King Edward VII-*class predreadnought*

To our parents, Dr. Clifford and Sharon Carlson and Gerry and Dottie Harris. Thanks for letting us play our games while we were growing up.

The Designers

Chris Carlson is one of the lead designers of the award winning *Admiralty Trilogy* series. He is an accomplished technical naval historian and engineer. His primary contribution was the design of the detection, combat, and ship damage models. He also made significant inputs to the communication and ship maneuverability rules.

Michael Harris is a dedicated historian and a long time supporter of the *Admiralty Trilogy* design team. His work focused on the command and control rules and the tactics primer, as well as reviewing all combat and ship damage models. He is also a prolific scenario designer having researched and developed many of the scenarios in *High Seas Fleet*.

Edited by Larry Bond and Charlie Spiegel

Acknowledgments

Thanks to Jon Acllin, Joe Austin, Bob Eldridge, Mark Hayes, Patrick Hreachmack, Ed Kettler, Christoph Kluxen, Gregory Kuntz, Brooks Rowlett, Steve Thorne, Chip Sayers, Terry Sofian, Rick Wehler, Jay Wissmann, Mal Wright and John Yarosz for their help in developing this game.

Special thanks to Mr. Dale R. Ridder, Mr. William Jurens, Mr. Nathan Okun and Mr. A. D. Baker III for their generous assistance.

Designers' Note

Developing a tactical naval wargame that accurately covers the tremendous technical advances from 1900 to 1924 was a considerable challenge. There were many fundamental changes in warship design, but the historical record is replete with the data needed to support accurate modeling. The same can be said of advancements in torpedoes, gunnery, and armor.

While we could model all the details of these systems and their performance, the cost in playability was unacceptable. Our goal has always been to make play as exciting and fast as possible, without compromising historical accuracy or losing the tactical "feel" of the game.

Fear God and Dread Nought (FG&DN) provides the necessary rules to fight any historical or hypothetical naval engagement from the turn of the century through World War I. The game system, like the others in the *Admiralty Trilogy* series, emphasizes playability. To compensate for the potentially large number of units involved in a WW I scenario, we worked especially hard on fast, "clean" combat systems, with a minimum of die rolling. This includes a revised critical hit system that reduces the time needed to resolve the effects of an attack, but without losing the drama this part of the rules brings to any game.

As Larry Bond is fond of saying, "The wargame state of the art is advancing." We are proud of this game, both for its elegant design and the information presented. This was a real cooperative effort, with both of us writing the rules and Larry providing his expert guidance and advice. We couldn't have done this without him. There is also that dedicated cadre of reviewers and game testers that assisted us greatly in bringing this game to fruition.

As always, any game can be improved, and if you have followed the progress of our other game designs over the years, you know we will make every effort to correct, improve, and expand the *Admiralty Trilogy* system.

Chris Carlson

Chris Carlson

Michael W. Harris

The designers of *Fear God And Dread Nought* are prepared to answer questions about play of the game system. They can be reached in care of Clash of Arms, Byrne Building, Lincoln & Morgan Streets, Phoenixville, PA, 19406

Foreword

I was honoured to be asked by the authors of this game to write a foreword but have to confess to doing so from a position of some ignorance. Although I have spent a lifetime studying the technical and operational development of warships, with a particular interest in the period covered by *Fear God and Dread Nought* I have never involved myself in war games. I have come to realise on reading these rules that I have probably missed a great deal - both in enjoyment and the potential to learn more of the possibilities of naval warfare. The authors have produced an ideal combination of accuracy and playability that allows for a study of the nature and probable outcome of an enormous variety of naval engagements. It provides the potential 'arm chair admiral' with an opportunity to test both actual and imaginary situations without the extended periods of boredom that characterise a real war. *Fear God and Dread Nought* is a remarkable achievement in level of detail and accuracy for a subject of such broad coverage and complexity. In fact the word 'game' undervalues the quality of this and similar simulations of human conflict. Whilst they can certainly give great enjoyment they also have the potential for very accurate simulation of the real world. Similar methods have been employed for many years by real navies both as a training tool for command in war and as an inexpensive means of evaluating the potential of various strategies and tactics.

The period chosen, 1900-1924, is particularly welcome as this era usually comes a poor second in coverage to the Second World War. This is in part due to the 1914-18 war being inconclusive in so many of its aspects and ultimately, despite the allied victory, leaving a feeling of success by default rather than feat of arms. The naval war was, by comparison with the 1939-45 conflict, a dull affair, which lacked major battles. Moreover, most of those that were fought have since been the subject of much debate and controversy. Despite this, there is a great deal to interest the war gamer - in fact it adds substantially to the interest. Apart from re-fighting those battles that did take place there is the potential to discover what might have happened had events taken a different turn. What if Jellicoe had deployed his fleet to starboard instead of port at Jutland on 31 May 1916 or what would have happened on the following day if the German Fleet had remained to the west Grand Fleet? While a game may not provide a definitive answer (nothing can) several games on the same basis could demonstrate the odds in favour of success by one side or the other.

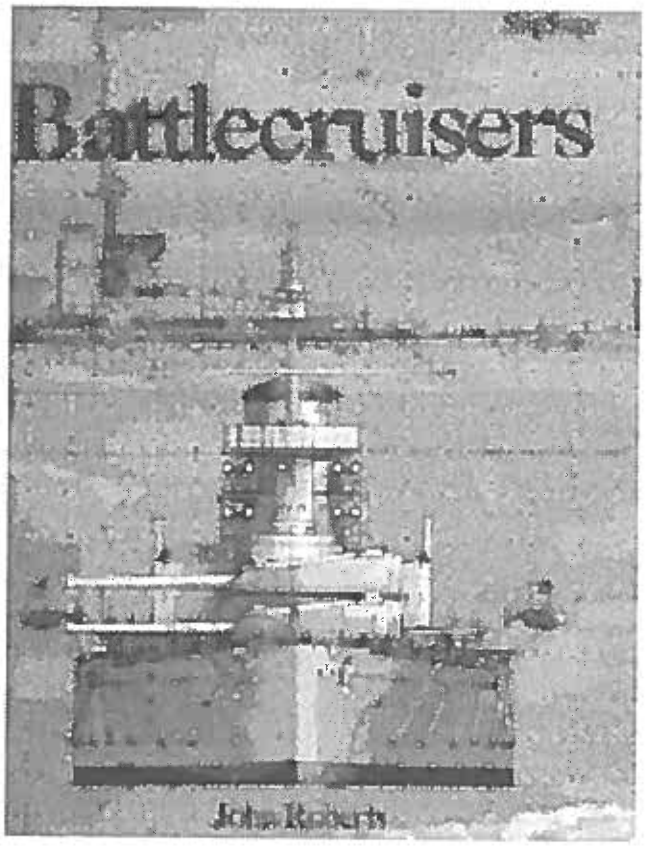
There is also the possibility of fighting actions that did not take place - ranging from totally imaginary battles (a second Jutland in 1918 for example) to the modification of the details of real events. In the latter case I have a particular favourite - in 1914 the British Rear Admiral Troubridge, influenced by the advice of his flag captain, decided against engaging the German battlecruiser *Goeben* and light cruiser *Breslau* with his four armoured cruisers on the basis that the enemy was a 'superior force'. It ruined the careers of both officers - what if they had engaged? A lot would depend on Troubridge's tactics but even if all his armoured cruisers had been sunk or disabled the Goeben would have been unlikely to have escaped unscathed. In such circumstances the German ship's chance of eluding her pursuers and making it to Turkey would have been much reduced. If someone tries this I for one would be interested in the result.

The authors are to be congratulated in providing a simulation with such a broad range of possibilities - much greater than the limited events discussed above - and I have no doubt that any game based on this work will be as enjoyable and informative as any for the later periods of the 20th century.

John Roberts
Mytchett, Surrey, UK.
November, 2000

John Roberts, a Bibliography

Invincible class, Warship Monograph One, Conway Maritime Press, 1972
Ensign series, with Alan Raven, Bivouac Books, 1975 and 1976
British Battleships of World War Two (with Alan Raven), Naval Institute Press, 1976
Man o' War series, with Alan Raven, RSV Publications, 1978, 1979, 1980
Editor, *Warship*, Vols III - VI, Naval Institute Press, 1979 -82
British Cruisers of World War Two (with Alan Raven), Naval Institute Press, 1980
Aircraft Carrier of Intrepid (Anatomy of a Ship Series), Naval Institute Press, 1982
Battlecruiser Hood, Naval Institute Press, 1982
Battleship Dreadnought, The, Naval Institute Press, 1992
Editor, *Warship 1994*, Naval Institute Press, 1994
Editor, *Warship 1995*, Naval Institute Press, 1995
Battlecruisers (Chatham Shipshape Series), Naval Institute Press, 1997
The First Destroyers, by David Lyon, John Roberts illustrator (Chatham Shipshape Series), Naval Institute Press, 1997



Slava-*class predreadnought*

Table of Contents

List of Sidebars

List of Illustrations

The illustrations that mark the beginning of each chapter, and those sprinkled throughout this book, are taken from Brassey's *The Naval Annual* from the years 1904 through 1913. These gorgeous black and white drawings were done by Mr. W. Fred Mitchell and Mr. Oscar Parkes.

Abbreviations

AA	Antiaircraft
AP	Armor-Piercing shell
APC	Armor-Piercing Capped shell
ASW	Antisubmarine Warfare
BHE	Base-Fuzed HE shell
CP	Common (shell type)
CPC	Common Capped
CRT	Combat Results Table
DP	Dual-Purpose
D6	Six-sided die
D10	Ten-sided die
D100	percentile dice (2 D10 read as tens and ones)
DC	Depth Charge
DF	Direction Finding. Using a receiver to find the direction of a signal
FC	Fire Control
fl	Full load displacement
GFC	Gunfire Control
HE	High Explosive shell
HF/DF	High-Frequency Direction Finding. Used to detect the location of radio transmissions at long range.
kts	Knots
kyds	Kiloyards or thousands of yards
Mk	Mark (variant or version)
NHE	Nose-Fuzed HE shell
NOE	Nap of the Earth
nm	Nautical Mile (2000 yards)
RT	Radio Telephony
SAP	Semi-Armor Piercing shell
SAPC	Semi-Armor Piercing Capped shell
std	Standard displacement
subm	Submerged displacement
WT	Wireless Telegraphy
yds	Yards. There are two thousand yards in a nautical mile.

Subject Index

German Nassau-*class dreadnought*

Chapter One - Introduction

1.1 Background. *Fear God and Dread Nought (FG&DN)* simulates naval warfare from 1900 through 1924. This period is the first of a number of major transitional phases for naval warfare during the 20th century. The all-big-gun dreadnought battleship would make its first entry onto the naval scene in 1905, and by 1914 they were the centerpieces of every major fleet. The aircraft carrier would appear as aircraft themselves went from being viewed as novel toys to useful instruments of war. Submarines would also come into their own during this time, but not as part of the fleet. Their role in attacking merchant shipping, or *guerre de course,* would take the world by surprise and mightily frustrate the Royal Navy - the sovereign of the sea.

The ships of the early dreadnought era were significantly different from those built today. Hulls were riveted, not welded. Designed to withstand the kinetic energy of armor-piercing shells, they could survive many hits and stay in action. Armor made up a significant fraction of the displacement of battleships (28% to 40%) and battlecruisers (19% to 37%). Most of the ships burned coal to produce steam, driving massive reciprocating piston engines. Oil-fired boilers and steam turbines were just appearing and were initially considered to be radical concepts. If you've seen the movie *Titanic*, you have a good idea of the state of the art in naval architecture and marine engineering of this period. Large crews were required to man the large-caliber guns of the main batteries, as well as to provide the scores of stokers needed to shovel coal and to run the steam power plants.

Advanced technology was changing the face of naval warfare. Wireless telegraphy became a standard feature in warships of this era and made tactical control of formations and long-range scouting possible. Radio communication was countered by direction finding and jamming. Fire control systems, based on crude analog computers, were just being introduced at the start of World War I. These early systems were ungainly and not very capable, but they were the first step toward what would culminate in the *Aegis* system of today.

The sensors that are the mainstay of today's navies didn't exist for the most part during this period. The initial experiments on radar wouldn't get started until the mid-1930s and sonar was in its embryonic stage. The passive hydrophones of this age were little more than stethoscopes in the water. There was no way to boost a weak signal, so a good set of ears and a stationary, quiet ship were required in order for these crude systems to have even a prayer of working. And when they did make a detection, all you knew was that there was a contact nearby. Active sonar was just in the basic research and development phase and wouldn't be truly fielded until 1922. The primary sensor was a sharp pair of Mk1 Mod 0 eyeballs.

Weapon systems also underwent drastic changes between 1900 and 1924. Gunnery, for example, saw a huge change with the arrival of "long-range" fire. At the turn of the century, 5,000 yards was considered to be the outer end of the envelope. By the end of WW I, gunnery duels between British and German ships had often occurred between 15,000 and 20,000 yards. Torpedoes also became more dependable and tactically useful as higher speeds (up to 45 knots) and longer ranges made them a greater threat. Mines would play a strategic role, both offensively and defensively, for the first time.

The goal of the *Admiralty Trilogy* in general is to let players understand naval warfare as it evolved during the 20th century at the tactical (i.e., individual unit) level. *Fear God and Dread Nought's* goal in particular is to provide a workable system that shows how naval forces during the dreadnought era were employed and allow a player with little or no experience in naval combat to understand the basic principles of naval warfare, and to use those principles to expand his knowledge of this historic period.

Fear God and Dread Nought keeps the details at a level appropriate for the player's role as a tactical naval commander. This lets the player to concentrate on decision-making and tactics. How should the screen be aligned? Should a light cruiser be detached as an advance scout? When should the line of battle be formed? The player gives orders appropriate to the units he is commanding and, as in the real world, must sometimes work with incomplete or faulty information.

Fear God and Dread Nought shows the player what kind of decisions must be made by a ship or formation commander during a WW I sea battle. It shows what information the commander has and how he uses it to make decisions. Most importantly, it allows the player to make decisions and to see the results.

All this makes *FG&DN* sound like a very serious simulation, but any wargame attempts to do this. We just want *FG&DN* players to understand that they can use the game not just to bash away at each other in a structured way, but to understand what happened out on the oceans of the world. It can be used not only to recreate famous naval engagements such as the battles of Jutland, Dogger Bank, and the Falklands, but also the U-boat campaign and the early amphibious actions off Gallipoli.

While we call *FG&DN* a game, there is no built-in play balance; it is more accurately called a simulation. The data are a reflection of historical weapons and equipment performance used with a game system that allows them to interact. Tactics useful in history will work in this simulation. Whether one player or the other will win 50 percent of the time, we can't say; that depends on the initial setup and the skill of the players, which is, after all, what it's all about.

Every player will learn some naval tactics while playing *FG&DN*. They will learn the relative value of naval units and how they work together. Players can reenact historical naval engagements and see what forces were at work, or try out hypothetical units which were on the drawing board to see if they would have been worthwhile. In the long run, players will be able to appreciate how a country's naval forces served its national interests.

But players do not have to understand naval warfare in order to play *FG&DN*. That understanding will come with experience as they play the game, seeing what works and what does not.

These rules assume a basic understanding of elementary terms (which have readily available dictionary definitions) like cruiser, destroyer, range finder, or torpedo. Anything beyond a basic knowledge of naval terms is explained in the appropriate rules section. A list of abbreviations is provided in the front of these rules.

As a player gets more experienced with *FG&DN* and does some reading, he or she may discover that a rule is too simple. Change the rule. We had to ruthlessly simplify many aspects of naval warfare to make the game both manually playable and easy to learn. *Fear God and Dread Nought* has a modular design which allows new sections of rules to be added or changed with a minimum of fuss.

Units are expressed in real-world terms: knots, kyds (1,000s of yards), kilograms, degrees. We were forced to use damage points to quantify a ship's ability to resist damage, but the formulas to convert any ship to this system are included in Annex L. It also has other useful values for metric conversion and for converting the game to different scales.

In the design of *FG&DN*, we had to make some basic assumptions about the way that units interact to produce what we considered a realistic result. These assumptions underlie the game and strongly influence the way it should be played.

1. The hardest part of naval warfare is finding and fixing your opponent's position. In WW I, this was a much harder problem than it is today, since the primary sensor was the lookout at the top a mast, who could be blinded by coal smoke.

2. In WW I, a ship could suffer many shell hits without its fighting efficiency being destroyed. However, a few torpedo hits would take even a battleship out of action. In general, underwater damage is more deadly than damage above the waterline.

3. Reaction times are greater in World War I than in modern naval warfare due to the slower speeds of aircraft and the reaction time of the weapon systems. It takes about 35 to 40 seconds for a 12-inch shell to travel to a target at maximum range, and about half that time for the results to be assessed and the corrections fed into the fire control system.

All information used in this game has been drawn from declassified Navy or civilian sources listed in the bibliography. We have tried to collect information from as many different sources as we could, compare it and try to resolve differences and use the best values. Thus, the information in this game is as accurate and as up-to-date as we could possibly make it. Since we have used a large number of sources in developing *FG&DN*, we've noted books or publications that we recommend as providing good summaries and background in various topics, or as being the most accurate and useful publications for a naval gamer to add to his library.

Unfortunately, unlike WW II or modern times, there isn't a wealth of secondary source information available on WW I weapon systems. Many of the weapons characteristics and performance data were obtained from archival sources or engineering analysis and then compared to the large volume of operational histories for validation. Theoretical performance figures must be balanced with the reality of the conflict. A gun that has been fired many times will not achieve its best trials range due to barrel wear. Heavily loaded aircraft will not achieve maximum performance due to load, poor maintenance, and tired crews. Weather will also have an effect on performance.

1.2 Scope. *Fear God and Dread Nought* covers surface, submarine, and air attacks on naval units, shore installations and aircraft.

Fear God and Dread Nought is a tactical, as opposed to an operational-level, game. Each scenario represents a single battle, which happened in a relatively short span of time and in a relatively small area. In between battles, naval commanders must worry about logistics, training, maintenance, and other problems.

The scenario supplement for *FG&DN, High Seas Fleet*, covers a number of WW I naval engagements (both historical and hypothetical) in several theaters of operation. Scenarios list the ships and planes involved in a battle, and the annexes provide characteristics for those ships, aircraft, and their weapons and sensors needed for the scenarios.

Ships of other nations can be added to the game by using Annex L.

