

The method of determining the Air Handling Capacity values for land air bases has been revised.

A selection of Italian 17.7” torpedoes has been added (for Escorts vessels and torpedo boats).

Correction to one item of Italian torpedo data.

Slight revision of usage of standoff and Tiny Tim weapons.

New in version 1.12

French cruiser torpedo for WW2

Marginals are marked thus for changes:

WARSHIP DATA WW2

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. More recent publications will tend to have benefited from subsequent historical and technical analysis, while Jane's was published at the time, and while it is seen as a respected and authoritative source with access to information that has never been possible since, the information is often based on the ideal values seen at the time (and also served as misinformation used by the naval powers against each other). Later sources tend to take account of how the vessels actually performed in action.

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.

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 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 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. The F values below have been rounded to the nearest whole number.

Bismarck displaces 41,700 tons, an F value of 43;

Yorktown displaces 19,875 tons, an F value of 19;

Kaga displaces 38,200 tons, an F value of 37;

Nachi displaces 10,980 tons as built, an F value of 10 or 13,000 tons as rebuilt in 1940/41, an F value of 12;

Giussano displaces 5,110 tons, an F value of 7;

The Tribal Class displaces 1,959 tons, an F of 4

3 − Structure (S)

The structural value of the vessel is derived from the Flotation value, 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: 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 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.

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

Condition	*Modifier*
Generic values for all vessels laid down: From 1919 onwards	 1.03
British vessels From 1919 to 1925 From 1926 to 1932 From 1933 to 1941 In 1942 (wartime shortages) In 1943 (wartime shortages) In 1944 and 1945	 1.12 1.21 1.16 1.10 1.13 1.16
German vessels From 1919 to 1924 From 1925 to 1935 From 1936 to 1945	 0.97 1.11 1.15
Italian vessels From 1911 to 1928 From 1929 to 1945	 1.15 1.20
Japanese vessels From 1919 to 1930 From 1931 to 1936 In 1937 and 1938 From 1939 to 1945	 1.12 1.14 1.10 1.11
United States vessels From 1913 to 1923 From 1924 to 1929 From 1930 to 1941 From 1941 to 1945	 1.11 1.15 1.21 1.18

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 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 feet, 96 aircraft. The Kaga has 6" Belt, 1.5" Deck, no Conning Tower armour, Flight Deck 815.5 x 100 feet, 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. 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 example of 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 in the table at the top of the next page show this in action.

That was not all that scary, was it ?

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.

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.
  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

Ship	*KCE*	*Armour Class*	*Structural Bonus*
Bismarck	(1.15)		
Belt 12.5”	14.375	10 (10.044)	60.66%
Deck 4.75”	5.463	5 (5.333)	14.02%
CT 14”	16.100	11 (10.760)	12.03%
Main Turrets			
14.25” x 4	16.388	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 0.79”	0.909	1 (0.849)	05.71%
CT 1.57”	1.806	2 (2.114)	04.03%
Turrets 1” x 4	1.150	1 (1.235)	12.86%
			= 44.63%
The Base value of S = 7.02 gets a bonus of 44.63% added (3.13) for a total of 10.15, 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.			

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.

In both cases the actual displacement used to initially calculate the Flotation value is the determining factor.

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.

When you start equipping your ship with guns, you will possibly start to find cases where the gun may shoot father than the ship can actually see.

The hull of the ship is now complete. All that remains is to add the weapons.

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

8 – Armament and Equipment

These rules incorporate guns with a calibre down to 3.9". The guns and torpedoes to be fitted can be found in the tables which follow. A standard reference work such as 'Conway's' will provide you with the details of which guns were fitted on which ships.

Weapons tables

These tables show details of the calibre and identification of the gun or torpedo in question, the IP value of the shell or warhead, and the maximum game range in range bands (RB). They also show the penetration or to hit modifier at the range band concerned. Finally the cost of each gun or torpedo tube is shown, as well as details of ship classes or types that carried the weapon. For further details see the tables concerned.

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.

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

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.

Anti Aircraft weapons

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.

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.

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 following table, 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
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	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	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

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 on the next page 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 above table 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.

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%

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 following set of abbreviations in the rules, mainly in the ship data tables. 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^l). The armament in the following 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*

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. These dual purpose guns give a DP anti-aircraft factor of √(16 guns x IP 2) = 6 (5.656). Short Range AA guns comprised 16 x 37mm SKC30 at 0.4 plus 12 x 20mm Flak 30 at 0.6, providing an SRAA factor of √(6.4+7.2) = 4 (3.688). The Structural value of 110 provides a Fire Control Value of 8 (8.33). The crew of 2092 provides 5 damage control teams (4.573). 4 scout planes are carried. The annotation for the main weapons is:

8x15" SKC/34 (L/48): AT2: B(x2).S(x2)

12x5.9" SKC/28 (L/52): AT2: PB(x3).SB(x3)

16x4.1" SKC/33 (L/60): S2: PB(x4). SB(x4)

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. These provide a DP anti-aircraft factor of √(8 guns x IP 3) = 5 (4.9). The Short Range AA outfit varied considerably during the war in the class. Initially they were all equipped with 16 x 1.1" guns at 1.1 giving √17.6 = 4 (4.195). The Hornet received an additional 30 x 20mm by October 1942 so her value was increased to √(17.6+30) = 7 (6.899) when she was sunk. By the end of the war the Enterprise carried 44 x 40mm at 1.8 and 32 x 20mm at 1.0 giving a total value of √(79.2+32) = 11 (10.545). The Structural value of 29 provides a Fire Control Value of 3 (2.93). The crew of 2175 provides 5 Damage Control Teams (4.664). The hangar is ventilated, she has 3 lifts and 2 catapults. The annotations for the weapons are:

8x5" Mk 12 (L/38): O1: PB(x4).SB(x4)

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). These provide a DP anti-aircraft factor of √(16 guns x IP 2) = 6 (5.65). Short Range AA guns comprised 22 x 25mm at 0.5, giving a factor of √11 = 3 (3.317). The Structural value of 55 provides a Fire Control Value of 5 (4.667). The crew of 2016 provides 4 Damage Control Teams (4.489). The hangar is normal (enclosed). There are three lifts and no catapults.