1.3 Players. *Fear God and Dread Nought* requires at least two players - one for each side in a scenario. True "blind" play requires at least three players, one of whom is the referee.

Players decide what forces under their control will attack or how they maneuver. Victory comes to the player with superior strategy and tactics.

A referee in *FG&DN* is in charge of the entire game; he or she keeps track of the situation and passes important information to the players before and during the game. The referee observes everything that happens in a *FG&DN* scenario, enforces the rules and makes sure that they are correctly interpreted. The referee determines what each side can detect and reveals it when it is detected. When the scenario is over, he or she can recount the action to both sides, telling them the close calls they had, the near misses, and the brilliant moves they managed to pull off.

1.4 Game Scale. *Fear God and Dread Nought* uses a variety of scales to compress time and distance in order to make an individual game more manageable

1.4.1 Turns. Two types of game turns are used. The Intermediate Turn represents 30 minutes, while the Tactical Turn represents 3 minutes.

1.4.2 Distance. Distance is measured in nautical miles (nm), the standard unit of distance at sea, or thousands of yards, often abbreviated as kyds (kiloyards). One nautical mile is about 2000 yards, or 6000 feet, just a little more than the 5280 feet of a standard (statute) mile. *Fear God and Dread Nought* uses a variable distance scale, but a typical scale is four inches equals one nm (1 inch = 500 yards). This is the smallest scale recommended for daytime surface engagements. Night engagements will require less room and, depending on the playing area, a scale of eight inches per nautical mile (1 in = 250 yards) may be possible.

Centimeters can also be used instead of inches for an even smaller scale. Since centimeter scales are always marked off in tenths, this can make measuring tenths of a nautical mile easy.

The tables below are provided to assist players in making the transition from one game distance scale to another.

1.4.3 Altitude. Height above sea level is measured in meters. Altitudes are also grouped into bands, ranging from Very Low to Very High. These are explained in Chapter Four.

1.4.4 Depth. Submarine depths are not measured exactly, but are grouped into depth bands explained in Chapter Three.

1.4.5 Speed. Speeds are given in knots (abbreviated "kts"; nautical miles per hour). One knot of speed allows a ship to move one nautical mile in an hour. A ship's or airplane's speed in knots divided by two gives the distance the platform moves in one 30-minute Intermediate Turn. The speed in knots divided by 20 gives the distance moved in one three-minute Tactical Turn. In some cases, speed is given in terms of distance covered in one three-minute Tactical Turn. For surface ships, this allows the player to use the "Three-Minute Rule," a standard rule of thumb used by mariners throughout the 20th century.

GAME SCALE SPEED/DISTANCE TABLES

(values in the table are distance moved in inches)

Tactical (3 min Turns)

Scale	Speed (kts)								
(inch:kyd)	1	5	10	15	20	25	30	35	40
1:5	.02	.1	.2	.3	.4	.5	.6	.7	.8
1:4	.03	.13	.3	.38	.5	.63	.8	.88	1
1:3	.03	.17	.3	.5	.7	.83	1	1.17	1.3
1:2	.05	.25	.5	.75	1	1.25	1.5	1.75	2
1:1	.1	.5	1	1.5	2	2.5	3	3.5	4
2:1	.2	1	2	3	4	5	6	7	8
3:1	.3	1.5	3	4.5	6	7.5	9	10.5	12
4:1	.4	2	4	6	8	10	12	14	16
5:1	.5	2.5	5	7.5	10	12.5	15	17.5	20
6:1	.6	3	6	9	12	15	18	21	24
7:1	.7	3.5	7	10.5	14	17.5	21	24.5	28
8:1	.8	4	8	12	16	20	24	28	32
9:1	.9	4.5	9	13.5	18	22.5	27	31.5	36
10:1	1.0	5	10	15	20	25	30	35	40

Intermediate (30 min Turns)

Scale	Speed (kts)								
(inch:nm)	1	5	10	15	20	25	30	35	40
1:6	.08	.42	.83	1.25	1.67	2.08	2.5	2.92	3.33
1:5	.10	.50	1	1.5	2	2.5	3	3.5	4
1:4	.13	.63	1.25	1.88	2.5	3.13	3.75	4.38	5
1:3	.17	.83	1.67	2.5	3.33	4.17	5	5.83	6.67
1:2	.25	1.25	2.5	3.75	5	6.25	7.5	8.75	10
1:1	.5	2.5	5	7.5	10	12.5	15	17.5	20
2:1	1	5	10	15	20	25	30	35	40
3:1	1.5	7.5	15	22.5	30	37.5	45	52.5	60
4:1	2	10	20	30	40	50	60	70	80
5:1	2.5	12.5	25	37.5	50	62.5	75	87.5	100
6:1	3	15	30	45	60	75	90	105	120
8:1	4	20	40	60	80	100	120	140	160
9:1	4.5	22.5	45	67.5	90	112.5	135	157.5	180
10:1	5	25	50	75	100	125	150	175	200

1.5 Materials. A boxed game consists of the following components:

Jump Start booklet (read this first!).
One *Fear God and Dread Nought* rules set.
One *High Seas Fleet* scenario booklet.
One Data Annex booklet.
Four sheets of die-cut ship and aircraft counters.
Two ten-sided dice (D10).
Two six-sided dice (D6).

In addition, the following materials are necessary:

Blank copies of the *FG&DN* Form 1 Ship Reference Sheet, *FG&DN* Form 2 Air Data Card, *FG&DN* Form 3 Aircraft Mission Planning Sheet. These forms are located in the back of the Jumpstart book.

A flat playing area approximately eight by eight feet.

A tape measure. Distances are always measured from bridge to bridge of the ships in question.

A protractor.

Graph paper. Submarine movement is best plotted on graph paper.

Pens and pencils.

A pocket calculator is not absolutely necessary, but will speed game play.

Dice. The minimum requirement is two ten-sided dice (D10) and two six-sided dice (D6). These are provided with the game. More dice may be useful, as they speed up play.

Miniature ships (or counters) representing those chosen for the game. If the ships for the scenario being played are not included on the counter sheet, miniature ships or counters must be made for them. See also section 1.7 Playing pieces.

1.6 Organization. *Fear God and Dread Nought* is organized into three sections. The Rules section contains the game concepts and rules. The Scenario section contains a variety of situations suitable for *FG&DN* battles. The Data Annexes contain detailed data about naval vessels, weapons, and aircraft used in the scenarios.

The Rules section is the heart of the *FG&DN* game system. It details how the game works, and how the ship and aircraft data are used. It explains why the rules operate in a particular way, in relation to real-world conditions.

It is designed to be used as a reference during play, with a detailed subject index which includes a list of all topics and tables. Since the rules pages are punched for a loose-leaf notebook, tabs can be added to speed the process.

The *High Seas Fleet* scenario supplement is a collection of situations that can be played with *FG&DN* . The scenarios include both historical battles and hypothetical encounters. Working from the scenarios or historical accounts, players can quickly learn how to create their own naval battles using *FG&DN.*

The Data Annexes provide detailed information, usable with these game rules, on ships, aircraft, submarines, and weapons in use during WW I. The ship annex (A) includes an alphabetical class index.

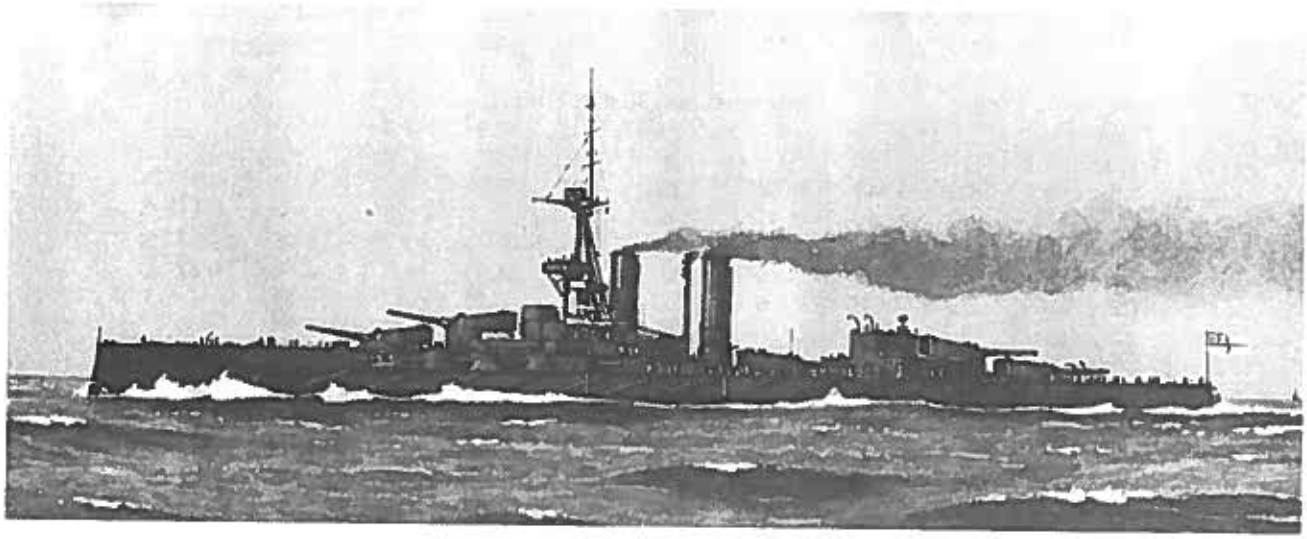
The Jumpstart book also contains master copies of the *FG&DN* forms. These master copies are suitable for photocopying. They should be kept unmarked to always serve as a source of additional copies. Players have permission to photocopy these forms, without restriction, for personal use.

1.7 Playing pieces. Miniature ship and aircraft models in 1/2400, 1/3000, and 1/6000 scale are ideal for *FG&DN.* Cardboard counters can be substituted for ship miniatures with no ill effect (except possibly an aesthetic loss).

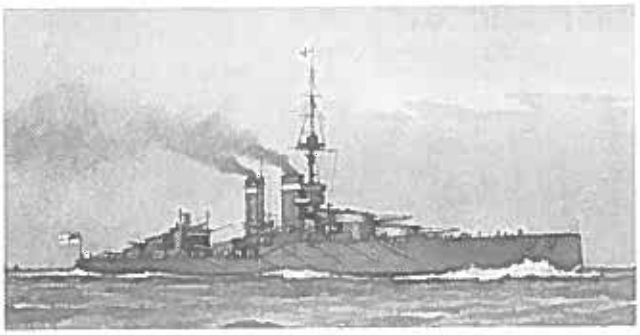
Counters can represents a single large ship or aircraft, a group of smaller units, or a spread of torpedoes.

Submarine miniatures should be placed on the board only when they are surfaced or detected.

Other ship scales are possible. With a large enough ground scale and enough playing room, *FG&DN* can be played with 1/1200 scale ships. It is also possible to play *FG&DN* directly on paper or a map, dispensing with ship models altogether. In that case, carefully label the map to identify the ships' tracks.



British Battleship Iron Duke *Naval Annual 1907*



King George V-*class dreadnought*

Chapter Two - Game Mechanics

Fear God and Dread Nought (*FG&DN*) simulates history. Its rules should describe, within limits, how naval warfare worked in WW I. Tactics that worked in the war should work equally well in this game. As it is with reality, common sense is a valuable asset with *FG&DN*. Rules or rule interpretations that seem silly should be changed or ignored. The game should feel real to its players.

2.1 Preparing for Play. After a scenario has been chosen, the players need one completed Ship Reference Sheet (FG&DN Form 1) for each ship and one completed Air Data Card (FG&DN Form 2) for each aircraft or group of aircraft. The ships and aircraft to be used are listed in each scenario. The master copies of the Ship Reference Sheet and the Air Data Card should be photocopied so that the originals remain blank for future games.

Using the order of battle information from the scenario, players prepare the Ship Reference Sheets and Air Data Cards by copying the appropriate data from the Data Annex booklet to the blank forms. These forms then contain all the information each player needs to fight his or her ships and aircraft during the scenario.

2.1.1 Filling Out the Ship Reference Sheet. Consult Annex A (in the Data Annex Book) and find the information for each ship in the scenario under its nationality and class name. Entering this data on the sheet will speed up play and reduce page flipping once the game begins. Annex A provides information for all ships of the class. Exceptions for individual ships of the class are listed in the remarks.

2.1.1.1 Basic Data. The first portion of the ship listing provides basic data about statistics and performance. Enter on the Ship Reference Sheet (in items 1 to 9) the ship's name, class, type, size class, speed (in knots), propulsion system, crew, total mounts, and armor ratings.

2.1.1.2 Damage and Speed Breakdown. Transfer the damage and speed breakdown figures from Annex A to the appropriate section of the Ship Reference Sheet. If the vessel is a surface ship, ignore the submerged speed section on the sheet.

2.1.1.3 Sensors. Ships carried very few sensors in WW I. They will be either searchlights, direction finders, or sonars (Annex H).

2.1.1.3.1 Searchlights. Find the Sensors section of the ship listing and enter the number and arcs of the searchlights on the Ship Reference Sheet. See section 5.2.4.1 for searchlight performance characteristics.

2.1.1.3.2 Sonars. From the Sensors section, enter the name of each sonar on the Ship Reference Sheet. Then turn to Annex H, find each sonar type, and transfer its statistics to the proper line of the Ship Reference Sheet.

2.1.1.3.3 Direction Finding (DF). This sensor was first unsed on a very few Allied destroyers towards the end of World War I, If a destroyer class was fitted with DF it will be listed in the Remarks section ofr that class in Annex A. See section 5.4 for details on detecting WT transmissions.

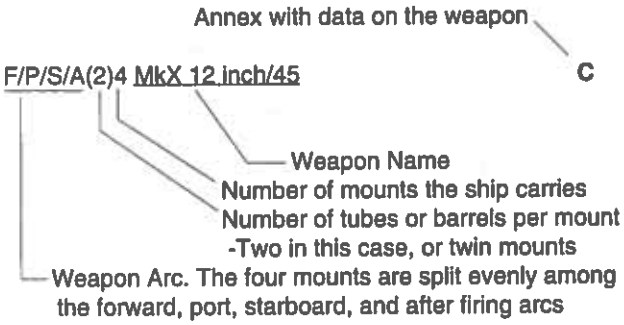
2.1.1.4 Weapons. Find the Weapons section of the ship listing and read each weapon line, noting its annex letter (in the right margin). Enter the name of the weapon in the appropriate section of the Ship Reference Sheet, then turn to Annex C (for guns), D (for ASW systems), E (for torpedoes), or G (for mines) to find each specific weapon type and transfer its statistics to the proper lines of the Ship Reference Sheet. The number and type of planes carried should be copied down in the Embarked Aircraft and Facilities portion of the Ship Reference Sheet.

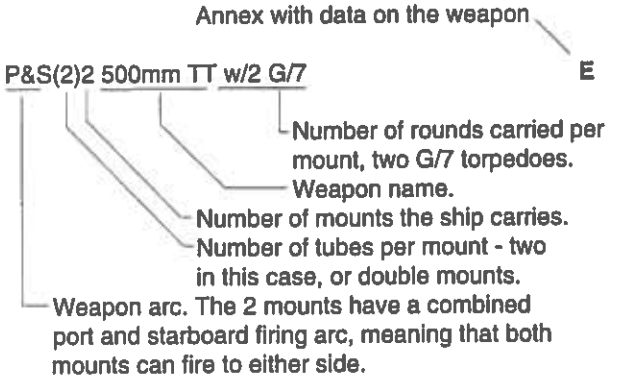
Weapons are presented in the ship listing in a specific format which shows the weapon's firing arc, number of barrels/rails/tubes per mount, the number of mounts of that type on the ship, the weapon name, the ammunition available per mount, and any weapon director present. The Weapon Data line examples below show this format and how to decipher this information.

If more than one mount is present, the mounts are equally split between the available arcs. Similarly, if more than one director is present, they are split between the available arcs.

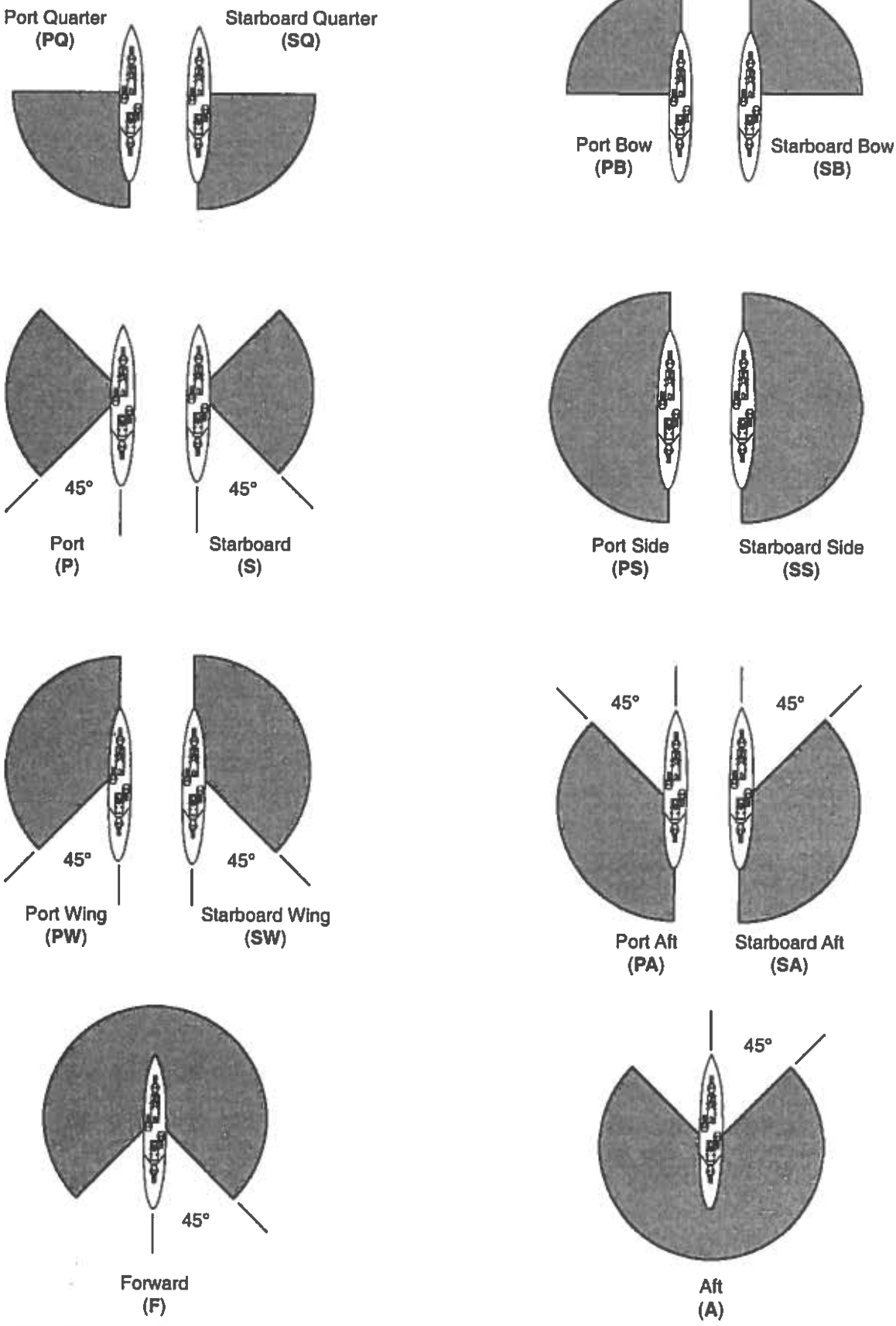
Some weapons, such as the Light Battery or antiaircraft guns, do not have firing arcs as their strength rating automatically includes arc limitations. Others have a

WEAPONS DATA LINE EXAMPLES





SHIPBOARD WEAPON FIRING ARCS



special arc or cannot pivot. This includes such things as depth charges, which are rolled off a ship's stern. These will be discussed in the rules for their use.

2.1.1.5 Weapon Firing Arcs. Each weapon mount has an arc of fire. A weapon mounted forward may not be able to fire aft because part of the ship's structure blocks its fire. Some weapons may not be able to pivot, or the arc is limited by the weapon's ability to turn after launch. The arc which can be used by each weapon mount is shown in the ship listing in Annex A. If a target is not within the firing arc of a weapon, that weapon will not be able to fire at that target.

Note: There is an subtle but important change in the arc coverage between *FG&DN* and *Command at Sea*. In *FG&DN*, the forward, aft, and side arcs are all smaller. Instead of having 60° (±30°) dead zones as in *CaS*, they are now 90° (±45°). Please examine carefully the Shipboard Weapon Firing Arcs diagram before beginning game play.

Some weapons can fire into more than one arc. If a gun mount can fire into both the Port Quarter and the Port arcs, its firing arc is described by combining the abbreviations with an ampersand (in this case, P&PQ).

A stroke (/) splits the arcs of multiple mounts: P/S(1)2 indicates that there are two mounts, one firing into the Port Arc and one into the Starboard arc. The parentheses refer to the number of tubes each mount has.

Example: P&PQ(1)1 indicates that there is one mount firing into both the Port arc and the Port Quarter. P&PQ/S&SQ(2)2 indicates that there are two twin-tubed mounts, one firing into both the Port arc and the Port Quarter, and one firing into both the Starboard arc and the Starboard Quarter.

During the pre-dreadnought era and WW I, most secondary batteries were in casemate mounts. All casemate guns could bear to port or starboard, but only a few (usually one or two on each side) could also fire into the Bow or Quarter arcs.

To simplify filling out Form 1, *FG&DN* uses a Casemate or CM arc. A ship with casemate guns can only fire one or two of them into the bow or quarter arcs and all guns on that side into the side arcs. There are very few ships that can fire up to four guns into either the bow or quarter arcs. This will be listed in the Remarks section of that ship's Annex A entry.

Example: The German *Kaiser*-class dreadnought has fourteen 15cm SKL/45 casemate guns, with seven each on the port and starboard sides. Thus, the Annex A entry would read CM(1)14 15cm SKL/45. Seven guns bear to starboard and seven guns bear to port. On this ship, two guns can fire forward and two guns aft.

2.1.1.6 Remarks. Find the Remarks section of the ship listing. Note any information which applies to the specific ship being written up, and transfer that data to the Remarks section of the Ship Reference Sheet. Especially important are items such as changes to the weapon systems and sensor fits.

2.1.1.7 Communications. Go to section 2.7 for the number of signal messages a ship can send and receive in a Tactical Turn. Also enter the range of the wireless telegraphy (W/T) sets that ship has on board.

2.1.1.8 Maneuvering Data. See the tables on page 3-2 for the ship's acceleration/deceleration rates and turning circle data.

2.1.1.9 Example. An example of a completed Ship Reference Sheet for a *Tiger*-class battlecruiser is provided. This vessel is used in the extended game example in the Jumpstart Booklet.

2.1.2 Filling Out the Air Data Card. Make one copy of the Air Data Card for each group of one to four planes of the same type. Generally, each aircraft that will operate alone should have its own card; aircraft that operate together can be consolidated on a single card.

2.1.2.1 Basic Data. The initial portion of the aircraft listing provides basic data about statistics and performance. Enter the aircraft type, mission, ceiling, gun attack and defensive ratings, and maneuver ratings (lightly and fully loaded) on the Air Data Card in items 1 to 5.

2.1.2.2 Speed and Altitude. Transfer the speed and altitude figures from the Annex B entry to the appropriate section of the Air Data Card.

2.1.2.3 Ordnance Loads. Find the Weapons section of the aircraft listing and choose one ordnance load from that section. Note the name of each weapon in the load and transfer the data to the appropriate section of the Air Data Card. Then turn to Annex D, E, or F, find the weapon, and transfer its statistics to the proper line of the Air Data Card.

2.1.2.4 Remarks. Find the Remarks section of the aircraft listing and read the comments carefully. Note any applicable information and transfer that data to the Remarks section of the Air Data Card.

2.1.2.5 Groups of Aircraft. The Air Data Card lists one to four aircraft of the same type and which will be used together. In the Remarks section of the Air Data Card, write distinct identifying numbers for up to four units to show the aircraft the card represents. These numbers are used to identify the individual aircraft when orders are given or targets identified. As aircraft are destroyed, these numbers will be crossed out.

2.2 Turn Sequence. In a fast-moving naval battle, many decisions have to be made quickly. If a commander lets the situation flow by, even for a few moments, he will get "behind the power curve" and never catch up.

Hoowever, the events that trigger a battle require few decisions and are stretched out over a long time. A typical naval engagement might consist of a naval force approaching a hostile shore. The commander defending the shore does not know the precise location of the enemy's force or their direction of approach. He sets up a plan, using surface patrols, submarines, and patrol aircraft or airships to search for the enemy. He assigns sectors for each unit to watch and then he waits.

After several hours, one of his airships spots the enemy force and radios its position. The commander orders a nearby surface group to close and attack. The ships are 30 nm away. Even at their highest speed, it will take more than an hour to close, and because of tactical considerations, it may take much longer. However, once in range, their attack could be over in a few minutes.

Ship Reference Sheet

1. Ship Name	2. Ship Class	3. Ship Type	4. Size Class	5. Speed	6. Propulsion	7. Crew	8. Total Mounts	9. Armor Class
HMS Tiger	Tiger	BC	A	28 kts	Steam	1121	22	18/6/45

Searchlights

Number of Positions and Arcs of Coverage				Range (yds)
1	2	3	4	
SB&S	PB&P	SQ&S	PQ&P	4,000

Damage Point Effects

Percent Damage	0%	25%	50%	75%	90%	100%
Damage Points	0	125	251	376	451	501
Surface Speed	28	21	14	7	0	Sinks
Submerged Speed					0	Sinks

Sonars (Annex H)

Name	Type	Active Range	Passive Range Surf Ship	Sub	Torpedo

Embarked Aircraft and Facilities

Guns (Annex C)

Arc(bbl)Mts	Name	Shell Type	Short Range	Pen	Dam/Mt	Med Range	Pen	Dam/Mt	Long Range	Pen	Dam/Mt	Extreme Range	Pen	Dam/Mt	Dir Type Max Rng
F/A (2)4	MkV 13.5in/45 (Lt Shell)	APC	0-4.8	46	27	4.9-11.4	36	22	11.5-17.6	26/5	16	17.7-23.8	19/8	14	Director Coin RF 15 kyds
		CPC		35	26		27	23		19/4	18		14/6	17	
		HE		7	45		6	44		4/1	36		3/2	35	
Case-mate (1)12	MkVII BL 6in/45	APC	0-2.9	18	9	3.0-7.0	14	7	7.1-10.8	7/1	5	10.9-14.6	4/2	4	Local Coin RF 15 kyds
		HE		3	14		2	14		1/0	11		1/0	11	
				100% vs Belt Armor			100% vs Belt Armor			70% vs Belt Armor 30% vs Deck Armor			40% vs Belt Armor 60% vs Deck Armor		

Light Battery Guns: None Light Battery Range: NA Light Battery Strength: NA

Antiaircraft Guns: 2xMkI 3in/20cwt, 5x0.303in Maxim MG Area AA Strength/Range: 2.0/6.5 kyds Light AA Strength: 0.7

Anti-Submarine Warfare Systems (Annex D)

Depth Charge Armament	Max Pattern Size:	Max Depth:
DC Type:	Total DCs Carried:	Damage:

Torpedoes (Annex E)

Arc(bbl)Mts	Torpedo Type	# Torps per mt	Speed kts	Dist/Tn kyds	Range kyds	Damage Points
2P/2S(1)4	Weymouth MkII	1	29	2.9	10.0	28
			45	4.5	3.8	

Maneuvering Data

Turn Type	Advance (yds)	Speed Loss per 45° turn	Acceleration (50% Max Spd)	Acceleration (>50% Max Spd)	Deceleration
Normal	300	3	6	3	8
Hard	200	4			

Mines

Mine Type	# of Mines Carried	Max Depth Band	Damage Points

Command and Control

Staff Carried On Board? Yes/No

Immediate Superior: HMS Lion

Visual Signals	# of Signals	W/T Types:	Range (nm)	Turn Delay
Flag Hoists:	4	Primary Set:	500	3
Flashing Light:	2	Auxiliary Set:	30	3
Total Signals:	4	Ship to Air Set:	30	3

Notes and Remarks

Fear God and Dread Nought is played with two different turns that divide time into fixed periods. The first is the Intermediate Turn. Thirty minutes long, it allows aircraft and ships to move long distances and close on opposing forces. Once one of the sides has detected the other and wants to react to that threat, play is switched to the three-minute long Tactical Turn. Experience has shown that it takes about as much time to perform a Tactical Turn as an Intermediate Turn. Obviously, moving long distances in Tactical Turns would mean a lot of wasted play time. Using Intermediate Turns speeds up play by allowing the two sides to close quickly in "real" time.

The sequence of events for both types of turns is similar. The difference is in the distance moved. The Intermediate Turn simply allows units to move quickly into contact when there are no reactions or decisions to be made.

TURN SEQUENCE

Intermediate Turn (30 minutes)	Tactical Turn (3 minutes)
Plotting Phase	Plotting Phase
Movement Phase	Movement Phase
	Planned Fire Phase
Detection Check Phase	Detection Check Phase
	Second Air Move Phase
	Reaction Fire Phase
	Resolution Phase
Amphibious Combat Resolution Phase	

2.2.1 Turn Concept. All play in *FG&DN* is simultaneous. Both players plot their actions at the same time; they reveal their orders and move their vessels at the same time; they fire their weapons at the same time.

Each Turn (Tactical or Intermediate) is divided into phases. These divide the turn into specific periods when specific actions may be taken.

Turns should be recorded as game times. For example, the first Intermediate Turn might be at time 0100 (zero one-zero zero hours on the twenty-four hour clock). The next turn would be 30 minutes later, at time 0130, the one after at 0200, and so on. If two units moved into detection range during the 0130 Intermediate Turn, the first Tactical Turn would be 0130. The next would be 0133 then 0136, and so on.

2.2.2 Transition Between Intermediate and Tactical Turns. Unless the two sides start the game directly in contact (within detection range of each other) they should start out moving in Intermediate Turns. If, at the end of any Intermediate Turn's Detection Check Phase, one unit has moved within the detection range of another, the action is stopped. The units involved are then placed at the maximum range of the sensor that made the detection. The action then continues in Tactical Turns.

A player can invoke Tactical Turns any time during the Intermediate Turn. This reflects the fact that although time is passing in 30-minute chunks, a player can react within three minutes, the length of a Tactical Turn, to a threat.

Game play may alternate back and forth between Intermediate and Tactical Turns. For example, if a cruiser squadron moves into detection range, the game switches to Tactical Turns. The squadron successfully detects the opposing force and performs a few actions, changing course and speed for instance. The other side has not detected the cruiser squadron and cannot until it gets closer. The cruiser squadron could go back to using Intermediate Turns if it would speed game play, with the option that if it loses contact, it can invoke a Tactical Turn to react.

This feature is especially useful in refereed actions, where the other side may never know it has been detected. If there are many groups of units all moving independently, only those in contact need go to Tactical Turns, while the rest continue moving in 30-minute segments. If an action between two units was over at 0148, and there were other uninvolved units still present in the game, there are 12 minutes until the next 30-minute break. The best way to get everyone moving together is to move the two units involved a distance equal to four Tactical Turns, then resume the action with everyone using Intermediate Turns.

2.2.3 Intermediate Turn Sequence. The following phases are executed by the players each Intermediate Turn.

2.2.3.1 Plotting Phase. Players write down (log) movement and other orders, usually standing orders, for

Standing Orders

Standing Orders are not only an integral part of naval command, but a great way to speed game play. By having both sides issue standing orders, the players can plot movement over long periods of time and quickly bring their forces together.

Standing orders are orders which remain in effect until canceled or expired. Every captain issues Standing Night Orders to the Officer of the Deck before he retires for the evening. A good admiral will issue standing orders before a battle, telling his captains what he plans to do and their part in the plan.

For example, one side on barrier patrol might issue the following standing orders. "Ships will patrol a 20 nm track running NW/SE at 15 knots until they detect an enemy." The other side could order. "Ships will steam in two columns on course 090° at 20 knots, zigzagging 30° to either side of base course every 20 minutes. Continue movement until 0900." The orders may be much more complicated, including both aircraft and ships, laying out search or attack plans.

By writing out these orders, the players are forced to think though their plan of battle. They can consider all the elements: Where will they most likely encounter the enemy? What should they do with their aircraft? Is there a submarine threat? What course should they follow?

Independently written, the players can cooperate in plotting their forces' movement, seeing where and how their forces encounter each others. The information can then be used to set up the battle. Alternatively, the orders can be turned over to a referee, who interprets and executes the orders, reporting back on detections to the appropriate commander.

If there are several players on one side, and one has been appointed commander, he should issue standing orders to cover what they will do in case of attack, how the formation will maneuver, and how they will accomplish their mission.

A little prior planning will improve both the speed of play and the quality of the game.

their forces. These can be written as a simple movement order, as an order to move until some specific time, or until some condition is met. These are the kind of orders a task force commander gives. For example, he might order the formation to turn to a new course and speed. He might order it to change course and speed until 1500 hours, then return to its original course, or to move towards another ship at 20 knots until it is 60 nm away. These orders are executed in 30-minute Intermediate Turns until it takes less than a full 30-minute turn to reach the spot. At that time the formation will not keep going, but play will stop and the player may issue new orders, or extend the old ones.

2.2.3.2 Movement Phase. Units move a distance equal to 30 minutes of travel. Aircraft launches and landings take place. Some units may start or end their move during the turn, and would not travel a full 30 minutes' distance. For example, if an airplane is ordered to take off half way through an Intermediate Turn, then it will move a distance equal to 15 minutes' flight.

2.2.3.3 Detection Check Phase. Players check to see if there are any hostile units within detection range. If there are, all units are backed up enough so that the potential contact is at the outer limits of the sensor's detection range. For visual detection, the units are placed at the modified detection range (see section 5.2.2). Play is then shifted to Tactical Turns.

2.2.3.4 Amphibious Combat Resolution Phase. Players total up Ground Combat Strength points from ground, naval, and air units and roll on the Amphibious CRT (see Chapter 10).

2.2.4 Tactical Turn Sequence. The following sequence of phases is executed by the players during each Tactical Turn.

2.2.4.1 Plotting Phase. Players write down (log) movement, firing, and other orders for their forces. Players may plan fire for the upcoming Planned Fire Phase only against targets detected in a previous turn's Detection Check Phase. Any messages to be sent this turn are to be written down in this phase.

Plotting ahead *(optional rule).* If one or both sides are undetected at game start, and if both players agree, players write their movement orders for one Tactical Turn ahead (the current turn and one more). While undetected, miniatures or counters may be present on the game board and visible to both sides. Writing movement orders for a future turn helps prevent a player from reacting (even subconsciously) to "undetected" movement made by the other side.

As soon as an opposing ship is detected, the future orders are voided, and the detecting player can replot the next turn's orders.

If torpedoes are to be fired by surface ships or submarines, players should plot ship movement at least one turn ahead (the current and one more). This artificiality is required because opposing players may see each other plotting torpedo fire or placing markers down in the Planned Fire Phase, but the weapons do not move until the following Movement Phase.

2.2.4.2 Movement Phase. Surface ships, submarines, and torpedoes move a distance equal to three minutes of travel. Aircraft launches and landings take place. All aircraft move a distance equal to one and a half minutes of flight (they will move an equal amount in the Second Air Movement Phase). Torpedoes that reach their target in this phase have a chance to hit and inflict damage.

The Three-Minute Rule

A useful trick for quickly figuring movement is the "Three-Minute Rule." Take a unit's speed in knots and add two zeroes on the end. This is how far it will travel in yards in three minutes. For example, a destroyer moving at 15 knots covers 1,500 yards in three minutes. This also works for aircraft, but there are usually more zeroes to keep track of. A plane flying at 100 knots will cover 10,000 yards, or 5 nm, in a three-minute period.

2.2.4.3 Planned Fire Phase. All weapons ordered to fire in the Plotting Phase are fired simultaneously. Surface and AA gunfire and attacks by aircraft are resolved immediately during this phase. ASW depth charge attacks can be made only in this phase and are resolved immediately.

Torpedoes are launched in this phase but they do not move until the next Tactical Turn, and their attacks are solved only in the Movement Phase.

2.2.4.4 Detection Check Phase. Players attempt to detect ships, subs, airships, and aircraft visually. Ships and airships can also attempt to detect submerged submarines if they are equipped with a sonar system. A unit can react only to detected threats, even though the controlling player may be aware of others.

2.2.4.5 Second Air Movement Phase. All aircraft move a distance equal to another one and a half minutes of flight. Bombing attacks are made for planes that have reached their targets and AA attacks are resolved.