The annotations for the weapons are:

10x8" Type I 3rd yr (L/50): C1: PB(x5).SB(x5)

16x5" Type 89 (L/40): S2: PB(x4).SB(x2); UT2: SB(x2)

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 provide a DP anti-aircraft factor of √(6 guns x IP 1) = 2 (2449). These were changed during the first refit in 1934 to eight 5" Type 89 (L/41) dual purpose guns in 4 twin shielded mounts, two on each broadside. These provide a DP anti-aircraft factor of √(8 guns x IP 2) = 4 (4.0). As built there was no SRAA outfit. After the 1940/41 rebuild she gained 8 x 25mm guns at 0.5 giving a factor of √4 = 2. In May 1944 these increased to 24 x 25mm, a factor of √12 = 3 (3.464); in July 1944 they were further increased to 52 x 25mm, a factor of √26 = 5 (5.099). 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. The Structural values of 16 or 18 both provide a Fire Control Value of 2 (2.07 or 2.20). The crew of 773 provides 3 Damage Control teams (2.780). 3 scout planes are carried. The annotation for the main weapons is:

10x8" Type II 3rd year (L/50): AT2: B (x2).CB.S (x2)

6x4.7" 10th year (L/46): S1: PB (x3).SB (x3) OR

8x5" Type 89 (L/41): S2: PB (x2).SB (x2)

12x24" Type 90: TT3: PB(x2).SB(x2) OR

8x24" Type 93m1: TT4: PB.SB OR

16x24" Type 93m1: TT4: PB (x2).SB (x2)

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. These provide a DP AA factor of √(6 guns x IP 1) = 2 (2.449). Four 21" Si 270 torpedoes are carried in two twin mounts, one per broadside. Short Range AA guns comprised 8 x 37mm at 1.7, giving a factor of √13.6 = 4 (3.688). The Structural value of 10 provides a Fire Control Value of 2 (1.67). The crew of 520 provides 2 damage control teams (2.280). 2 scout planes are carried. The annotation for the main weapons is:

8x6" Ansaldo 1926 (L/53): AT2: B (x2).S (x2)

6x3.9" OTO1928 (L/47): S2: PB.CB.SB

4x21" Si 270: TT2: PB.SB

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. This would provide a DPAA factor of √(2 guns x IP 2) = 2.*

Short Range AA guns comprised 4 x 40mm at 1.4, giving a factor of √5.6 = 2 (2.366). This was later increased to 2 x 40mm at 1.8 and 12 x 20mm at 1.0, making a factor of √(3.6+12) = 4 (3.95).

The Structural value of 4 provides a Fire Control Value of 1 (1.27). The crew of 250 provides 2 damage control teams (1.581). The annotation for the main weapons is:

4x4.7" Mk IX (L/45): S2: B (x2).S (x2)

or

3x4.7" Mk IX (L/45): S2: B (x2).S

1x4" Mk XVI (L/45): S2: S

4x21" Mk IX: TT4: CB

9 – 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 Equipment Cost

- Aircraft carriers have specific equipment costs (see below)

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.

Other additional equipment is fitted at a cost of:

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

Hull cost

The value of the hull is calculated taking:

- (Structure S plus Flotation F) x Speed ÷ MVR, rounded to the nearest whole number.
- 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) or some carriers (WW2); First World War vintage Pre-dreadnought Battleships.

Equipment cost

- The value of equipment 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 decimal points in this calculation, and only round to the nearest whole number when all the weapons have been costed.
- 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 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.
- 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.
- The cost per DP factor is 10. This increases to 15 if the ship can use VT fuses.
- The cost per SRAA factor is also 10.
- 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.
- Aircraft carrier costs are derived in the same way. The aircraft handling capacity is treated as “equipment” and the method of calculation is shown in the next section.
- Air bases are treated similarly, and the calculation of their value is shown in a subsequent section.

Scout and float planes

Scout aircraft were carried extensively (mainly by cruisers) until the middle of the Second World War, when carriers gained the upper hand. They could be used for gunnery spotting but in these rules they are restricted to scouting. 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. Each aircraft carried adds a fixed equipment charge the final cost of the vessel:

- 50 points per scout aircraft carried

Radar

For details of costs and effects of radar see the radar section later and in the rules.

10 – Carriers

Carriers have an operational capability which is derived from the size of the flight deck or runway and the number of lifts available. This is referred to as the handling capacity (H), and the base figures is derived 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 that permits aircraft to warm up below decks. 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.

This 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.

  Yorktown has a Flight Deck area of 68,972 square feet, three lifts 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, providing a handling capacity of 15 (12.356 + 3).

In many cases, one or more catapults are available to launch aircraft. These cost an additional:

- 10 points per catapult

Handling Capacity

A carrier can handle a number of aircraft in one game turn. This number (H) is derived from the size of the flight deck or runway and the number of lifts or dispersal areas. 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.

10.1 – 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 and radar.

Yorktown with a cost of 390 points, and capacity of 96 aircraft would give the enemy a VP bonus of 374 points. Kaga with a cost of 617 and 81 aircraft gives a bonus of 500 points. Both assume Crew Quality 0.

10.2 – 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 Enterprise 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 Enterprise 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 Enterprise.

Ship			*Costs*
(S plus F) x Speed ÷ MVR			
Bismarck			
(110+43) x 29 ÷ 12 =		369.75	370
15": 184.3 x (8 x 1.4) =	2064.16		
5.9": 10.7 x (12 x 1.0) =	128.40		
4.1": 5.2 x (16 x 1.0) =	83.20		
DP x 6 =	60.00		
SRAA x 4 =	40.00		
		2375.76	2376
Total			2746
Yorktown			
(29+19) x 33 ÷ 12 =		132.00	132
5": 7.6 x (8 x 1.0) =	60.80		
DP x 5 =	50.00		
SRAA x 4 =	40.00		
		150.80	151
Handling 17 x 10 =	170.00		
Catapults 2 x 10 =	20.00		
		190.00	190
Total			473
(This excludes costs of aircraft)			
Victory point bonus is 473 x 96% = 454 (454.08)			
If equipped with VT fuses the DPAA outfit will cost 75 points increasing the overall value by 25 points to 498, which would make the bonus value 478 (478.08)			
Kaga			
(55+37) x 28 ÷ 12 =		214.67	215
8": 21.6 x (10 x 1.0) =	216.00		
5": 4.4 x (16 x 1.0) =	70.40		
DP x 6 =	60.00		
SRAA x 3 =	30.00		
		376.40	376
Handling 15 x 9 *=		135.00	135
Total			726
(This excludes costs of aircraft)			
* Carrier has poor safety measures			
Victory point bonus is 726 x 81% = 588 (588.06)			
Nachi (1929)			
(16+10) x 36 ÷ 10 =		93.60	94
8": 24.9 x (8 x 1.4 + 2 x 1.2) =	338.64		
4.7": 2.6 x (6 x 1.0) =	15.60		
24" TT: 9.1 x (12 x 1.0) =	109.20		
DP x 2 =	20.00		
		483.44	483
Total			577
Nachi as refitted 1934			
(16+10) x 36 ÷ 10 =		93.60	94
8": 24.9 x (8 x 1.4 + 2 x 1.2) =	338.64		
5": 4.4 x (8 x 1.0) =	35.20		
24" TT: 17.9 x (8 x 1.0) =	143.20		
DP x 4 =	40.00		
		557.04	557
Total			651
Nachi as rebuilt 1941			
(18+12) x 34 ÷ 10 =		102.00	102
8": 24.9 x (8 x 1.4 + 2 x 1.2) =	338.64		
5": 4.4 x (8 x 1.0) =	35.20		
24" TT: 17.9 x (16 x 1.0) =	286.40		
DP x 4 =	40.00		
SRAA x 2 =	20.00		
		720.24	720
Total			822
The later SRAA increases to 3 and 5 increase the costs by a further 10 or 30 points.			