2.2.4.6 Reaction Fire Phase. Shipboard guns which have not been used so far this turn may now fire at any target, including ones just detected. AA guns fire again. Torpedoes and ASW depth charges may not be fired in this phase. Aircraft fire as in the Planned Fire Phase Gunfire and unguided weapon attacks by aircraft are resolved immediately. Guns fired only in the reaction fire phase do half normal damage.

2.2.4.7 Resolution Phase. Die rolls for damage control are made now.

2.3 Ship Size Classes. Many rules are based on the size of the ships involved. This includes maneuvering, detection and damage. To simplify things, ships are grouped into **size classes**. The rules will refer to size A, or size C, or so on. The classes are:

SIZE CLASS TABLE

Class	Example Ship Types
A	BB, BC, CV, Large Merchant
B	AMC, OBB, CR, OCR, Large Merchant
C	CL, CS, DL, Medium Merchant
D	DD, ODD, TB, SS (surf), Small Merchant
E	PC, SSC (surf), CTB, Trawlers

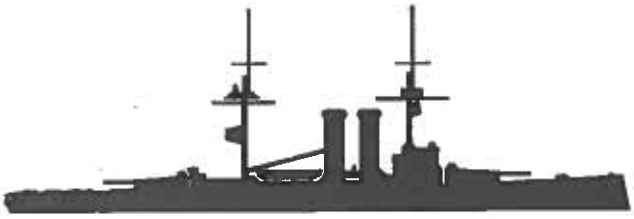
(refer to the Annex booklet for a list of ship type classifications)

SHIP SIZE CLASS COMPARISON

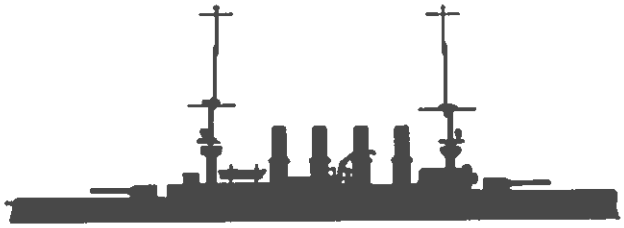
Submarine (SS) - Size Class D: *U5* class

Light Cruiser (CL) - Size Class C: *Chatham* class

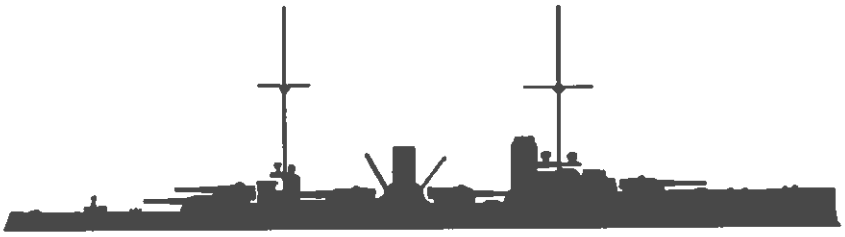
Destroyer (DD) - Size Class D: *Beagle* class



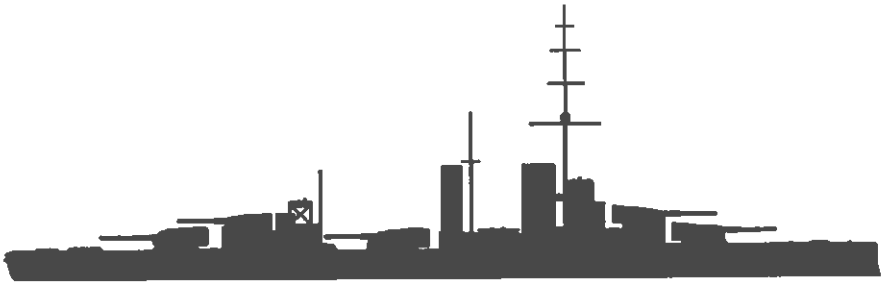
Old Battleship (OBB) - Size Class B: *King Edward VII* class



Armored Cruiser (CR) - Size Class B: *Scharnhorst* class



Battlecruiser (BC) - Size Class A: *Seydlitz* class



Battleship (BB) - Size Class A: *King George V* class

2.4 Target Aspect. Gun and torpedo fire depend on the apparent aspect of the target. A bow-on battleship is a smaller target than a destroyer broadside to an observer.

Using the Target Aspect Diagram, players can decide whether they have a broad, quarter, or narrow aspect on the target. This affects their ability to hit the target.

2.5 Plotting Movement Orders. Since units move simultaneously, movement must be plotted ahead of time. For surface ships, players record course and speed, which cannot be changed during the turn. Any increase or decrease in speed should be checked against the ship's acceleration/deceleration ability (section 3.1.1). If the player wants the ship to steer evasively (section 3.1.4), he applies the modifier to figure out the ship's final speed over the water.

Direction and course changes can be written in any clear, consistent manner. It may be in terms of a destination ("Head for Horns Reef") or be based on another ship's movements ("Close on enemy battleship, turn to parallel its course at 1500 yards.") Remember to keep it simple and

focus on the goal of the movement, not the process itself.

Subs and planes must have their depth or altitude specified, as well as speed and course.

2.5.1 Secret Submarine Movement. In a two-player game, allowing submerged submarines to stay hidden requires cooperation between the two sides. First, the surface player, who is assumed to have no knowledge of the sub's exact position, should plot ahead for three to four Intermediate Turns (Standing Orders).

At the same time, the submarine player plans his attack, based on the initial setup. He also plans at least three Intermediate Turns in advance.

The players then match their two plans and determine when and where the sub is detected, or if it makes it to the planned firing position undetected.

Once the sub's presence is detected, or fires and hits a target, the surface ship player can change his standing orders.

2.5.2 Torpedo Movement. Torpedoes move in each Movement Phase starting the Tactical Turn after they are fired. Torpedoes are moved like any other units, however, the firing player can invoke proportional movement if it looks like the torpedo has a chance of hitting (see Chapter 3 (3-1) and section 6.3.1).

If torpedoes are fired, or if it is expected that torpedoes will be used in a game, the players should plot their ship's movement one Tactical Turn in advance (the current and one more). If new units are detected or a ship suffers damage, the affected player can alter his movement plot at that time, writing a new set of orders for that Tactical Turn and the next one.

2.6 Command and Control. Command and Control (C^2) is one of the most critical and yet least simulated areas of naval warfare due to its complexity and many variables. Yet it is the unique method and manner by which fleets at sea are operated to avoid chaos and achieve victory. C^2 covers two basic areas: Command - the organization or chain-of-command of forces at sea, and Communications - the processes and mechanisms that allow coordination of thiose forces.

2.6.1 Command. Command structure and organization, essential parts of all naval operations, are scenario dependent and based upon the types and number of units involved. The number of players may also affect any command structure for each game, so let common sense and fair play be your guide.

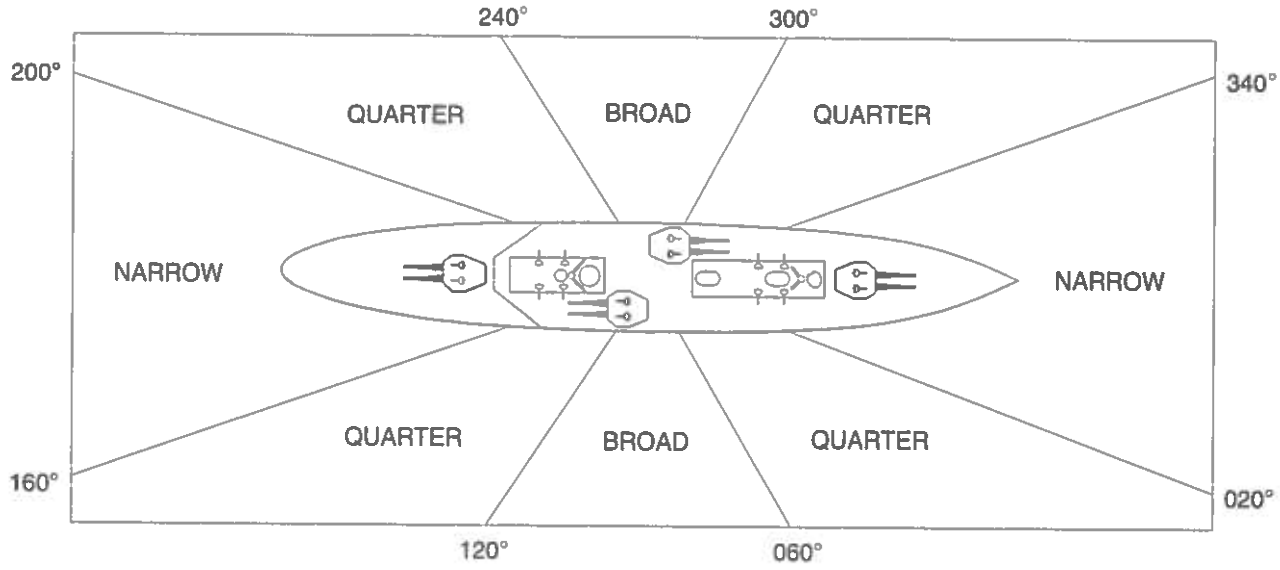
The basic unit for naval organizations at sea is the individual ship. Each organization level builds up from the ship based on groupings of ships by ship type, by mission or by scenario design. The main purpose behind organizing ships and establishing a chain-of-command is to minimize confusion and save time when coordinating action. Instead of a commander having to tell seven separate destroyers to attack the enemy with torpedoes, he simply orders the squadron to which the seven ships belong to attack. Each destroyer captain understands this means him and plots his movement to attack.

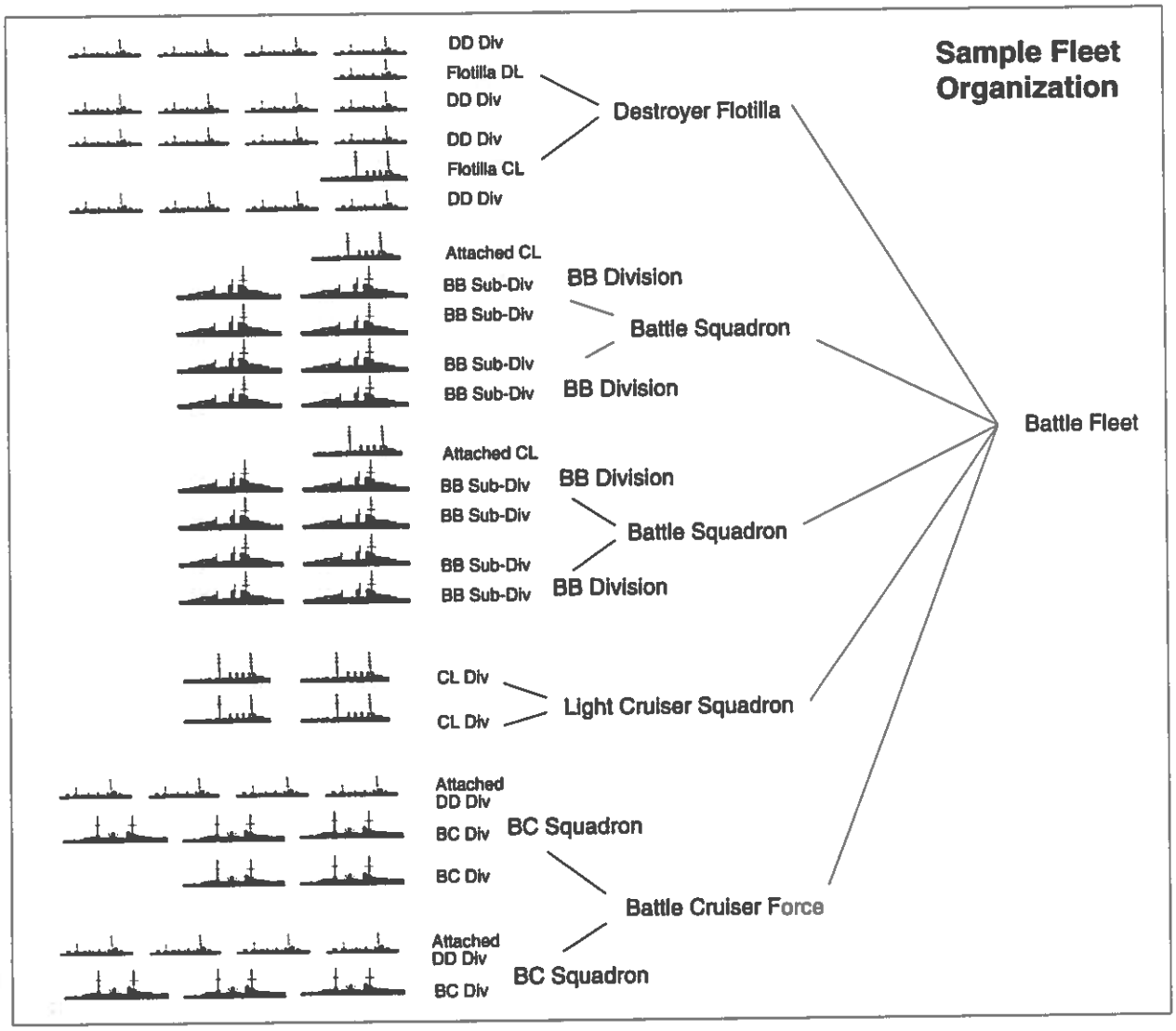
The command structure should be clearly outlined at the start of each game so that each ship (and player) is identified in the organization. This is especially important for issuing orders and passing information. However, having a command structure also means dealing with the potential loss of command.

2.6.1.1 Loss of Command. One of the drawbacks to having a command structure is when that structure is broken or interrupted. If the ship carrying the organizational commander is sunk or loses the ability to communicate, then that organization has suffered a loss of command. This is true until either the next senior in command signals who is the new commander, someone in that organization sends a signal assuming command of the organization, or the current commander shifts to another ship and signals he is back in command.

Until there is a functioning commander, that organization cannot operate as a unit. No new formation movement

TARGET ASPECT DIAGRAM (RELATIVE ANGLES)





or coordinated attacks are allowed. The organization will act to carry out the last order given prior to loss of command. Ships may operate independently to attack if necessary, but any coordination must be done via ship to ship communications.

For example, if a ship carrying a flotilla commander is sunk, then that flotilla is temporarily not under command. Either the next senior in command must issue an order directing a ship to become the flotilla commander or one of the ships in the flotilla sends a signal assuming command of the flotilla. In either case, a signal must be sent telling the flotilla who is the new commander. This can delay the flotilla's ability to act at a crucial moment in the battle or fail to seize an opportunity. (Command succession could be covered in the standing orders to prevent this problem).

2.6.2 Organization. Different navies have used different terms for their fleet organizations as they developed. Large formations are made up of smaller ones that fit together like a floating jigsaw puzzle. Sometimes the same grouping of ships can be referred to in two different ways. The first is usually an administrative designation and the second intended for Fleet operations. The following table is provided as a simplified summary. The organizations are in descending order of size and scope.

Fleet - Largest organization of different ship types, also used to refer to the entire Navy.
Force- Smaller organization of different ship types.
Squadron - Grouping of ships usually of the same type, can be any class of ships.
Flotilla - Grouping of ships usually of the same type, usually destroyers or submarines.
Division - Grouping of ships usually of the same type, can be any class of ship.
Half-Flotilla - Grouping of ships usually of the same type, usually destroyers.
Sub-Division - Grouping of ships usually of the same type, can be any class of ship.

Example: The Grand Fleet Battle Orders before the Battle of Jutland organized the British Dreadnought Fleet (36 battleships) into nine divisions, each split into two subdivisions.

Divisions 1 through 6 had four battleships each, the 7th Division had five battleships (and was also designated as the 5th Battle Squadron), while the 8th Division (four battleships) and 9th Division (three battleships) were also designated as the 3rd Battle Squadron.

Wireless Telegraphy and RadioTelephony

The origin of wireless telegraphy and radio telephony dates back to an 1888 prediction by Sir William Crookes, who stated that electromagnetic waves, just recently being experimented with, could be used for communications. He was right and in 1896 the British Royal Navy and Italian inventor Signor Marchese Guglielmo Marconi were in a mixed cooperative/competitive relationship that assisted and drove one another. The newly developed wireless telegraphy had a limited range of only few miles, but the implications were tremendous and would forever change naval communications.

By the mid-1800s, the electronic telegraph had rapidly become state-of-the-art for long distance communications and in 1866 the first transatlantic cable was in place. By the end of the 1870s, the Admiralty in London was in touch with every major British naval base throughout the world via telegraph. Telegraph cables crisscrossed all the major oceans of the world and all of the major powers used the telegraph to maintain contact with their far-flung colonies and to collect information on one another. For communicating at sea, however, the telegraph was still land-bound and ships could not directly benefit from the device. Although dispatch vessels could quickly pass on information gathered at sea and telegraph stations sped the messages around the world, ships at sea were still limited to visual communications.

Wireless telegraphy (WT) changed all that and finally allowed communications with ships at sea. Through the 1890s, the range and power of the wireless sets continued to increase. By 1897, Germany had entered the wireless game after Professor Slaby witnessed one of Marconi's demonstrations in England. After a cross-channel demonstration, France became interested in wireless telegraphy as well. The first true test of wireless communications was during the Royal Navy maneuvers of 1899, where scouting cruisers were able to communicate their discoveries back in time for decisive action to be taken. The wireless had proved itself in a tactical application.

The United States Navy was also interested in wireless technology, but Marconi's financial entanglements proved to be unacceptable and the USN decided to wait and see before getting too involved. By 1901, wireless transmission ranges had grown to over 130 miles and the Royal Navy decided to equip all battleships and cruisers of her three main fleets. The year 1901 also witnessed the first transatlantic wireless communication. In 1902, the US Navy returned to the competition and purchased two sets from different manufacturers to test each for the best performance before placing any larger orders. The set selected was the German Slaby-Arco and these sets were used successfully in the 1903 summer maneuvers, allowing one US force to locate and surprise their opponents, despite mist and rain, before they could launch an intended landing. Increasingly, WT was demonstrating its potential for supporting the war at sea.

That potential was put to test during the Russo-Japanese War. The Japanese Navy made extensive use of wireless telegraphy to maintain contact between scouting or patrol forces and supporting groups. The blockade of Port Arthur was made possible only through wireless communications that summoned main Japanese forces whenever the Russians made any move. The Russians, however, were more passive in their use of wireless and used it to listen for the presence of Japanese ships instead of for their own command and control. The chaos that ensued after the initial Russian losses following both the sortie from Port Arthur and the battle in the Straits of Tsushima could probably have been prevented had the Russians used WT to rally their ships for a coordinated defense. The Japanese made extensive use of WT after the battle and coordinated their actions effectively against the Russian stragglers.