Ship			*Costs*
(S plus F) x Speed ÷ MVR			
Giussano			
(10+7) x 37 ÷ 8 =		78.63	79
6": 8.9 x (8 x 1.4) =	99.68		
3.9": 2.2 x (4 x 1.0 + 2 x 1.2) =	14.08		
21" TT: 5.4 x (4 x 1.0) =	21.60		
DP x 4 =	20.00		
SRAA x 4 =	40.00		
		195.36	195
Total			274
Tribal Class			
(4+4) x 36 ÷ 5 =		57.60	58
4.7": 5 x (8 x 1.4) =	56.00		
21"TT: 5.8 x (4 x 1.2) =	27.84		
SRAA x 2 =	20.00		
		103.84	104
Total			162
Alternative torpedo types cost:			
(1940) 6.3 x (4 x 1.2) =		30.24	
this increases the total weapons cost to 106 (106.24) giving an increase of 2 points to the total ship cost to 164 points.			
(1941) 6.7 x (4 x 1.2) =		32.16	
this increases the total weapons cost to 108 (108.16) giving an increase of 4 points to the total ship cost to 166 points.			
(1943) 9.3 x (4 x 1.2) =		44.64	
this increases the total weapons cost to 121 (120.64) giving an increase of 17 points to the total ship cost to 179 points.			
The increased SRAA factor of 4 later in the war would increase any of these values by a further 20 points.			
If the alternative heavy AA outfit was shipped from 1941, the basic values would be different again:			
(1941 variant)			
(4+4) x 36 ÷ 5 =		57.60	58
4.7": 5 x (6 x 1.4) =	42.00		
4": 4.5 x (2 x 1.4) =	12.60		
21"TT: 6.7 x (4 x 1.2) =	32.16		
DP x 2 =	20.00		
SRAA x 2 =	20.00		
		126.76	127
Total			185
The 1943 variant would have a torpedo cost of 44.64 which would increase the weapons outfit to a total of 139 (139.24) and an overall cost of 197.			

11 – Final cost calculation examples

These tables show the final calculations for our sample ships. The calculations are shown so you see how we reach the numbers. The weapons show the basic cost then the multipliers for the mounts on the ship. Mounts with the same costing modifier have been combined.

No additional figure has been added for scout planes which could be carried by three of the ships, nor has a cost been added for radar. The costs assume Crew Quality 0.

12 – 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 and 4 x 7" MK 2 L/45 guns 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 5.7 x 2.0 = 68.40

  4 x 12.5 x 2.0 = 100.00

  SRAA value 8 x 10 = 80.00

  The total value excluding aircraft and aircraft payload is 2288 (2288.40)

13 – 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.

14 – Table of Guns by Nationality and Calibre

The tables on the following pages show the calibre and identification of the gun in question, the IP value of the shell, and the maximum game range in range bands (RB).

The gun tables show 5 range bands (I-V) with the Armour Class penetrated at each range band. This value has been pre-calculated and uses the same underlying calculation as those used earlier when determining the AC of the ship.

Finally the cost of each individual gun is shown, as well as details of ship classes or types that carried the weapon.

DP guns capable of using VT fused ammunition are indicated thus:

If using VT fused ammunition you must use the higher cost figure during construction. Such ammunition is only available to Great Britain and the United States, and from 1943 onwards. As a rule of thumb not every vessel is equipped with such ammunition.

A note should be made about the sort order in the table under each nation. The table follows a descending order of calibre, subdivided where necessary by calibre length (the 'L/*nn*' values). All weapons with the same game data are grouped into the same row.

4.5" Mks I / III; IV (L/45) ***Anti Aircraft Capable (VT)***	3	4 (2)	4	2	1	0	—	7.8	BB-Queen Elizabeth; BC-Renown; CV-Ark Royal, Illustrious, Implacable, Indomitable; CL-Dido; DD-Z, Ca Classes