By 1905, the British had decided that wireless telegraphy would be standard issue on all ships larger than destroyers, and soon most major navies followed suit. In 1907, the Royal Navy made two major changes to the use of WT. First was a shift from the standard "inker" or tape recording method of receiving wireless signals to an earphone reception method. This change allowed the speed of reception to almost double, although initially senior Royal Navy officers were doubtful of trusting message reception to a single 'lowly' signal man instead of having hard copy that several men and officers could read and check. Second, the Admiralty formally issued the 'Instructions for the Conduct of W/T Signaling.' This document defined procedures and frequencies for Royal Navy use by organization and by purpose. One of the more innovative changes was the designation of an "Admiral's Wave" or preset frequency that a designated ship would monitor for the squadron or group and would inform others whenever the Admiral or staff sent out a signal.

Meanwhile, the Royal Navy continued to push the envelope of WT use. In 1909, a wireless set was placed on an airship for testing as a long-range aerial scout. Unfortunately, there were significant problems with the airship itself, which wrecked in 1911 while trying to leave its shed. However, in 1912, wireless sets were being tried in seaplanes and by 1914, working sets and working aircraft were both available. Although the range of seaplanes was somewhat limited and aviation was still a very dangerous endeavor, the combination of aircraft and WT was an attempt to expand the detection capability of the Fleet by means other than surface ships. Similarly, the Royal Navy expanded the role of the submarine by testing submarine wireless sets in 1910, with all "modern" submarines being outfitted by 1913. Unfortunately, the lack of space for bigger sets and shorter antennas kept the range of submarine wireless sets somewhat limited.

In 1912, the US Navy appointed a Fleet Radio Officer in response to a disastrous Fleet exercise in the Caribbean. Massive changes were undertaken in training, WT procedures and configuration control. These efforts were proven in 1913, when a fleet of seventeen battleships was forced to maneuver in close quarters during a sudden squall and did it successfully and completely by wireless.

During the Great War, advances in WT technology and procedures continued to progress. Ranges and equipment reliability improved and the speed of processing signals greatly improved. At the start of the war, signal flags and repeating cruisers were the preferred method and could process a maneuvering signal in 2-3 minutes, whereas a wireless signal took 10-15 minutes. However, by the end of the war a WT signal was just as fast as signal flags, did not require a relay ship to pass it on, and covered a much larger area and therefore more ships. WT would probably have supplanted signal flags as the primary communication method except for the danger of the enemy intercepting radio signals and the advantages that Signals Intelligence was able to provide.

During the 1920s, improvements in wireless technology allowed navies to replace low-frequency (LF) shore stations with high frequency (HF) transmitters. The advantage of HF transmissions was the ionospheric bounce or skipping characteristic of the HF waves that allowed communications over tremendous distances. By 1929, the Admiralty was able to directly communicate with stations in Singapore, Ceylon and Halifax. Shipboard WT sets continued to remain LF as the HF bounce was impractical for ships, since there was no guarantee that the ship would be placed where it could receive the bounced signal.

In the early 1930s, HF sets had grown in power and were finally placed on board ships, also providing the advantage that HF transmissions were not detectable via the bounce and so could not be used to direction-find a ship as had been done during WW I with LF transmissions. (This would later change during WW II when methods to detect and locate HF transmissions were successfully developed and used).

A sample Battle Fleet organization is shown on page 2-9.

2.6.3 Formation Movement. Formation movements are the best reason for having a well-run command structure. A single order can shift an entire destroyer flotilla to cover a submarine threat or maneuver a battle squadron from divisional columns to a single battle line. Formation integrity is what makes a group of ships effective. It allows for concentration of firepower and mutual protection. Therefore keeping formations intact or maneuvering ships into a new formation can be critical to victory.

A standard maneuvering procedure used by most navies was the simple "follow the leader" and used by ships in a column or line ahead. In this manner ships could keep their relative formation and the risk of collision was miimized. It also eliminated the need for additional communications. Often ships drifted into open columns so that they could see signals from the ship in front for course or speed changes, or tactical signals from the formation commander such as fire disposition or which enemy to engage.

For *FG&DN*, the advantage of following the leader is that only the lead miniature or ship counter needs to be carefully moved on the playing surface. All other ships are then moved to maintain formation on the leader.

2.6.4 Formation Changes. *(optional rule)* Any formation other than a line ahead requires a signal to adjust the course and speed. This is because the column formation was the easiest (and safest) formation for traveling from point A to point B. Only when the tactical situation required a more advantageous arrangement, would ships shift from their formation. Tactics decided the best formation. (For more specifics on tactics and formations, see the Jumpstart Booklet).

If a signal for the course and speed is not received, a D10 detection die roll is required to detect the new course and speed of the guide. A 1-4 indicates only a change in relative position is detected, 5-7 the correct course is observed, and 8-10 the correct course and speed are estimated. Unfortunately, this may come too late if steaming in close formations.

2.6.5 Plotting Movement Orders. Using Communications Message Form (FG&DNForm 6 in the Jumpstart Booklet), an organizational commander indicates the group(s) that need to maneuver, the desired movement and indicate time to begin the maneuver. When received, the ships being ordered plot their new courses and speeds to take effect as ordered. If following the leader, players can simply indicate "follow in wake of USS *Texas*" or some manner that indicates which ship they are following. If maintaining a relative position to a guide ship, then indicate the bearing and range to be maintained and place the ship appropriately.

When executing plotted orders, they are to be followed as written. Even if the order seems wrong, orders must be obeyed. For example, in the 1920s, a division of U.S. destroyers was operating off the coast of California in column formation. The order was given to change course and turn . . . towards the shore! All of the ships except one turned together as ordered and went aground. However, it was the Commanding Officer of the destroyer that did not turn who was court-martialed . . . for failure to obey an order.

While blind obedience to orders may seem unnatural to those unfamiliar with naval tradition, the man in command usually is presumed to have better information and more experience. That makes his decisions, by definition, the best. Besides, failure to obey usually results in the end of a career – yours.

2.6.6 General Orders. Good communications is essential for victory at sea. Having a common understanding of what those signals mean is just as important. The common reference for all ships and commanders is known as "General Orders." These are issued by the admiral and his staff, and are meant to ensure that the same order means the same thing throughout the fleet. General Orders provide instructions or guidelines ranging from very specific directives to general guidance.

The selection below outlines the types and intents of these orders:

Operations Orders	Overall general orders with basic guidance. Usually helps to make clear why ships are underway and in that area.
Standing Orders	Basic guidelines on how ships are to operate together as a group. Outlines roles and responsibilities.
Battle Instructions	Basic formations and pre-set maneuvering signals. Provides the concept and vision of commander's intentions and expectations.
Fighting Instructions	Specific guidance for specific circumstances. Usually time or location sensitive. Usually applies to a single engagement or type of engagement.

Players should take advantage of using general orders to establish who will do what when the enemy is encountered. This saves time and effort spent on sending signals telling others what to do. A simple signal to "execute Plan A," is far easier than sending a lengthy message to all five light cruisers to form a scouting line 5 nm in front of the formation with 2 nm between ships. The Royal Navy Grand Fleet Battle Orders used two-letter flag combinations to quickly communicate different tactics and formations.

Example: A destroyer division on patrol spots an enemy minelaying cruiser they have been searching for. Fighting instructions have already been issued that upon sighting the enemy, the patrol is to split into two pairs and attack from different directions, splitting the cruiser's fire. At the same time, the Division Commander sends a wireless signal back to the Flotilla Commander reporting contact with the enemy. No new orders were required and each destroyer player can replot his movement based on the detection of the enemy cruiser.

2.7 Communications. Communications is crucial for the coordination and execution of naval warfare. Scouts must report back when they have discovered the enemy in order for the Fleet Commander to act. Likewise, Fleet Commanders must tell the fleet when to deploy in order to form the line of battle. Proper execution depends on accurate communications between various units. There are numerous systems and methods that have been developed to make this occur, but *FG&DN* has broken these down into two functional areas: Visual Signals (2.7.1) and Electronic Signals (2.7.2).

The term "signal" indicates the method and manner of communicating. The term "message" refers to the content of any signals. All messages are drafted during the Plotting Phases of either the Intermediate or Tactical Turns and sent or received during the Detection Phase. The signaling method determines how long it takes for the message to be read and understood. The specific mechanics of communicating is found in section 2.7.3, Communications Procedures.

2.7.1 Visual Signals. Until the development and use at sea of wireless telegraphy and radio telephony, all communication between ships, submarines, aircraft and the shore was accomplished by visual means. In *FG&DN*, visual signals are organized into Flag Hoist, Signal Lights, and Rockets or Flares. Each method has its own benefits and drawbacks.

Flag Hoist is reasonably fast and the most comprehensive form of signaling. Because it relies on code books to translate the signal into message content, Flag Hoist is reasonably secure. Since Flag Hoists are readable by several units at once and the process uses the up and down motion of the flags to coordinate action, Flag Hoist is best for group communication.

Flashing Light is the most secure method because it is normally readable only by the unit at which the light is aimed, and can be encoded as well. But Flashing Light requires each character to be sent individually, and if there are questions or problems, repeated by the receiver. Flashing Light is normally the backup to Flag Hoist except at night, when it is the primary signaling method.

Rockets and Flares are the fastest means of signaling and readable by several units at once, but are limited in the number of messages they can convey and have limited security since anyone can see them. For *FG&DN*, Rockets and Flares are used for emergency signals only.

The number of visual signals a ship can send or receive during a turn is determined by equipment and personnel on board. If a ship carries a command staff on board, they provide additional personnel to send and receive more signals. The table below shows the number of visual signals permitted during a Tactical Turn.

VISUAL SIGNAL CAPACITY TABLE

Ship Class	Basic No. of Flag Hoist Signals	No. of Flag Hoist Signals with Staff*	No. of Flashing Light Signals	Max No. of Total Visual Signals
A	4	5	2	4 or 5*
B	3	4	2	3 or 4*
C	2	3	2	2 or 3*
D	2	N/A	2	2
E	1	N/A	1	1

Note: The asterisks in the last column refer to the number of total visual siignals when a staff is embarked.

2.7.1.1 Flag Hoist. The signal flags used for Flag Hoist signals are large cloth flags and pennants (approx. 3-4 feet in length), each with a unique meaning; the letters of the alphabet, numbers 1 through 0, and several special purpose flags and pennants. The flags and pennants are displayed on signal hoists, which are lines suspended from various yardarms down to the signal bridge.

VISUAL SIGNALS RANGE TABLE

Visibility	Flag Hoist Range (in Kyds)	Daytime Flashing Light Range (in Kyds)	Nighttime Flashing Light Range (in Kyds)
100%	8.0	16.0	26.0
85%	6.8	13.6	22.1
75%	6.0	12.0	19.5
60%	4.8	9.6	15.6
50%	4.0	8.0	13.0
40%	3.2	6.4	10.4
25%	2.0	4.0	6.5
10%	0.8	1.6	2.6
5%	0.4	0.8	1.3
2%	0.2	0.3	0.5

Each navy had its own code or signal book which defined what each signal meant, in addition to international versions for common communications. In *FG&DN*, the Flag Hoist process has been simplified to avoid the need for these massive signal books.

The number of signals a ship can hoist and relay depends upon the number of actual hoists and signal personnel aboard, both of which are based on the size of the ship. The Visual Signals Capacity Table shows the number of Flag Hoist signals a ship can hoist or relay in one turn. Sending a Flashing Light signal at the same time will reduce the number of possible Flag Hoist signals by one, and a ship is always allowed one rocket or flare signal.

The detection ranges for reading a Flag Hoist signal are shown in the Visual Signals Range Table. These ranges are affected by the same factors that affect visual detection found in section 5.2.2.1

Because the angle of the signal flags, as well as smoke from stacks and gunfire, sometimes obscured the Flag Hoist signal from the intended recipient, relay ships were often stationed to make sure that signals were successfully passed from one ship to another. With the long dreadnought lines of battle, this task often fell to the attached light cruisers. For destroyer squadrons or flotillas, this became a primary reason for assigning a light cruiser or large destroyer as the flotilla leader.

In order to read a Flag Hoist signal, a ship must be within the Broad or Quarter Aspect of the ship displaying the Flag Hoist. (See section 2.4 for the Aspect Diagram.)

2.7.1.2 Flashing Light. Flashing Light signals are sent by the light sets similar to search lights and have a limited range. The daylight and nighttime ranges are listed in the table on page 2-12. Because of the limits of signal personnel and equipment, only one Flashing Light signal may be sent per side (port/starboard) at a time.

2.7.1.3 Flare and Rockets. Flares and Rockets are used for emergency signals and have a detectable range equal to Flashing Lights. In order to ensure no confusion between signals, only one flare/rocket signal can be sent at one time.

2.7.2 Electronic Signals. With the advent of Wireless Telegraphy (WT) and Radio Telephony (RT), naval communications changed drastically. The span of control greatly increased as commanders could now communicate with ships and aircraft out of visual sight and shore commands could contact Fleet units at sea. Wireless Telegraphy was Morse code or dash-dot communications. Radio Telephony was voice communications. WT was the primary method of electronic signaling with exception of RT for naval gunfire spotting later in World War I.

2.7.2.1 Range of WT/RT. The range of WT/RT depended greatly on the frequency and power of the transmission, which was determined by the type of transmitter used, as well as the receiver at the other end of the signal. To keep the volume of these many sets to a manageable level, the Wireless Range Capability Table describes the sets carried by the different ship classes and the progress of technology.

2.7.2.2 Jamming of WT/RT. One way to prevent an enemy from communicating with WT or RT was to broadcast a continuous signal on the same frequency so that the receiving set could not separate the intended signal from the radio "noise." This is called jamming. To jam an enemy's radio, a ship must transmit a constant signal. However, a radio/wireless set being used to jam cannot be used to send a message at the same time.

During the early years of radio, jamming was not as successful as had been anticipated. The chances of successfully jamming an enemy's signal depended upon proximity to the receiving radio set.

WIRELESS RANGE CAPABILITY TABLE

	Pre-1917 Primary Set	Pre-1917 Auxiliary Set	1917-1922 Primary Set	1917-1922 Auxiliary Set	Post-1922 Primary Set	Post-1922 Auxiliary Set
Battleships	500 nm	30 nm	1000 nm	50 nm	1500 nm	100 nm
Battlecruisers	500 nm	30 nm	1000 nm	50 nm	1500 nm	100 nm
Cruisers	100 nm	5 nm	500 nm	50 nm	1000 nm	50 nm
Light Cruisers	100 nm	5 nm	500 nm	50 nm	1000 nm	50 nm
Destroyers	50 nm	N/A	100 nm	30 nm	500 nm	50 nm
Torpedo Boats	50 nm	N/A	100 nm	N/A	500 nm	50 nm
Submarines	30 nm	N/A	500 nm*	N/A	500 nm	N/A
Auxillaries	5 nm	N/A	50 nm	N/A	100 nm	N/A
Scouting Aircraft	15 nm	N/A	150 nm	N/A	400 nm	N/A
Spotting Aircraft**	30 nm	N/A	30 nm	N/A	180 nm	N/A
Rigid Airships	100 nm	N/A	400 nm	N/A	1000 nm	N/A
Non-Rigid Airships	75 nm	N/A	150 nm	N/A	500 nm	N/A
Harbor Control	5 nm	N/A	50 nm	N/A	100 nm	N/A
Shore Site	1800 nm	N/A	2500 nm	N/A	3500 nm	N/A

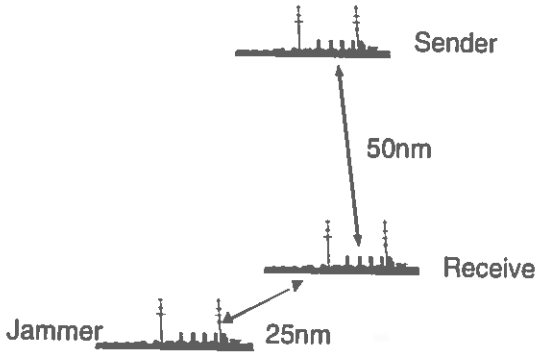
* German U-Boats had range of 700 nm.
** Voice Communications (RT)

SIGNALS PROCESSING CAPABILITY TABLE

	Send	Receive	Understand	Relay
Flag Hoist	Turn 1 Detection	Turn 1 Detection	Turn 2 Plotting	Same Turn
Flashing Light	Turn 1 Detection	Turn 1 Detection	Turn 2 Plotting	+1 Turn
Pre-1917 RT/WT	Turn 1 Detection	Turn 3 Detection	Turn 4 Plotting	+1 Turn
1917-1922 RT/WT	Turn 1 Detection	Turn 2 Detection	Turn 3 Plotting	+1 Turn
Post 1922 RT/WT	Turn 1 Detection	Turn 1 Detection	Turn 2 Plotting	+1 Turn

The base chance for successfully jamming a signal is 25%. This is modified by the distance of the sender to the receiver and the jamming set to the receiver. Subtract the two distances in nautical miles from one another. If the jamming set is closer, then add the difference to the base 25%. If the sending set is closer, then subtract the difference from the base 25%.

Example: A jamming radio is 25 nm from the intended receiving station and the sending unit is 50 nm from the receiver. This adds 25 to the base 25% for a total chance of 50% successfully jamming the signal.



Inadvertent jamming can occur when three or more ships in the same formation attempt to send signals during the same Tactical Turn. Each ship has the same 25% chance of jamming the other's signals.

2.7.3 Communications Procedures. Using the Communications Message Form, fill out the message to be sent and indicate the signaling method used.

Be sure to note the range between units in order to check against visibility conditions or in cases of attempted jamming.

With the exception of Flag Hoist signals, relaying a signal adds one Tactical Turn to receipt of any message. The base chance to correctly read any signal (within range) is 80%. All visual signals are affected by the visibility modifiers found in section 5.2.1.1 Flag Hoist signals are also affected by the bearing of the observer to the angle of the flag and must be in the broad or quarter aspect. Relayed signals must be correctly read in order to properly send on to the intended recipient.

Example: During Turn 0909, HMS *Orion* drafts a tactical message during the Plotting Phase for HMS *Arethusa* to "Scout ahead of formation." The message is sent by Flag Hoist. HMS *Arethusa* is within visual range and during the Detection Phase of Turn 0909 receives the message. A die roll of 32 indicates HMS *Arethusa* can read the message. Movement orders can now be rewritten during the Plotting Phase of Turn 0912. During the Movement Phase of Turn 0912, HMS *Arethusa* changes course and speeds towards her new destination.

2.7.4 Guard Ships. *(optional rule).* Because of the lack of trained WT/RT personnel on board most ships, many ships did not maintain a constant watch on the radio sets. Instead one ship was designated as the guard ship to monitor the proper frequencies for the group or organizations and inform other ships by visual means when a WT or RT signal was received.

2.7.5 Fog of War *(optional rule)* When the time has passed for the signal to be received, determine if the receiving ship is still within range. If so, roll percentile die to see if the signal was properly received. There is a 80% chance of receiving the signal properly.

If the die roll was successful, the receiving ship may read the message form. If the die roll was unsuccessful, the fog of war has occurred. Use 81-90% as a delivery delay of 1-3 turns, and 91-00% as loss of 3D6 characters from the message. Use fair play as the guide, since the goal is not to have greater than 50% of the message lost. The intent is to induce the fog of war, not a total blackout. Referees may choose to get creative in delaying delivery or concealing part of the Communication Message Form.

Example: Using the optional rule for Fog of War, on Turn 1515, SMS *Kolberg* drafts a message for SMS *Seydlitz* during the Plotting Phase reporting "3 enemy BCs bearing 090 at 10 nm." The message is sent by WT with a pre-1917 primary light cruiser set. *Seydlitz* is within WT range and during the Detection Phase of Turn 1521 rolls to read the message. The die roll is 76, so the message is understood. During the Plotting Phase of Turn 1524, *Seydlitz* drafts a flag hoist signal to the Second Scouting Group to change course and increase speed. During the Detection Phase of Turn 1524, the other German battlecruisers, except SMS *von der Tann*, successfully roll to read the signal. That player rolled a 82, so the signal is received late. The second die roll is a 2, so the signal is understood on turn 1527, just as the rest of the Second Scouting Group turns towards the enemy during the Movement Phase of Turn 1527. *Von der Tann* will now be out of position and must hurry to get back into formation.

Jean Bart-*class dreadnought*

Chapter Three - Ship and Sub Movement

Ships, submarines, aircraft, and torpedoes move in the Movement Phase of the Intermediate and Tactical Turns. Aircraft also move in the Second Air Movement Phase of the Tactical Turn.

Proportional Movement. Since miniatures may move several inches on the playing surface in the course of a single Movement Phase, if their paths cross it may be hard to tell if two units pass close to each other. This is important if there is a chance of two ships colliding, ramming, torpedo attacks, or other special situations.

To see how closely two units approach each other, move the involved units first in small steps. The standard Tactical Turn of three minutes is broken down into three one-minute segments, each step being one-third the length of a regular move.

In the example below, a very fast unit will cross the path of a slower one. At the end of the Turn they are far apart, but how close do they come? The diagram on the right shows how to move the units in smaller steps. Unit A reaches the intersection first, and is clear by about a minute by the time unit B arrives. At 35 knots, this is an interval of 1167 yards, so there is no risk of collision. Players may wish to measure the distance at each step to see if they come within collision distance (250 yards)

Any player may invoke proportional movement to resolve a possible movement conflict after all movement for a Turn has been plotted.

If the players wish, they may use intervals of less than one minute for proportional movement. If one or both of the units are at high speed, a one-minute interval may not show their positions clearly enough. In that case, use 30 seconds, or some other convenient time period.

Proportional movement can also be applied to an Intermediate Turn, with the forces in question moving at intervals of five, ten, or fifteen minutes, as the players or referee desire. The goal is to allow exact measurement of the distances between units with the fewest steps.

3.1 Ship Movement. Ships and submarines have a maximum speed listed in Annex A. This can be reduced by damage received in combat. Ships may move at any speed up to the maximum speed available to them. This may be limited by sea state.

When a ship is damaged, look at the Damage and Speed Breakdown Chart on the Ship Reference Sheet. As it accumulates damage, a ship's speed is automatically reduced. Each 25% of its maximum damage reduces a ship's speed by 25%, until it reaches 90% damage, when its speed is zero (it is "dead in the water"). The ship sinks if it reaches 100% damage.

3.1.1 Speed Change. Players order speed changes in the Plotting Phase of a Tactical Turn. The amount of acceleration or deceleration is limited by the size of the ship, and for acceleration, its starting speed must also be considered. A ship will automatically accelerate during a turn to try and maintain its speed unless specifically ordered not to do so.

A ship can move from a dead stop to half of full speed quickly, but above that water resistance increases greatly and the rate of acceleration is less. Acceleration rates are listed in the Ship Acceleration/Deceleration Table. There are separate tables for warships and merchants. Submerged and surfaced submarines are treated normally (that is, there are no special rules for them), rated by their size class.

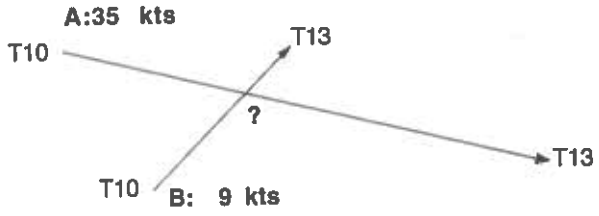
Speed changes ordered in the Plotting Phase of a 30-minute Intermediate Turn are assumed to happen immediately.

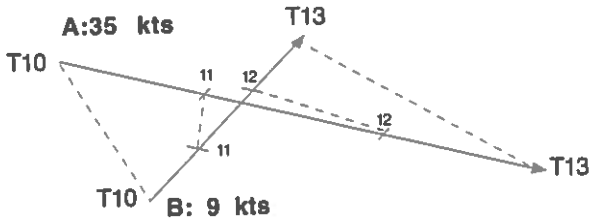
3.1.2 Astern. Maximum speed astern for any surface ship or submarine is half its maximum speed forward. The maximum astern acceleration rate is one half of the ahead value. Deceleration rates are unchanged.

3.1.3 Course Changes and Turning. Ships need a minimum distance to turn. Called "advance," it is the distance the ship moves in the original direction as the rudder bites and the ship starts to change direction. Large ships need more space than small ones.

In many cases, such as maneuvering in open water, advance distances will not be an issue. At other times,

Proportional Movement





Unit A arrives at intersection at time T11, Unit B arrives at time T12.

SHIP TURNING DISTANCE

Warship Size Class	Distance with Standard Rudder (yds)	Speed Loss per 45° turn (kts)	Distance with Hard Rudder (yds)	Speed Loss per 45° turn (kts)
A	300	3	200	4
B	300	3	200	4
C	200	2	100	3
D	200	2	100	3
E	100	2	50	3
Fast E	100	1	50	2

Merchant Size Class	Distance with Standard Rudder (yds)	Speed Loss per 45° turn (kts)	Distance with Hard Rudder (yds)	Speed Loss per 45° turn (kts)
B/C	300	3	300	4
D	200	2	100	3
E	100	1	50	2

- All values are for a single 45° turn.
- Move the required distance first then turn the ship up to 45°.

SHIP ACCELERATION/DECELERATION RATES

Warship Size Class	Accel per Tac Turn from 0 - 50% Max. Speed	Accel from 51 - 100% Max. Speed	Deceleration per Tac Turn (Any Speed)
Fast A/B	6 kts	3 kts	8 kts
Slow A/B	4 kts	2 kts	6 kts
C	8 kts	4 kts	10 kts
D	10 kts	5 kts	12 kts
E	10 kts	5 kts	12 kts
Fast E	20 kts	10 kts	22 kts

Merchant Size Class	Accel per Tac Turn from 0 - 50% Max Speed	Accel per Tac Turn from 51 - 100% Max Speed	Deceleration per Tac Turn (Any Speed)
B/C	3 kts	2 kts	4 kts
D/E	2 kts	1 kts	3 kts

- Note: Merchant passenger liners, because of their engine power and high speeds, are treated as combatants for acceleration/deceleration purposes.
- "Slow" ships have undamaged maximum speeds less than 20 knots.
- "Fast E" ships are coastal torpedo boats or motor torpedo boats.
- Coasting to a stop halves the deceleration rate.
- Changing course 45° or more in a Tactical Turn halves the acceleration rate.
- Astern acceleration is half the ahead rate.

such as at slow speed or in restricted waters, the exact amount needed will be very important. For example, when navigating through narrow channels, US Navy navigators will not only mark the point of the turn, but will precalculate the advance and mark that spot on the chart. The order to turn is given at that point.

The Ship Turning Distance table lists the advance for each ship by size class for both a Standard and Hard rudder. Most turns are made with Standard rudder, but in emergency situations it can turn a little tighter by "putting it over to the stops." There is a risk of the rudder jamming, though, 5% (5 or less on a D100). If it does jam, treat it as a Rudder Critical Hit. The ship continues to circle in that direction until the Critical Hit is fixed.

Unless otherwise plotted, all turns are assumed to use Standard rudder.

Merchants are less maneuverable than warships, and have their own table.

To turn, first move the ship the required distance, based on its size class and the rudder used, then pivot it in place up to 45°. A turn greater than 45° must be made in steps of 45° or less. There is no reduction in the distance required for a turn of less than 45°, except that adjustments of 10° or less per Turn do not need to be accounted for.

Even if a ship has moved in a straight line for several

turns, the player must still move it the stated distance in a straight line before beginning a turn. Advance is the distance the ship moves along its original course line *after* the rudder is put over. If a player knows ahead of time that he will turn in a particular spot, and there is sufficient maneuvering room, he can order the turn then, and the ship will be allowed to make a turn at the start of its next Movement Phase.

When a ship turns, it significantly increases the drag forces it experiences and the ship will slow down. For every 45° turn made, there is a speed loss depending on the rudder angle and ship's size. This loss is listed in the Ship Turning Distance table and is applied for each 45° turn up to a maximum of four times. Beyond the fourth 45° turn the ship has reached its new steady state and will not experience any additional speed loss.

In most cases, the speed lost will be regained within one or two Tactical Turns, unless the ship makes a large course change. The Ship Acceleration/Deceleration Rates Table (see also section 3.1.1) shows the amount a ship can accelerate in one three-minute Tactical Turn.

Example: A Size Class D destroyer, moving at 30 knots, makes two 45° turns with standard rudder. This causes a speed loss of 4 knots, while it can accelerate 2.5 knots (rounded down to 2 knots) at the same time. The normal acceleration of 5 knots is halved because the destroyer turned. If the total speed loss from the ship's turns in a Tactical Turn is more than the acceleration for the ship in the same turn, reduce its speed for the present turn by the difference. In the above example, the destroyer loses 2 knots and would have an effective speed of 28 knots for the same Tactical Turn.

Example: A fast battleship (size class A) is moving at 10 knots. It covers 1,000 yards in a three-minute Tactical Turn. At the beginning of the Turn, in the Plotting Phase, the player writes that he wants to change course 90° to the left, using standard rudder. In the Movement Phase, he figures out the speed made good through the turn by subtracting the speed loss per 45° turn and adding the acceleration rate. Taking the ship's initial speed of 10 knots, the player subtracts 6 knots for the two 45° turns and adds 3 knots for his acceleration rate (halved during a turn) for a modified speed of 7 knots. Thus, the ship covers only 700 yards in the Tactical Turn. The player then moves the battleship 300 yards, pivots it 45°, moves it another 300 yards, pivots another 45°, and moves a final 100 yards.

In the above example, the amount turned and the distance traveled was critical because of the ship's slow speed. Perhaps the battleship, damaged or caught at slow speed, needed to unmask her batteries, or was attempting to comb a spread of torpedoes. In cases such as these, the table becomes critical. At higher speeds, a ship can maneuver more freely.

Example: A destroyer (size class D) moving at 30 knots would normally cover 3,000 yards in a three-minute Tactical Turn. Turning 45° after each 200-yard increment (standard rudder), it could make about one and a half circles in the water in three minutes at a steady speed of 24 knots.

3.1.4 Evasive Steering. Ships that want to become harder surface gunfire targets can steer irregular courses, or "chase salvoes." By turning toward the shell splashes from the last enemy salvo, a ship can throw off the enemy's gunfire corrections. It is not foolproof, but it does help.

Of course, the rapid, unexpected turns also throw off the maneuvering ship's gunners as well, and ships steering evasively cannot fire torpedoes.

Rather than try to model every twist and turn of a ship in the water, a ship that wants to maneuver evasively just plots it and declares it during the Movement Phase. The ship moves normally, but covers only 75% of the distance it normally would. The distance lost is due to steering to the left and right of the base course, and the speed loss caused by all the turns.

A ship must have a speed of 20 knots or more to steer evasively. Speeds slower than that do not give the ship enough maneuverability. Ships of size class B or smaller can steer evasively. Larger ships (size class A) are not maneuverable enough to use the tactic effectively. While a ship is steering evasively, subtract 10% from gunfire attacks on it if it is a size class B ship, and 15% if it is a size class C, D or E. Also subtract 20% from the ship's own gunfire attacks.

3.1.5 Effects of Weather. As the action of wind and weather increases the wave height, a ship pitches and rolls. If the weather is severe enough, the ship starts to "pound," part of its length leaving the water as a trough passes and then crashing into the next wave. The shock can damage sonar domes and steering gear and even buckle hull plates in severe cases. It also means a rough ride for the crew.

As the sea state increases, ships must slow down to prevent pounding. If the weather gets rough enough they must "heave to," turning to keep their bows to the wind and slowing to bare steerageway (3-5 knots). Combined with a strong wind pushing the ships, they are essentially stationary.

Check the Sea State/Speed Table to see how fast a ship can go in any sea state. Cross-reference the ship's size class with the sea state. An "M" means that the ship can move at maximum speed. An "H" means the ship must heave to. A fraction – 3/4, 1/2, or 1/4 means that the ship may move at no more than that much of its maximum speed. Engineering casualties may already restrict a ship's speed, but the fraction of a ship's speed is based on its original, undamaged speed.

SEA STATE / SPEED TABLE

Sea	Ship Size class				
State	A	B	C	D	E
1	M	M	M	M	M
2	M	M	M	M	M
3	M	M	M	M	M
4	M	M	M	3/4	3/4
5	M	M	3/4	1/2	1/2
6	3/4	3/4	1/2	1/2	1/4
7	1/2	1/2	1/2	1/4	H
8	1/4	1/4	1/4	H	H
9	H	H	H	H	H

M = Maximum speed, no restrictions
H = Ship must heave to.

Surface Ship Formations and Maneuvering

Ships are organized into formations to help commanders control their movements, allow for mutual support, and concentrate their firepower. There are several basic formations:

• Column or Line Ahead is the simplest formation. Each ship follows the one in front, with a spacing of 300 to 500 yards between each vessel. The leader usually served as the "Guide," with all other ships conforming to its movements. Naval doctrine was to put ships of the same class, or similar tactical capabilities, into divisions using Line Ahead. Lighter forces would have their own columns on the flanks of the main body, or they might be spread out ahead of the heavies.

Column or Line Ahead Formation

Multiple columns are used to ease formation keeping, to enhance visual communications, and to reduce the length of the formation that would be vulnerable to torpedo attack from a submarine. Before going into battle, the fleet would "deploy" into a single, very long column formation called the battle line. See the discussion on deployment below.

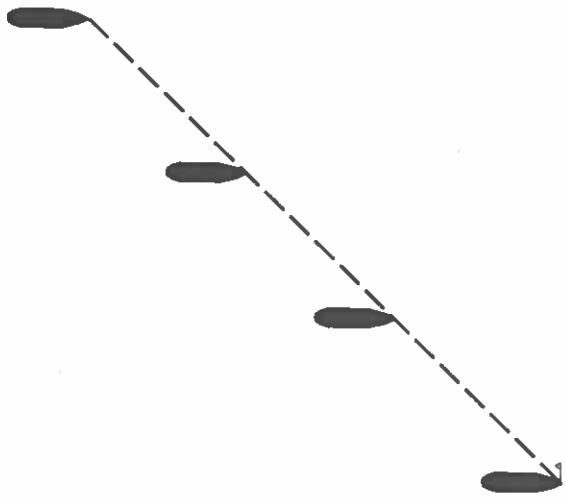
Columns take a long time to pass a point, and to change course all ships in the column must turn at the same spot in the water if they want to keep in formation. If they all turn at the same time, instead of in sequence, they change from column into line abreast.

• Line Abreast formations typically was used for scouting. The wide frontage increased the chance of sighting enemy surface forces. The guide could be on either flank or in the center. Depending on the range of the scouting line's weapons, it may not allow concentration of firepower if an enemy is too far to one side. Only the searching ships' forward guns may be fired, unless the formation is changed.

A line abreast formation can be slanted to one side or the other, echeloned across the path of the vessels. This is called "Line of Bearing," and is used if the enemy is expected to approach from a direction other than straight ahead.

Line formations are difficult to maintain and are clumsy to turn, since the innermost ship in line must remain almost stationary, while the outermost ship must steam at high speed.


Line Abreast

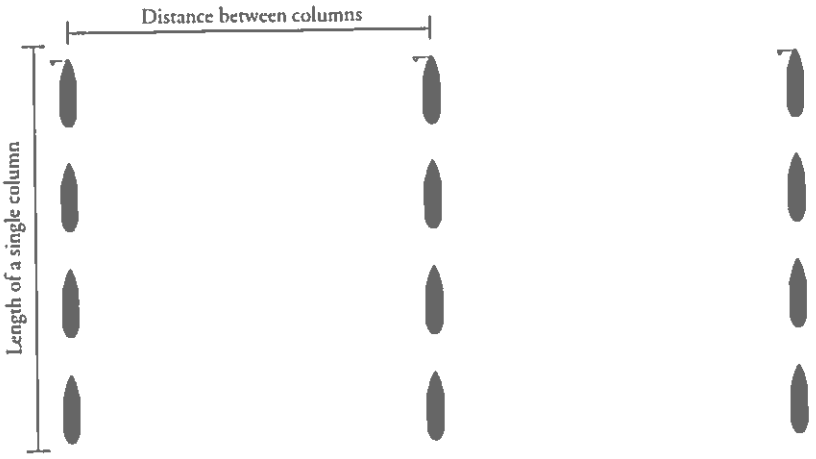

Line of Bearing

• Deployment is the tactical maneuver that transforms a cruising formation, typically line ahead or columns disposed abeam, into a single line of battle. The maneuver starts with multiple divisions of warships in parallel line ahead formations, when the order is given to deploy the fleet on the left-hand or port wing (see the diagrams on page 3-5). Since the port column will form the van of the new line, the ships in that column start the maneuver by turning 90° to port, unless ordered to do otherwise. The center and starboard column lead ships also turn 90° to port and proceed to link up with the port column. Each ship in the columns will "turn in succession," that is, they will turn at the same spot as the ship ahead of it.