Weapon	***IP***	***RB***	***I***	***II***	***III***	***IV***	***V***	***Cost***	***Typical Ships (* denotes vessel never constructed)***
France									
15" M 1935 (L/45)	9	5	14	12	11	9	8	113.0	BB-Richelieu
13.4" M 1912 (L/45)	9	5	12	10	8	7	6	92.8	BB-Bretagne
13" M 1931 (L/50)	7	5	13	10	9	7	6	76.0	BC-Dunkerque
12" M1910 (L/45)	6	5	11	9	7	5	4	54.5	BB-Courbet; B-Danton
8" M1931 (L/55)	3	5	8	6	4	3	2	18.7	CA-Algerie
8" M1924 (L/50)	5	5	8	6	4	3	2	31.1	CA-Duquesne, Suffren
6.1" M1920 (L/50)	2	5	6	4	2	1	0	8.4	CV-Bearn; CL-Duguay-Trouin, Jeanne d'Arc
6" M1930 (L/55)	2	5	6	4	2	1	0	8.4	BB-Richelieu; CL-Emile Bertin, La Galissonniere
5.9" Tbts (L/45)	2	3	4	3	1	—	—	5.6	AMC-Barfleur, Charles Plumier
5.45" M1910 (L/55)	2	4	5	3	2	1	—	7.1	BB-Bretagne, Courbet; SL-Arras, Lille
5.45" M1929; M1934 (L/50)	2	4	5	3	2	1	—	7.1	DD-Le Fantasque; Mogador
5.45" M1923 (L/40)	2	4	4	3	1	0	—	5.7	DD-Guepard
5.45" M1927 (L/40)	3	4	4	3	1	0	—	8.6	CLML-La Tour d'Auvergne; DD-Aigle, Vauquelin; SL-Bougainville
5.1" M1935 (L/45) ***Anti Aircraft Capable***	3	5	5	3	2	1	0	10.7	BC-Dunkerque
5.1" M1932 (L/45)	3	5	5	3	2	1	0	10.7	DD-Le Hardi
5.1" M1919; M1924 (L/40)	2	4	4	3	1	0	—	5.7	DD-Bourrasque, Chacal, L'Adroit
3.9" M1932 (L/45)	1	3	3	2	1	—	—	2.2	CVS-Cdte Teste; TB-La Melpomene; SL-Chamois, Elan
3.9" M1927; M1930 (L/45) ***Anti Aircraft Capable***	1	3 (2)	3	2	1	—	—	2.2	BB-Lorraine, Richelieu; CA-Algerie
Germany									
16" SKC/34 (L/52)	15	5	15	13	11	10	9	200.6	H-Class*
15" SKC/34 (L/48)	15	5	14	12	10	9	7	184.3	BB-Bismarck
11.1" SKC/34 (L/51)	9	5	11	9	7	5	4	81.8	BC-Scharnhorst
11.1" SKC/28 (L/49)	6	5	11	8	6	5	4	51.7	BC-Deutschland
11.1" SKL/40 (L/36)	4	5	8	6	5	4	3	26.5	B-Schlesien
8" SKC/34 (L/56)	4	5	8	6	4	3	2	24.9	CA-Hipper
5.9" SKC/25 (L/57)	3	5	6	4	2	1	0	12.6	CL-K Class, Leipzig, Nuernberg
5.9" SKC/28 (L/52)	3	5	5	3	2	1	0	10.7	BB-Bismarck; BC-Deutschland, Scharnhorst; CV-Graf Zeppelin
5.9" Tbts KC/36 (L/46)	3	5	5	3	2	1	0	10.7	CL-Emden (rearmed 1942); DD-Types 1936A, 1936A (Mob)
5.9" SKL/45 (L/42)	2	4	5	3	2	1	—	7.1	CL-Emden; AMCs
5" SKC/34 (L/42)	4	4	4	3	1	0	—	11.4	DD-Types 1934, 1936, 1936B
5" SKC/41 (L/42) ***Anti Aircraft Capable***	4	5 (3)	4	3	1	0	0	11.6	DD-Types 36C*, 41*, 42C*, "Zerstörer 1945"*
4.1" SKC/33 (L/60) ***Anti Aircraft Capable***	2	4 (2)	4	2	1	0	—	5.2	BB-Bismarck, H-Class; BC-Deutschland, Scharnhorst; CA-Hipper
4.1" SKC/28 (L/51)	2	4	4	2	1	0	—	5.2	TB-Types 1923, 1924
4.1" SKC/32 (L/46) ***Anti Aircraft Capable***	2	3 (2)	3	2	1	—	—	4.4	B-Schlesien; TB-Types 1935, 1937, 1939; SL-F Class

Weapon	*IP*	*RB*	*I*	*II*	*III*	*IV*	*V*	*Cost*	*Typical Ships (* denotes vessel never constructed)*
Great Britain									
18” Mk II (L/45)	12	5	17	15	13	12	10	184.2	BB-N3 (1920 design)*
18” Mk II (L/45)	14	5	16	14	13	11	10	204.4	BB-N3 (1921 design)*
16” Mk I (L/45)	8	5	14	12	11	9	8	100.5	BB-Nelson, G3*
16” Mks II; III; IV (L/45)	15	5	14	12	11	9	8	188.4	BB-Lion*
15” Mk II (L/45)	13	5	13	12	10	8	7	153.5	BB-King George V (1940 design)*
15” Mk I (L/42)	13	5	13	11	10	8	7	150.0	BB-Queen Elizabeth, Royal Sovereign; BC-Hood, Renown; MO-Erebus, Marshal Soult, Roberts
14” Mk VII (L/45)	11	5	12	11	9	8	6	120.2	BB-King George V
8” Mks IX; X (L/50)	4	5	8	6	4	3	2	24.9	CA-Proposed WWII cruisers*
8” Mk VIII (L/50)	4	5	7	6	4	3	2	23.5	CA-London, Norfolk, York, Exeter, Kent
7.5” Mk VI (L/45)	4	4	7	5	3	2	—	20.4	CA-Hawkins
6” Mk XVII (L/50)	2	3	5	4	2	—	—	7.2	CV-Eagle
6” Mks XXII, XXIII (L/50)	3	5	5	4	2	1	0	11.5	BB-Nelson; CL-Arethusa, Leander, Perth
6” Mk XXIII (L/50)	2	5	5	4	2	1	0	7.7	CL-Edinburgh, Fiji, Gloucester, Southampton, Swiftsure
6” Mk XII (L/45)	2	3	5	3	2	—	—	6.7	BB-Queen Elizabeth, Royal Sovereign
6” Mk XII (L/45)	1	4	5	3	2	1	—	3.5	CL-Caledon, Carlisle, Ceres, Effingham
6” Mk XII (L/45)	2	4	5	3	2	1	—	7.1	CL-D Class, Emerald, Enterprise
5.5” Mk I (L/50)	4	4	5	3	2	1	—	14.2	BC-Hood, Furious
5.5” Mk I (L/50)	4	3	5	3	2	—	—	13.3	CV-Hermes
5.25” Mk I (L/50) ***Anti Aircraft Capable (VT)***	2	5 (3)	5	3	2	1	0	7.1	BB-King George V; CL-Dido
4.7” Mk XI (L/50)	2	4	4	3	1	0	—	5.7	DD-L, M Classes
4.7” Mks I/II (L/45)	1	3	4	2	1	—	—	2.5	DD-Amazon, Scott, Shakespeare, W Class (Mod)
4.7” Mks IX; XII (L/45)	2	3	4	2	1	—	—	5.0	DD-A to J, K, N, O, S, T, U, W, V, Tribal, ex Turkish, ex-Brazilian Classes
4.7” Mks VII; VIII; X (L/40) ***Anti Aircraft Capable (VT)***	2	3 (2)	3	2	1	—	—	4.4	BB-G3*, N3*, Nelson; CV-Courageous; CLM-Adventure
4.5” Mks I / III; IV (L/45) ***Anti Aircraft Capable (VT)***	3	4 (2)	4	2	1	0	—	7.8	BB-Queen Elizabeth; BC-Renown; CV-Ark Royal, Illustrious, Implacable, Indomitable; CL-Dido; DD-Z, Ca Classes
4.5” Mk IV (L/45) ***Anti Aircraft Capable (VT)***	4	4 (2)	4	2	1	0	—	10.3	DD-Battle
4” Mk V (L/45)	2	3	3	1	0	—	—	3.4	DD-V Class
4” Mk IX, X (L/45)	1	3	3	2	1	—	—	2.2	BC-Renown; DDE-Flower
4” Mk XV (L/45) ***Anti Aircraft Capable***	2	3 (2)	3	1	0	—	—	3.4	BC-Repulse; CV-Eagle, Hermes; CA-York, Canberra; CL-Sydney
4” Mks XVI; XVII; XXI (L/45) ***Anti Aircraft Capable (VT)***	2	4 (2)	3	2	1	0	—	4.5	BB-Barham, Malaya, Warspite, Royal Sovereign; BC-Hood; CV-Furious; CA-Exeter, Kent, London, Norfolk; CL-Arethusa, C Class, Danae, Dragon, Edinburgh, Effingham, Fiji, Gloucester, Leander, Southampton; DD-L, V, W, Tribal; SL-Hunt
4” Mk XIX (L/40)	2	2	1	0	—	—	—	1.3	SL-Castle, Flower, River

Weapon	*IP*	*RB*	*I*	*II*	*III*	*IV*	*V*	*Cost*	*Typical Ships (* denotes vessel never constructed)*
Italy									
15” Ansaldo 1934 (L/50)	9	5	15	13	11	9	8	118.5	BB-Littorio
15” Ansaldo 1914 (L/40)	11	4	13	11	9	8	—	119.0	BB-Carraciolo*; MO-Alfredo Cappellini, Faa di Bruno
12.6” M1934; 1936 (L/44)	8	5	12	10	8	7	5	81.9	BB-Andrea Doria, Conte di Cavour
12” M 1909 (L/46)	7	5	12	9	7	6	5	67.4	BB-Andrea Doria, Conte di Cavour
10” M1908 (L/45)	5	5	9	7	5	4	3	36.2	CA-San Giorgio
8” Ansaldo 1924; 1927; 1939 (L/53)	3	5	8	6	4	3	2	18.7	CA-Bolzano, Trento, Zara
7.5” M1908 (L/45)	2	5	7	5	3	2	1	10.4	CA-San Giorgio
6” Ansaldo 1934; OTO 1936 (L/55)	2	5	6	4	2	1	0	8.4	BB-Littorio; CL-Abruzzi
6” Ansaldo 1926 (L/53)	2	5	6	4	3	1	1	8.9	CL-Giussano
6” OTO 1929 (L/53)	3	5	5	4	2	1	0	11.5	CL-Cadorna, Duca d'Aosta, Montecuccoli
5.3” OTO 1937; Ansaldo 1938 (L/45)	2	4	5	3	2	1	—	7.1	BB-Andrea Doria; CL-Capitani Romani
4.7” M1909 (L/50)	1	3	4	2	1	—	—	2.5	BB-Cesare
4.7” Ansaldo and OTO (L/50)	1	4	5	3	2	1	—	3.5	BB-Conte di Cavour; DD-Folgore, Freccia, Maestrale, Navigatori, Oriani, Soldati
4.7” OTO 1926; VT 1924; SCA 1918 (L/45)	1	3	4	3	1	—	—	2.8	DD-Leone, Sauro, Sella, Turbine
4” SA 1917 (L/45)	1	3	4	2	1	—	—	2.5	TB-Curtatone, Generali, La Masa, Mirabello, Palestro, Sirtori
4” SA 1914 (L/35)	1	3	3	2	1	—	—	2.2	TB-Audace, Pilo; SL-Diana
3.9” OTO 1928 (L/47) ***Anti Aircraft Capable***	1	3 (2)	3	2	1	—	—	2.2	BB-Conte di Cavour; CA-Bolzano, San Giorgio, Trento, Zara; CL-Abruzzi, Cadorna, Duca d'Aosta, Giussano, Montecuccoli
3.9” OTO 1931 (L/47)	1	3	3	2	1	—	—	2.2	TB-Ariete, Ciclone, Pegaso, Spica; SL-Gabbiano
Japan									
18.1” 5th Year (L/45)	14	5	16	14	12	11	10	201.5	BB-13*
18.1” Type 94 (L/45)	18	5	16	15	13	12	11	271.4	BB-Yamato
16.1” 3rd Year (L/45)	14	5	14	12	11	9	8	175.8	BB-Amagi*, Kaga*, Kii*, Nagato
14” Vickers, 41st Year (L/45)	10	5	12	10	9	7	6	105.2	BB-Fuso, Ise; BC-Kongo
8” I 3rd Year (L/50)	2	5	7	5	4	2	1	10.8	CA-Aoba (1926), Furutaka (1926)
8” I 3rd Year (L/50)	4	5	7	5	4	2	1	21.6	CV-Akagi, Kaga (single guns and two gun turrets); CA-Nachi (1927)
8” II 3rd Year (L/50)	4	5	8	6	4	3	2	24.9	CA-Aoba, Furutaka, Mogami, Nachi, Takao, Tone
6.1” 3rd Year (L/60)	2	5	6	4	3	1	0	8.8	BB-Yamato; CA-Mogami (1935); CL-Oyodo
6” 41st Year (L/50)	2	4	5	3	2	1	—	7.1	BB-Fuso; BC-Kongo
6” 41st Year (L/50)	2	5	5	3	2	1	0	7.1	CL-Agano
5.5” 3rd Year (L/50)	2	3	5	3	2	—	—	6.7	BB-Ise (as built); CV-Hosho; CL-Tenryu
5.5” 3rd Year (L/50)	3	4	5	3	2	1	—	10.6	BB-Amagi*, Ise (later), Kaga*, Kii*, 13*; CL-Sendai, Yubari; CML-Okinoshima
5.5” 3rd Year (L/50)	2	4	5	3	2	1	—	7.1	BB-Nagato (as built); CL-Kuma, Nagara
5.5” 3rd Year (L/50)	3	5	5	3	2	1	0	10.7	BB-Nagato (later); CVS-Nisshin; CL-Katori
5” 3rd Year (L/51)	2	4 (2)	4	2	1	0	—	5.2	DD-Akatsuki, Asashio, Fubuki, Hatsuharu, Kagero, Shimakaze, Shiratsuyu, Yugumo
5” Type 89 (L/40) ***Anti Aircraft Capable***	2	3 (2)	3	2	1	—	—	4.4	BB-Fuso, Ise, Nagato, Yamato; BC-Kongo; CV-Chitose, Hiryu, Junyo, Kaga, Kaiyo, Ryuho, Ryujo, Shinano, Shinyo, Shokaku, Soryu, Taiyo (some), Unryu, Zuiho; CA-Mogami, Nachi, Takao, Tone; DDE-Matsu, Tachibana
4.7” 10th Year (L/46) ***Anti Aircraft Capable***	1	4 (2)	4	2	1	0	—	2.6	CV-Akagi, Taiyo; CA-Aoba, Furutaka, Takao (some); CL-Yubari
4.7” 3rd; 11th Year (L/45)	1	4	4	2	1	0	—	2.6	DD-Kamikaze (1942), Minekaze (1942), Mutsuki (1942), Wakatake (1942); TB-Otori, Tomozuru
3.9” Type 98 (L/65) ***Anti Aircraft Capable***	2	4 (2)	4	2	1	0	—	5.2	CV-Taiho; CL-Oyodo; DD-Akitsuki
Jugoslavia									
5.5” Skoda (L/66)	2	5	5	3	2	1	0	7.1	DD-Premuda
4.7” Skoda (L/46)	2	4	4	3	1	0	—	5.7	DD-Beograd