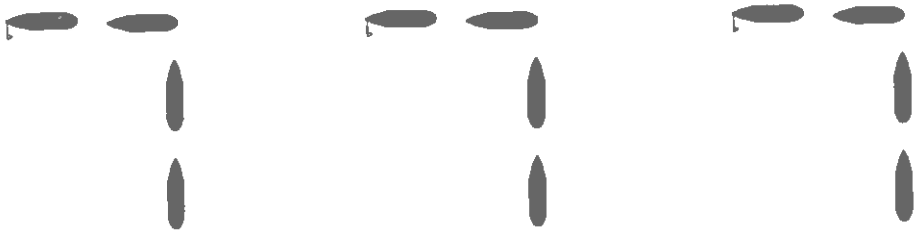
In order to do this maneuver safely, there must be sufficient room between the columns so that when the turns are made there is little chance of a collision. The typical rule of thumb was that the distance between columns should be equal to the length of an individual column plus the normal separation distance between ships in that column. The Grand Fleet battle orders called for 6 to 11 cables (1,200 to 2,200 yards) between the columns, depending upon visibility.

Finally, after all of the divisions have completed their turns, the fleet is now formed into one long battle line that will allow the fleet to fire all their guns at the enemy. By forming a single line of battle, the individual ships do not have to worry about having to fire over a friendly ship in another column and the probability that the enemy would be obscured by smoke is significantly reduced.

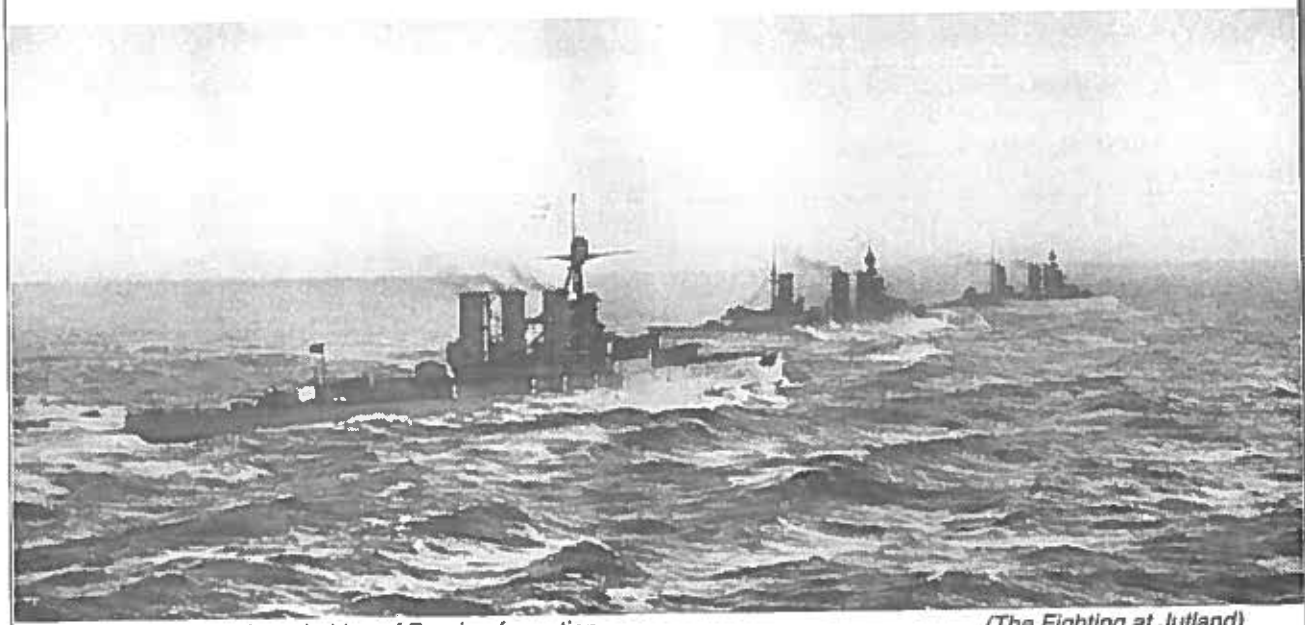
Multiple divisions in Line Ahead or Column formations disposed abeam.



Deployment initiated on the port wing column. Columns turn in succession 90° to port.



Deployment completed with the divisions in a single line of battle.



Royal Navy battlecruisers in Line of Bearing formation. *(The Fighting at Jutland)*

3.2 Submarine Movement. Submarines maneuver on the surface in the same manner as surface ships. Submarines are also capable of changing depth.

3.2.1 Depths and Depth Changes. Submarines may change depth, moving between specific depth levels. These depths are Surfaced, Periscope Depth, Shallow Depth, and Intermediate Depth. Intermediate Depth is divided into two zones: I and II.

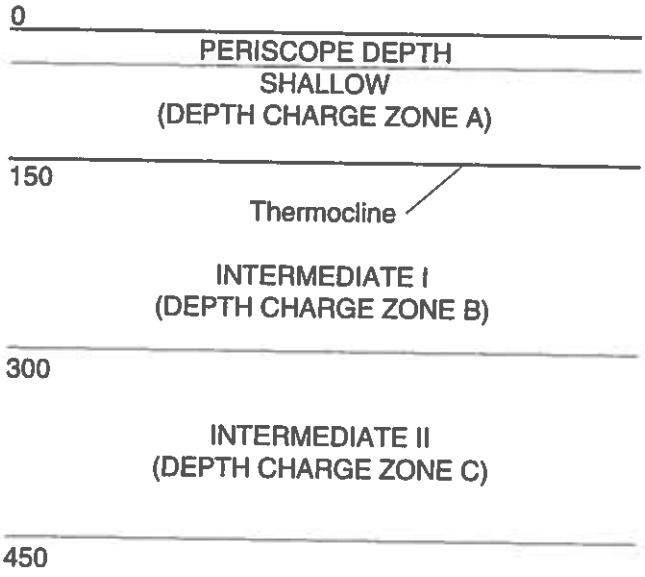
The fewer number of depth bands in *FG&DN* is because submarines were less advanced than those in WW II. During WW I, a deep-diving submarine was one that could go to about 250 feet. Towards the very end of the war, submarines with maximum depths of 328 ft (100 m) were just starting to hit the water. The depth zones are used only in resolving the sub's position for depth charge attacks. The illustration below shows the different depth levels and zones.

A submarine can change depth by plotting the desired depth as a movement order on the Log Sheet. It takes one Tactical Turn to move from any depth zone (including the surface) to the adjacent depth zone. This is ordered during the Plotting Phase of one turn, and the submarine is considered to be at the new depth at the beginning of the next Tactical Turn (exception: see 3.2.2 Crash Dive). Because these early submarines were relatively unstable while submerging, they cannot turn during the Tactical Turn that they are in the process of diving.

Example: A submarine at Shallow Depth may plot to move to either Periscope Depth or Intermediate Depth Zone I. At the beginning of the following Tactical Turn, it is considered to be at the new depth.

3.2.1.1 Surfaced. A surfaced submarine is treated as a Size Class D or E surface ship. Orders to submerge are given in the Plotting Phase. While it is submerging, ships may attack it normally in both the Planned Fire and Reaction Fire Phases. The sub is completely submerged (at Periscope Depth) at the beginning of the next Tactical Turn after the dive is ordered.

DEPTH ZONES



A surfacing sub may fire its weapons in the Reaction Fire Phase of the turn in which it surfaced. A diesel-electric submarine that is surfacing, however, cannot start its diesel engines until the next Tactical Turn. Steam-powered submarines have to wait an additional Tactical Turn before it can switch to the steam turbines. The boilers have to be lit and this requires the submarine to have the funnels raised and locked into position. This cannot be done while the decks are awash.

3.2.1.2 Periscope Depth. The submarine is submerged, but is close enough to the surface to use its periscope.

A submarine at Periscope Depth is visible (during the daytime) as a dark shadow in the water. This shadow is visible to aircraft at Low altitude only, at a distance of up to one nm (2000 yards) during the Detection Phase. This distance can be reduced by the visibility conditions. See section 5.2.3 for resolving detection.

If a submarine moves at 8 knots or more at Periscope Depth, it leaves a visible wake on the surface. This "Kelvin wake" is created by the sub's hull and is present even if the periscope is lowered. It is visible to aircraft at Medium or Low altitude at a distance of up to 3 nm in sea states 0-3 during the Detection Phase. See section 5.2.3 for resolving detection. A submarine will not create a visible Kelvin wake below Periscope Depth or above Sea State 3.

The Periscope Depth Zone is included in the "A" band for depth charge attacks.

3.2.1.3 Shallow Depth. The submarine is above the thermocline, but deeper and less detectable than at Periscope Depth.

The thermocline is a sharp change in water temperature that can reflect sound waves. Sonar detection ranges through a thermocline are reduced. This phenomenon was not well understood until WW II.

A sub at Shallow Depth may not use its periscope. All depth charge patterns that detonate at Shallow Depth have an "A" after the number of charges, e.g., "5A." (The Shallow Depth Zone is included in the "A" band for depth charge attacks).

3.2.1.4 Intermediate Depth. The submarine is below the thermocline (the layer) and has a smaller chance of being detected by surface ships.

Intermediate Depth is divided into two Zones, I and II. The player may move between zones (maximum depth allowing), but must record which zone he is in at all times. It takes one Tactical Turn to change depth from one zone to an adjacent zone. The vast majority of submarines in WW I could only use the Intermediate I depth zone.

All depth charge patterns that detonate at Intermediate I have a "B" after the number of charges while attacks in Intermediate II have a "C".

3.2.2 Crash Dive. If a surfaced submarine is detected during a Tactical Turn, it may choose to crash dive during the Reaction Fire Phase. This is an emergency maneuver designed to avoid an impending attack. The submarine may not fire or take any other action during the phase. It may only make a crash dive if it has detected an enemy unit. At the beginning of the next Tactical Turn, the submarine is submerged at Shallow Depth.

This tactic was developed during WW I and was not used until early 1917 when German U-boats changed their procedures to allow them to rapidly dive and thus avoid being rammed by an enemy destroyer.

Allied submarines were not capable of crash diving.

3.2.3 Submerged Submarine Movement. Undetected submarines move in reference to an arbitrary fixed point on the playing surface. The submerged submarine is plotted on a piece of graph paper (recommended scale is 10 squares/inch with each square representing 500 yards). A sub's starting point may be randomly determined or mutually agreed upon. The submarine player will keep track of the other's ships and will notify his opponent when the sub is detected. Detected but submerged submarines are represented by a counter, and moved normally. If contact is lost, remove the counter, or leave it at the last known position ("datum").

3.2.4 Submarine Battery Endurance. A diesel submarine actually uses "diesel-electric" propulsion. While surfaced, it is powered by diesel or "petrol" (gasoline) engines, and can devote part of the engines' power to charging batteries. Steam-powered submarine designs were also used during WW I, but they proved to be very difficult to use tactically because they took much longer to switch between propulsion modes. (They could switch very quickly between the "working" and "broken" modes, though.)

When a submarine submerges, it uses electric motors, which are fairly quiet at slow speed. The batteries can deliver power sufficient for creeping speeds for some time. If, on the other hand, the sub moves at its flank submerged speed, that same battery charge will not last even an hour. This might be enough to get a sub out of danger, but it will have to recharge its batteries soon thereafter.

Each submarine in the game has a battery endurance rating in units of charge. Because most nations in WW I used the same battery technology, there was not a significant difference between the designs. All large ocean-going subs (SS type) have one battery rating, while all smaller coastal subs (SSC types) have another.

SUBMARINE BATTERY TABLE

Ocean-Going Submarines (SS)

Speed (knots)	Discharge Rate Unit/Int Turn	Battery Level	Charging Rate Units/Int Turn
1	0.5	0 - 35	4.5
2	0.6	36 - 45	2.5
3	1.0		
4	1.3		
5	2.0		
6	3.8		
7	7.5		
8	16.0		
9	28.0		

Coastal Submarines (SSC)

Speed (knots)	Discharge Rate Unit/Int Turn	Battery Level	Charging Rate Units/Int Turn
1	0.5	0 - 19	3.0
2	0.6	20 - 25	1.5
3	1.0		
4	1.3		
5	2.0		
6	3.8		
7	7.5		
8	16.0		
9	28.0		

All ocean-going boats have a battery rating of 45 units. The coastal subs had about half the battery capacity with 25 units.

The Submarine Battery Table lists the discharge rate as the sub's speed changes. The faster the sub travels the more charge it uses per Intermediate Turn. To find out how many units the battery loses in a 30-minute Intermediate Turn, look up the sub's speed using the correct type, either coastal or ocean-going, on the Submarine Battery Table. The number next to it is the number of charge units used.

If the players are using Tactical Turns and the sub has changed speeds, average the sub's speed each ten Tactical Turns, round to the nearest whole knot, and use the applicable value in the Submarine Battery Table.

The number of units represents the average discharge rate over the ten Tactical Turns and is subtracted from the sub's battery level.

Example: A German *U5* class (ocean-going) sub has been submerged for several hours and presently has a battery rating of 35 charge units (out of a maximum of 45). During the next Intermediate Turn, the sub moves at a speed of 5 knots. Referring to the table, this uses 2.0 units of charge, so at the end of that 30-minute IntermediateTurn its level is reduced to 33 units.

A submarine can only recharge its battery by running its diesels or steam plant when surfaced. Each Intermediate Turn that the submarine is in the surfaced propulsion mode, several charge units can be added back to the battery level. Because part of the submarine's power is being used to run generators, the sub may only move at half speed (halve the maximum possible speed for its damage status).

The number of units added back depends on the battery's starting level. A "flat," or near-empty battery can take a faster charging rate than a nearly full one.

If a sub must use Tactical Turns while charging, prorate the amount of the charge by the number of Turns spent at less than half speed. For example, if a sub starts an Intermediate Turn charging its batteries, then must submerge after six Tactical Turns have passed, the sub gets 60% of the units it would get for a full Intermediate Turn.

Example: At dusk, the same *U5* class submarine surfaces after a long hard day of dodging Royal Navy antisubmarine patrols. Its battery rating is a very low 5 charge units, out of a maximum of 45. It immediately proceeds to charge its battery, but is only able to spend three Intermediate Turns recharging before a Royal Navy airship forces it to submerge. On the first Intermediate Turn, the *U5* added 4.5 charge units, raising the battery level to 9.5. The second Turn, it added another 4.5, which brings the battery up to 14 units. During last Turn, it adds 4.5 more for a total of 18.5 charge units.

3.3 Torpedo Movement. Torpedoes are fired in the Planned Fire Phase, after movement for the Turn is completed. When fired, place two counters next to the firing ship. One marks the torpedoes' starting position, the other is for the torpedo salvo itself. The torpedo salvo marker is not moved until the following Movement Phase.

In the Tactical Turns following the launch, the torpedoes move in a straight line in the direction chosen by the firing player (within firing arc limits). Counters can be used

to show the location of torpedoes on the way to their targets. Torpedo speeds are listed in Annex E.

3.3.1 Speed. Some torpedoes have several speeds listed in Annex E. Slower speeds give the torpedo a longer range. Any available speed may be chosen at the time of launch. It cannot be changed once the torpedo is launched.

3.3.2 Course Changes. A torpedo can make one course change (±45°) to anywhere within the firing arc of its mount. Virtually all torpedoes during WW I were fitted with gyros which were set before launch, and surface ships had trainable tubes. Once on its preset course, a torpedo cannot turn.

3.3.3 Depth Changes. All torpedoes are launched either from the surface or from Periscope Depth. Torpedoes during WW I do not have the ability to go deeper than Persicope Depth.

3.3.4 Range. Annex E lists the range for each torpedo. If a torpedo reaches maximum range without hitting anything, it runs out of fuel and stops wiithout exploding

Minimum arming range for all torpedoes is 300 yards (1/7 nm). If one is fired at a target inside that distance, it will not arm and will therefore not explode if it hits a ship.

3.4 Collisions and Ramming. Whenever two ships not engaged in towing pass within 250 yards (.25 kyd or 0.125 nm) of one another, there is a risk of collision. Any time a submarine is surfaced, or at Periscope Depth within 250 yards, there is a risk of collision with a surface vessel. Two submerged submarines are not at risk of collision unless both are at Periscope Depth and a deliberate attempt to ram is made. Unless they are attacking a ship, aircraft at Very Low altitude are also at risk of collision if they pass within 250 yards of a ship.

3.4.1 Resolution. Whenever there is a risk of collision, look at the Collision table and Roll D6. Players must declare before the die roll if they are attempting to ram or avoid a collision. No declaration means an attempt to ram.

If the result, including modifiers, is a 6 or more, then a collision has occurred. Both ships have their speed reduced by 25%, and if one ship is larger, the smaller ship's by 25% for each difference in size class.

Example: A battlecruiser (size class A) collides with a destroyer (size class D). Both ships were at 25 knots. The battlecruiser's speed is reduced by 25% to 19 knots. If the destroyer is not sunk outright, its speed will be reduced by 25%+75% (the battlecruiser is three size classes larger) and it is dead-in-the water (DIW).

3.4.2 Damage. When a collision occurs, each ship inflicts damage on the other based on its size. A bigger ship inflicts more damage on the other vessel than a little ship.

Roll D6 for each ship and consult the right-hand column of the Collision Table. *Each player takes the percentage he rolled and multiplies it times the original damage point value for his ship. This is the number of damage points he inflicts on the* ***other*** *vessel.*

Resolve the damage normally. If any critical hits result, they are rolled on the torpedo damage column of the Critical Hit Table (Secton 8.1). Damage results are applied immediately (that is, during the Movement Phase).

Aircraft that collide with ships are destroyed (see section 8.2.9 Fire). The ship suffers damage equal to D6 times the aircraft's damage value. Any ordnance carried by the aircraft will not detonate. Aircraft ordnance is not fuzed to explode until after it has been dropped.