Weapon	*IP*	*RB*	*I*	*II*	*III*	*IV*	*V*	*Cost*	*Typical Ships (* denotes vessel never constructed)*
Netherlands									
5.9” QF Mks 6;-11 (L/50)	2	5	6	4	2	1	0	8.4	CL-De Ruyter, Sumatra, Tromp; GB-Flores, v Nassau
4.7” QF Mks 5; 6; 7 (L/50)	2	4	5	3	2	1	—	7.1	CVS-Willem van de Zaan; DD-Van Galen, Van Ghent; SL-Van Kinsbergan
4.7” Mk 8 (L/45)	2	4	4	2	1	0	—	5.2	DD-Callenburgh, Z1; GB-K3
Poland									
4.7” M 1934/1936 (L/50)	2	4	5	3	2	1	—	7.1	DD-Grom; ML-Gryf
Russia									
16” B37 (L/50)	17	5	15	14	12	10	9	235.5	BB-Sovetskii Soyuz*
12” M 1937 (L/55)	10	5	11	9	7	6	5	92.9	BC-B36 (Pr 25)*
12” M 1940 (L/55)	11	5	11	9	7	6	5	102.2	BC-B50 Kronshtadt (Pr 69)*
12” M1907 (L/52)	7	5	11	9	7	6	5	65.0	BB-Gangut, Imp Nikolai I*
12” M1907 (L/52)	8	5	11	9	7	6	5	74.3	BB-Parizhskaya Kommuna
7.1” M B-1-K 1931 (L/57)	3	5	8	5	4	2	1	17.3	CA-Krasnyi Kavkaz
7.1” M B-1-P 1932 (L/57)	2	5	8	5	4	2	1	11.5	CA-Kirov, Maxim Gorkiy
6” B 38 (L/57)	3	5	6	4	3	1	0	13.2	BB-Sovetskii Soyuz*; CA-Kronshtadt*
5.1” B 13 M1913 (L/55)	2	4	5	3	2	1	—	7.1	CL-Pamyat Merkuria, Profintern; ML-Marti
5.1” B 13 M 1936 (L/50)	2	5	5	3	2	1	0	7.1	DD-Gnevnyi, Leningrad, Opitnyi, Storozhevoi, Tashkent (single turrets)
5.1” B 13 M 1936 (L/50)	3	5	4	3	2	1	0	9.7	DD-Ognyevoi, Tashkent (twin turrets)
4.7” M1905 (L/50)	2	4	4	3	1	0	—	5.7	BB-Gangut
4” Obuchov M1911 (L/60)	2	4	4	2	1	0	—	5.2	DD-Old; SL-Uragan
3.9” B 34 (L/56) ***Anti Aircraft Capable***	2	5 (3)	4	2	1	0	0	5.2	BB-Sovetskii Soyuz*; BC-Kronshtadt*; CA-Kirov, Maxim Gorkiy; SL-Uragan, Yastreb
3.9” Minizini (L/50) ***Anti Aircraft Capable***	2	3 (2)	3	2	1	—	—	4.4	CA-Krasnyi Kavkaz; CL-Profintern
Spain									
12” VSM Mk H (L/50)	5	4	11	9	7	6	—	44.6	BB-Espana
8” M1924D (L/50)	3	5	8	6	4	3	2	18.7	CA-Canarias
6” Vickers Carraca (L/50)	2	4	5	4	2	1	—	7.6	CL-Mendez Nunez, Principe Alfonso, Reina Victoria Eugenia
4.7” Vickers (L/45)	2	3	4	2	1	—	—	5	DD-Alsedo, Churruca
4.7” Mk F (L/45)	3	4	4	2	1	0	—	7.8	CA-Canarias; CL-Mendez Nunez
4.1” SKC/32 (L/46)	2	3	3	2	1	—	—	4.4	CL-Principe Alfonso; MS-Eolo
Sweden									
11.1” M 1912 (L/45)	8	5	10	8	6	5	3	65.6	CB-Sverige
6” M1930 (L/55)	2	5	6	4	2	1	0	8.4	CL-Gotland (turrets)
6” M1930 (L/55)	2	4	6	4	2	1	—	8.3	CL-Gotland (casemates)
6” M1912. M1903 (L/50)	1	3	5	3	2	—	—	3.3	CB-Sverige; CB-Oskar II; C-Fylgia
4.7” Bofors 1924 (L/45)	2	4	4	2	1	0	—	5.2	DD-Ehrenskoeld, Goeteborg, Klas Horn, Visby
4.1” M1940 (L/50)	2	3	3	1	0	—	—	3.4	MS-Arholma
Thailand									
8” I 3rd Year (Japanese) (L/50)	4	5	7	5	4	2	1	21.6	CB-Dhonburi

Weapon	*IP*	*RB*	*I*	*II*	*III*	*IV*	*V*	*Cost*	*Typical Ships (* denotes vessel never constructed)*
United States									
16” Mks 2; 3 (L/50)	14	5	15	13	11	10	9	187.2	BB-South Dakota*; BC-Lexington*
16” Mk 7 (L/50)	17	5	15	14	12	11	10	238.9	BB-Iowa; BC-Montana*
16” Mks 1, 5, 8 (L/45)	11	5	14	12	11	9	8	138.1	BB-Maryland
16” Mk 6 (L/45)	17	5	14	13	11	10	9	221.6	BB-North Carolina, South Dakota,
14” Mks 4; 6 (L/50)	8	5	13	11	9	8	6	90.1	BB-New Mexico, California (as built)
14” Mks 7; 11 (L/50)	9	5	13	11	9	8	6	101.4	BB-California, New Mexico
14” Mk B (L/50)	10	5	13	11	9	8	6	112.6	BB-North Carolina* (as designed)
14” Mks 1; 2; 3; 5 (L/45)	7	5	12	10	9	7	6	73.6	BB-Nevada, Pennsylvania, Texas
14” Mks 8; 9; 10; 12 (L/45)	8	5	13	11	9	7	6	89.0	BB-Nevada, Pennsylvania, Texas
12” Mk 8 (L/50)	10	5	11	9	8	6	5	94.9	BC-Alaska
12” Mk 7 (L/45)	8	5	11	9	7	6	4	73.8	BB-Wyoming
8” Mks 9-15 (L/55)	3	5	8	6	4	3	2	18.7	CV-Lexington; CA-New Orleans, Northampton, Pensacola, Portland, Wichita
8” Mks 12; 15 (L/55)	4	5	8	6	4	3	2	24.9	CA-Baltimore
6” Mks 12; 14; 15; 18 (L/53)	3	5	6	4	2	1	0	12.6	BB-South Dakota; BC-Lexington*; CL-Omaha
6” Mk 16 (L/47)	4	5	6	4	2	1	1	17.0	CL-Brooklyn, Cleveland
6” Mk 17 (L/47)	3	4	5	3	2	1	—	10.6	GB-Erie
5” Mk 16/0 (L/54) ***Anti Aircraft Capable (VT)***	4	5 (3)	5	3	2	1	0	14.3	BB-Montana
5” Mks 7; 8; 15 (L/51)	2	4	4	3	1	0	—	5.7	BB-California, Maryland, Nevada, New Mexico, Pennsylvania, Texas, Wyoming; CV-Langley, Long Island, Sangamon; DD-Brooks, Fox, Gilmer, Hatfield, Kane
5” Mk 12 Single (L/38) ***Anti Aircraft Capable (VT)***	3	3 (2)	4	2	1	—	—	7.6	CV-Enterprise, Essex, Hornet, Wasp; CA-Wichita ?; DD-Bagley+, Dunlap+, Farragut, Gridley+, Mahan (+stern mounts)
5” Mk 12 Twin (L/38)	3	3 (2)	4	2	1	—	—	7.6	DD-Porter, Somers
5” Mk 12 Single (L/38) ***Anti Aircraft Capable (VT)***	4	3 (2)	4	2	1	—	—	10.1	CVEs; CA-Wichita; DD-Bagley+, Benham, Benson, Dunlap+, Fletcher, Gleaves, Gridley+, J.C.Butler, Rudderow, Sims, (+bow mounts)
5” Mk 12 Twin (L/38) ***Anti Aircraft Capable (VT)***	4	3 (2)	4	2	1	—	—	10.1	BB-Iowa, North Carolina, South Dakota; BC-Alaska; CV-Essex; CA-Baltimore; CL-Atlanta, Brooklyn (some), Cleveland; DD-Sumner, Gearing
5” Mks 10; 11; 13; 17 (L/25) ***Anti Aircraft Capable***	4	3 (2)	3	2	1	—	—	8.7	BB-California, Maryland, New Mexico, Nevada, Pennsylvania; CV-Lexington, Ranger; CA-New Orleans, Northampton, Pensacola, Portland; CL-Brooklyn (some)
4” Mks 7; 8; 9; 10 (L/51)	1	3	4	2	1	—	—	2.5	DD-Flushdecker

15 – Table of Ship Torpedoes by Nationality and Calibre (overleaf)

These tables show the calibre and identification of the torpedo in question, the IP value of the warhead, and the maximum game range in range bands (RB) or 10cm for some types.

Torpedoes show 5 range bands (I-V), with the Torpedo “To Hit” modifier at each range band.

Finally the cost of each torpedo tube is shown, as well as details of ship types or classes that carried the weapon. The cost is taken to 1 decimal place. The date allows you to arm the ship with the appropriate type of torpedo for actions at certain dates.

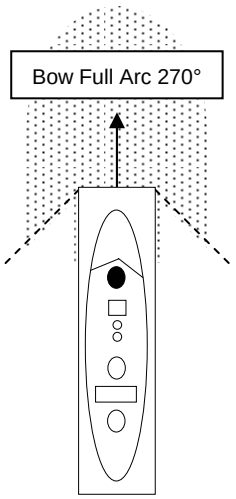
15 – Table of Ship Torpedoes by Nationality and Calibre

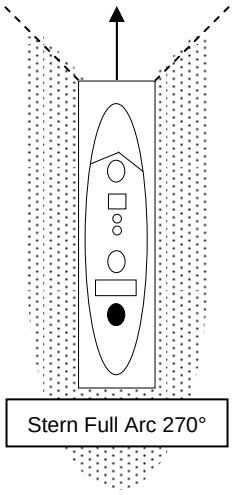
Weapon	*IP*	*RB*	*I*	*II*	*III*	*IV*	*V*	*Cost*	*Typical Ships*
France									
17.7" M12D Toulon	4	2	+0	−1	—	—	—	3.0	Destroyers and Capital ships
17.7" M18 Toulon	4	1	−1	—	—	—	—	1.6	Destroyers and Capital ships
21.65" 19D Toulon	5	3	+0	+0	+0	—	—	5.4	Destroyers
21.65" 19V Toulon	5	1	+0	—	—	—	—	2.3	Destroyers
21.65" 23DT Toulon	5	3	+1	+1	+0	—	—	6.3	Destroyers
21.65" 23D Toulon	5	3	+1	+1	+1	—	—	7.6	Cruisers
Germany									
21" G7a T1	5	3	+1	+1	+0	—	—	6.3	Surface ships
Great Britain									
18" Mk VII, VIII	4	1	+0	—	—	—	—	1.9	Pre WW1 Torpedo boats, Destroyers
21" Mk II	4	2	+0	−1	—	—	—	3.0	ex US Destroyers
21" Mk II	5	2	+0	−1	—	—	—	3.7	ex US Destroyers
21" Mk IV and IV*	5	3	+0	+0	−1	—	—	5.0	ex US Destroyers
21" Mk V	5	3	+1	+0	−1	—	—	5.4	A and B Class Destroyers, Kent Class 8" Cruisers
21" Mk VII	5	1	+0	—	—	—	—	2.3	8" Cruisers (1926)
21" Mk IX	5	3	+1	+1	−1	—	—	5.8	Some 8" cruisers, Leander class and later 6" cruisers, A class and later Destroyers (1930). Mk IX** was principal WW2 torpedo
21" Mk IX*	5	3	+1	+1	+0	—	—	6.3	
21" Mk IX**	5	3	+1	+1	+1	—	—	6.7	
21" Mk IX**	7	3	+1	+1	+1	—	—	9.3	Above vessels after 1943 (Torpex warhead)
21" Mks X; X*	5	3	+1	+0	−1	—	—	5.4	Polish Destroyers, H Class Destroyers (1940)
Italy									
21" Si 270/533 x 7.2 M	5	3	+1	+0	−1	—	—	5.4	Cruisers and Destroyers
17.7" W 200/450 x 5.75 and 5.45	4	2	+1	−1	—	—	—	3.3	Torpedo Boats
17.7" W 200/450 x 5.70	4	2	+0	−1	—	—	—	3.0	Torpedo Boats
17.7" W 170/450 x 5.53	4	1	+0	—	—	—	—	1.9	Torpedo Boats
17.7" W 200/450 x 5.75 and 5.45	5	2	+1	−1	—	—	—	4.1	Torpedo Boats
17.7" W 200/450 x 5.70	5	2	+0	−1	—	—	—	3.7	Torpedo Boats
17.7" W 170/450 x 5.53	5	1	+0	—	—	—	—	2.3	Torpedo Boats
Japan									
21" Type 6	4	3	+0	+0	+0	—	—	4.3	Destroyers
24" Type 8 No 1	5	2	+1	+1	—	—	—	4.8	Destroyers and Light Cruisers
24" Type 8 No 2	6	4	+1	+1	+0	+0	—	9.1	Destroyers and Light Cruisers
24" Type 90	6	3	+1	+1	+1	—	—	8.0	Cruisers and Fubuki Class Destroyers (1933)
24" Type 93 Model 1*	7	5	+2	+2	+2	+2	+1	17.9	Surface ships (1935)
24" Type 93 Model 3*	9	5	+2	+2	+2	+1	+1	22.0	Surface ships (1944)
*Note that special rules apply for critical hits when a ship is carrying this weapon									
Russia									
17.7" 45-36N	4	1	+1	—	—	—	—	2.1	Novik class Destroyers (1936)
17.7" 45-36NU	5	1	+1	—	—	—	—	2.7	Novik class Destroyers (1939)
21" 53-27	5	1	+0	—	—	—	—	2.3	Surface ships (1927)
21" 53-36	5	2	+1	−1	—	—	—	4.1	Surface ships (1936)
21" 53-38	5	2	+1	+0	—	—	—	4.4	Surface ships (1938)
21" 53-38U	6	2	+1	+0	—	—	—	5.3	Surface ships (1939)
21" 53-39	5	2	+2	+1	—	—	—	5.2	Surface ships (1939)
United States									
21" Bliss-Leavitt Mk 8	4	3	+1	+1	+1	—	—	5.3	Flushdeckers
21" Mks 11; 12	4	3	+1	+1	+0	—	—	5.0	Destroyers and Cruisers (1926; 1930)
21" Mk 15	7	3	+1	+0	+0	—	—	8.2	Destroyers and Atlanta Class Light Cruisers (1935)
21" Mk 17	6	3	+2	+2	+2	—	—	9.5	Destroyers (1945)

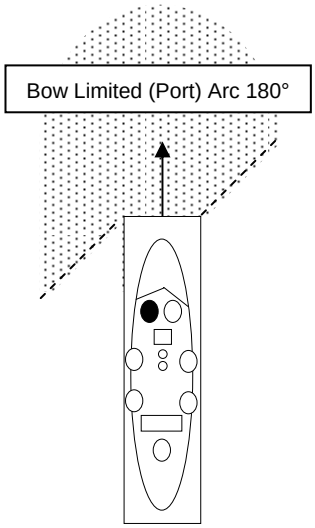
ARCS OF FIRE

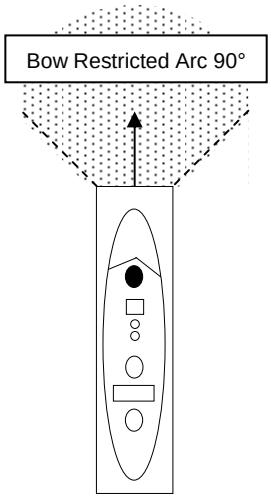
The diagrams below indicate the arcs of fire used in the rules. Clearly they are not all shown, but each of the categories can be established from the diagrams and the table. The abbreviation is that which appears in the ship data tables.

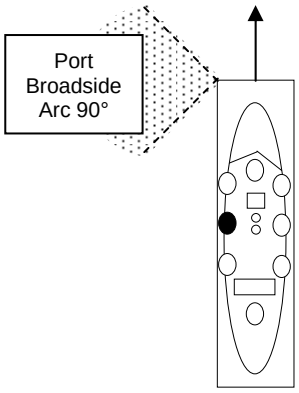
Arc	*Abbreviation*	*Definition*
Bow or Stern Full arc	B S	Weapons are mounted on the bow or stern of the ship, covering an arc of 270° centred in those directions, consisting of the Bow or Stern plus BOTH Broadside arcs.
Bow or Stern Limited arc	BLP BLS SLP SLS	Weapons are mounted side by side on the bow or stern of the ship, covering an arc of 180° consisting of the Bow or Stern plus ONE Broadside arc.
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.
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.
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.

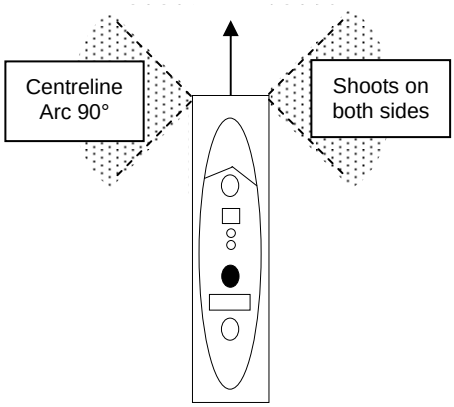


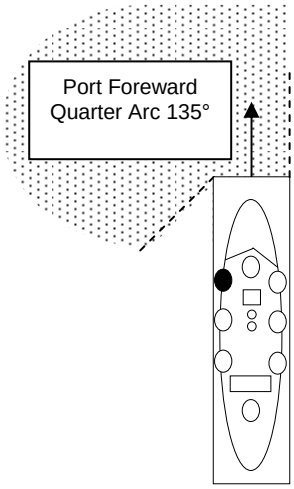












RADAR

Introduction

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.

9.3 – 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).

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	—	—