COLLISION TABLES

D6 Roll	Collision Result
1	No Effect
2	No Effect
3	No Effect
4	No Effect
5	No Effect
6	Collision

D6 Roll	Ship Damage
1	5%
2	15%
3	20%
4	25%
5	30%
6	40%

Die Roll Modifiers for chance of collision. The modifiers on this table are cumulative:

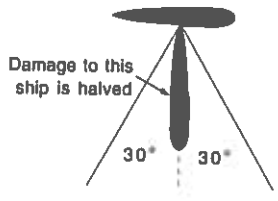
Per Small size ship involved (Size class D)	-1
Per Large size ship involved (Size class A)	+1
Per ship deliberately attempting to ram	+2
If Bridge critical hit and attempted ram	-1
If Bridge critical hit and attempted avoidance	+1
If one ship attempts to ram a stationary ship	+3
Per ship over 20 knots attempting to ram	-1
Per ship over 20 knots avoiding collision	+1

Die roll modifiers for collision damage:

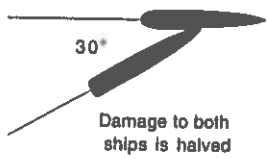
- For each point of belt armor less than the other ship, reduce the percent damage inflicted by one. For each point of belt armor more than other ship, increase the percent damage inflicted by one.
- A ship making a bow-on ram (within 30° of perpendicular impact) reduces the damage it suffers by half. A glancing blow (an angle 30° or less between the ships' courses) halves the damage for both ships.
- Add 1% to the damage percentage for both ships for each knot of relative speed. To find out the relative speed, add the two speeds if the two bows are pointed toward each other, subtract the lower from the higher if the bows are pointed in the same direction, and use the higher of the two speeds if it is a bow-on ram.

The minimum damage inflicted on a ship is 5% of the damage points of the vessel it collides with.

Bow-on Ram



Glancing Collision



Example: HMS *Invincible* successfully rams a *V150* class destroyer in the side, so it will be a bow-on ram for the battlecruiser. The relative speed was 15 knots. *Invicible's* damage point rating is 345; the *V150's* is 23. The battlecruiser's belt armor rating is 14, the destroyer's is zero. *Invincible's* player rolls D6 and gets a 2, or 15%. This

is modified by the armor difference (+14) to 29%. *V150's* player rolls D6 and gets a 4, or 25%. This is modified by the armor difference (-14) to 11%. *Invincible* inflicts 29%+15% (for speed) of 345 or 152 damage points on the *V150*. The destroyer inflicts 11%+15% (for speed) of 23 points or 6 points, halved because *Invincible* rammed with its bow (3 damage points).

3.5 Restricted Waters. In some locations, a ship does not have the ability to maneuver freely. These areas are called restricted waters and could be due to natural or man-made objects which place limits on a ship's course and/or speed.

3.5.1 Grounding. If a ship is within 2 kyds of shore and it is not in a harbor or port, it is in "shoal water", and there is a chance of it running aground. The exact width of shoal water may vary from scenario to scenario.

Roll D100 for each 3-minute Tactical Turn that a ship is within 2 kyds of shore ("in shoal water").

GROUNDING TABLE

Distance from shore (yds)	Grounding %	Size class modifier	
1801-2000	10	A	+10%
1401-1800	20	B	+5%
801-1400	30	C	0%
401-800	40	D	-5%
201-400	60	E	-10%
0-200	90		

If a ship runs aground, it takes D6 times its speed in knots in damage points, treated as underwater (torpedo) damage for resolution and criticals. Torpedo protection systems do not protect a ship from grounding damage.

It takes 2D6 Intermediate Turns to free a grounded ship. A grounded ship cannot be attacked by torpedoes set to run deep.

3.5.2 Nets and Booms. In WW I, rivers, harbor entrances and other narrow passages were often protected by booms or nets to prevent enemy ships and subs from entering.

Booms are floating logs or other constructions that are stretched across a passage and fastened to shore on each side. They were sturdy enough so that a ship attempting to pass through them would be damaged, perhaps even sunk.

Booms can be moved aside by a small boat kept nearby for that purpose. It takes six minutes (two Tactical Turns) to move a boom out of the way and another six minutes to replace it.

A boom may be specified in the scenario or it may be agreed on by both players as part of the game's setup. It will have a damage point rating, and is treated as a narrow aspect size class E target.

If a ship attempts to pass through an opening blocked by a boom, it automatically suffers a collision with the boom. Resolve the damage as a normal collision, using section 3.4.2.

A boom cannot be destroyed by gun or torpedo fire or "conventional" attacks. It can be destroyed in a game by ramming (the ship autmatically hits because boom is stationary). The chance of it being destroyed is equal to the damage it takes in a Tactical Turn divided by the damage points remaining after the Turn's damage is applied.

Example: A Royal Navy *Bristol*-class light cruiser rams a 150 damage point, armor class 4 boom, guarding the entrance to a German-held harbor. The *Bristol* has a belt armor rating of 2 and is moving at 20 knots, which becomes the relative speed.

The player controlling the boom rolls D6 and gets a three, or 20%. The relative speed of the two units adds 20% to this, making it 40%. Another 2% is added for the armor class difference between the boom and the light cruiser, so the boom inflicts 42% of its damage point rating on the *Bristol*, or 63 points, halved for being a bow-on ram to 32 points.

The *Bristol's* player rolls a four, or 25%, increased by the relative speed to 45%, but reduced by 2% for the difference in armor ratings by to 43%. The *Bristol* inflicts 62 damage points (0.43 x 144 = 62) on the boom. The chance of the boom being destroyed is then 62/(150-62) = 62/88 or 70%. The Royal Navy player rolls D100, and gets a 54, successfully destroying the obstacle.

Nets are similar to booms, but are suspended underwater. Made of woven wire cables, they are very strong and block the passage of submarines by fouling the sub's control surfaces and screws. They also serve as a means of detecting a sub as it attempts to penetrate the harbor's defenses. Even if the submarine gets through the net, the defenders are now alerted to the sub's presence.

Like booms, nets have a damage point rating. A typical net section will usually have 10 to 15 damage points. A heavy net, like those used to secure a major harbor, could be as high as 20 to 25 damage points. They can be rammed like booms, but even if the ramming sub successfully destroys (pierces) the net, there is a 50% chance of the net fouling the ship's screws or control surfaces, causing it to stop immediately. If the submarine does not pierce the net, the probability of fouling is 75%. A submarine that is fouled requires D6 Intermediate Turns to free itself. Antisubmarine nets only affect submarines in the Shallow Depth band.

Submarines on the surface are unaffected by submerged nets (without a boom). Submarines at Intermediate Depth are unaffected by nets, because they only extend through the Shallow depth band.

Example: A German *U5* class submarine attempts to penetrate one of the indicator nets laid by the Dover Patrol between England and France. The net has 12 damage points and the *U5* has 11 damage points. The *U5* attempts to penetrate the net by ramming it at a speed of 7 knots.

The submarine player rolls a five, or 30%, increased by the relative speed to 37%. The *U5* inflicts 4 damage points (0.37 x 11 = 4) on the net. The chance of the net being pierced is then 4/(12-4) = 4/8 or 50%. The German player rolls D100 and gets a 42, thus successfully piercing the net. The German rolls D100 again to check for fouling and rolls an 88, which indicates that no fouling occurs and the submarine can continue its movement. If the net is being watched, however, the defenders are still alerted ("I say, George, we have a nibble. What were you using for bait?")

During WW I, many antisubmarine nets also had mines or flares woven onto them. The mines were spaced at 100 to 200 yd intervals and like the net they were attached to, only affected submarines at Shallow Depth. Net mines therefore, get a minefield attack as well as the

possibility of fouling. See section 11.2.4 Mine Nets to resolve these attacks.

Nets are treated like booms for the purposes of being moved and may be used by themselves, or in combination with a boom.

Nets and booms can also be destroyed by infiltration teams or parties landed by boat. The chance of their success will depend on the scenario and will described in the special rules section of the scenario description.

3.5.3 Steaming In Marked Channels. Narrow channels may lead ships in and out of harbor, past underwater hazards, or be the result of minesweepers clearing a path through a minefield. In all cases, the lane represents safe passage for a ship, and leaving the channel puts the vessel at great risk.

Channels and the hazards surrounding them will be described as part of a scenario. For example, the map of a harbor may show a defensive minefield with a single channel in and out. If the game is refereed, the referee will determine what waters are restricted. In some cases the existence of a channel may not be known to both sides.

If a ship moving through a channel uses evasive maneuvering (3.1.4) to reduce its chance of being hit, it risks leaving the safe channel area and running afoul of whatever hazard exists. Roll a D10. If the die roll is less than the ship's speed divided by 3 (round down) the ship has left the channel; i.e., it is now in the minefield and subject to attack or has the possibility of running aground.

Example: A destroyer approaches a hostile beach through the swept channel of a minefield. It is fired on by a shore battery and the next turn it elects to steer evasively. Its speed is 14 knots. Dividing by three and rounding down, the chance of leaving the channel is 4 or less on a D10.

A ship that suffers a Bridge or Rudder critical may be forced leave the channel as a direct result - circling to the left or right. Even if the damage result allows a ship to continue on its ordered course, it has a chance equal to its speed divided by 3 on D10 of veering off course enough to leave the channel.

A ship steaming in a channel at night or in other conditions where the visibility is 10% or less at more than 7 knots has the same chance of D10 rolled against speed/3 of leaving the channel. The visibility restriction may be caused by weather or smoke.

If a ship leaves the channel and enters shoal water or a minefield, refer to the appropriate rules section to find out what happens.

3.6 Towing. A damaged ship may need to be towed to port or at least out of a threatened area. Over the long term, ships are too valuable to abandon, since a damaged ship can be repaired much more cheaply and quickly than a replacement ship could be built.

Procedure: Ships may be towed by another ship one size class smaller than themselves. Thus, an armored cruiser (size class B) can tow a battleship (class A), but a light cruiser (size class C) cannot. A specialized towing vessel (an ocean going tug), has the equivalent towing capability of a size class C ship, and two tugs can combine their efforts to tow even the largest vessel.

The vessel to be towed must not have any major or severe fire or flooding criticals. It must spend five Tactical Turns preparing to be towed, which involves rigging towing hawsers and other specialized equipment on the forecastle.

The towing vessel must also spend three Tactical Turns (nine minutes) preparing its towing gear on the fantail, and must not suffer from more than one engineering critical hit, or have an uncorrected rudder critical hit.

On the turn the towing line is to be passed, the two ships must both be dead in the water (speed zero), and within 50 yards of each other (miniatures or counters touching). The two ship's bows must be pointed in the same direction, with the towing ship forward of the towed ship.

During the approach, as long as the towing ship's speed remains below 10 knots inside the 250-yard limit, there is no risk of collision.

In order to successfully rig the tow, the towing player must roll D10 subtract the sea state and get a three or better. This is rolled in the Plotting Phase of each Tactical Turn until the hookup is successfully made. The towing vessel must remain stationary, adjacent to the ship to be towed until the hookup is made.

Once under tow, acceleration is limited to one knot every three Tactical Turns up to a maximum of five knots.

There is a chance of the tow line parting, (see Tow Parting Table) based on the ships' speed and the sea state. This chance of parting should be rolled every 30-minute Intermediate Turn on D100. Weather effects (section 3.1.5) prevent tugs from being used in Sea State 7 and above.

The maximum turn rate while towing is 5° per three-minute Tactical Turn. Course changes of greater than 5° per Tactical Turn will automatically part the tow line.

TOW PARTING TABLE

Chance on D100 of the Towline parting

	Sea State			
Speed	0-1	2-3	4-5	6
1	01	02	05	10
2	01	03	10	20
3	01	04	15	30
4	02	05	20	40
5	03	06	25	50

Although a tow is time-consuming to rig, it can be broken by declaring it in the Plotting Phase, and moving the ships independently in the following Movement Phase. Remember the movement capabilities of each ship, and their acceleration limits.

3.7 Getting Underway. This is normally not done during a sea fight, but ships surprised in harbor may be forced to get underway quickly.

Ships in port will have some part of their engineering plant shut down, to allow the crew to rest and perform maintenance. Steam-powered ships can be at one of three readiness levels.

The first and lowest level is called "cold iron." In this case a ship is moored to a pier, its boilers completely shut down. Electrical power and other housekeeping services are provided from shore. It takes some time to light a boiler, build up steam, and "warm up" the propulsion plant. If the process is pushed too much, it will wreck the engines.

If the crew are not even at their stations, it will take more time before the ship is "ready to answer all bells."

Ships will sometimes have one boiler lit off to provide power while the other boilers have "warm water" but are not producing steam. This is called "inport steaming" and ships in this condition significantly reduce the amount of time needed to get underway.

Finally, ships that are moored to a buoy or anchored will have their engineering plant fully operational. This is a safety precaution, since if the mooring chain or anchor chain parts, the ship would be adrift.

Times to get underway from cold iron are shown on the underway times table. If the ship is at inport steaming, roll on the table, but halve the resulting time.

Diesel propulsion plants are simpler, but also require some time for preparation, and to get the crews on station.

It will take different amounts of time for ships to get underway, depending on their size and propulsion plant type.

UNDERWAY TIMES TABLE

Diesel		Steam	
Size Class	Minutes	Size Class	Minutes
A & B	NA	A & B	4D6 x 10
C	NA	C & D	3D6 x 10
D & E	2D6 x 5	E	3D6/2 x 10

The order to get underway can be issued at the same time as the order to go to General Quarters.

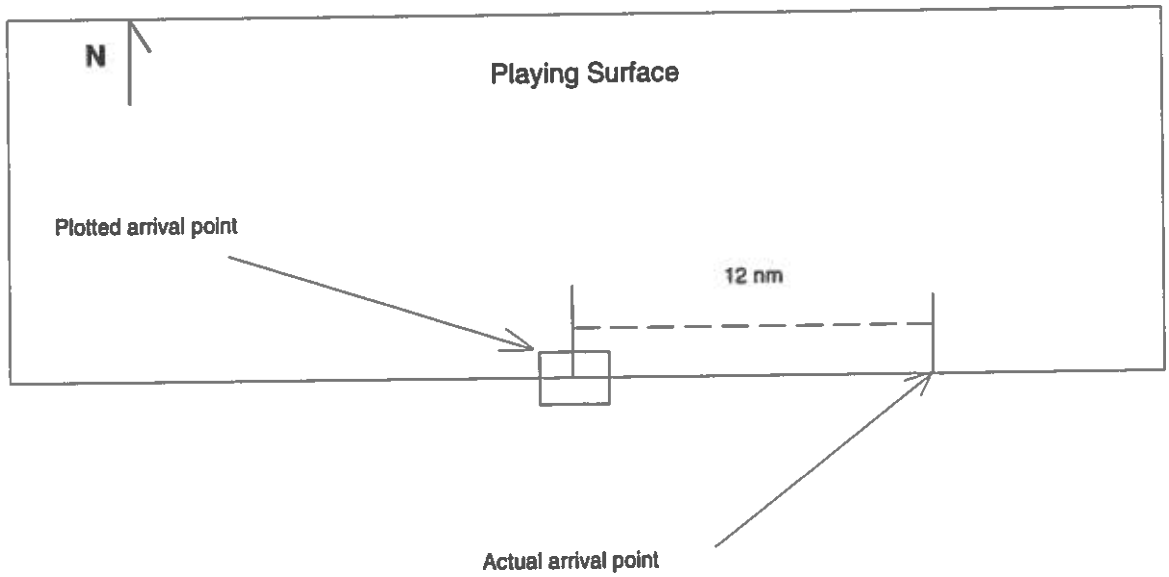
3.8 Arrival of Units in the Battle Area. Unless the battle involves only a few units, they will probably not all fit on the playing surface at the same time, or be involved in the battle at the same time. Some distant units may be ordered to attack, but will take time to reach the scene.

If both sides' units will not all fit on the playing surface at the start of the game, the two sides must plot their own positions and course and speed (and those of the enemy that are known) on graph paper. As the new units move into the battle area, the controlling player should notify the enemy player when an arriving unit is eligible for detection. Even if it is not present on the playing surface, if its position allows it to be detected, the enemy player must be given an opportunity to detect it.

3.8.1 Errors in Navigation. As new units arrive on the scene of battle, the commander of the arrving force rolls for the magnitude of navigation error his units have accumulated. During WW I, it was not uncommon for ships to be 10 to 15 nm off where they thought they should be. To simulate this uncertainty, the arriving force's controlling player rolls a D6 for the direction of the error and 3D6 for the magnitude.

On the direction roll, a roll of 1-2 means that the force arrives on the playing surface to the right of where their plot says they should be. A roll of 5-6 means the force is to the left of their plot. Once the direction is known, roll 3D6-6 for the distance in nm the force is off their planned positon.

Example: A force of four battlecruisers arrive at the scene of a major fleet engagement already in progess. The plot maintained by the commander of the battlecruiser division shows that they will come on to the playing surface at about the mid-way point of southern edge. Rolling D6 and getting a 2 indicates that the formation is to the right of their plotted entry point. Rolling 3D6, with the results of 4, 5, and 3, gives the magnitude of the error as 6 nm. Thus, the battlecruiser division will actually arrive 6 nm east of his plotted position.



British airship R33

Chapter Four - Aircraft Movement

Planes move at greater speeds than ships and subs and are much more maneuverable. There are two air Movement Phases in a standard 3-minute Tactical Turn.

Plotted aircraft movement should include speed and direction, altitude, changes, and turns. Aircraft may arrive in, or move out of, the battle area and still be in the game. Record the positions of off-board air units on paper.

4.0.1 Stepped Aircraft Movement. Aircraft rarely fly in a straight line for three minutes in combat. Pilots can react and turn much more quickly than ships, and in a fast-moving aircraft, three minutes is a long time.

If an aircraft player wishes, he may "step" though his movement, dividing his three-minute Tactical turn into as many as six 30-second rounds, three in the Movement Phase and three in the Second Air Movement Phase. This allows a player to react to developing situations, but it *will* slow down the game. Use it sparingly, or experiment first, to understand its effects.

At the beginning of a turn, an aircraft player may declare that he is stepping through his turn. Other aircraft, especially enemy aircraft that might interact with it, must also step through their movement, but planes that will not interact with the stepping player may move normally.

Each stepping aircraft player turns his plane as desired, then moves a distance equal to 30 seconds of flight. This is done three times during the Movement Phase. Once all planes have stepped through the movement, play proceeds to the Planned Fire Phase and then the Detection Phase. In the Second Air Movement Phase, the aircraft players execute another 3 steps.

During stepped movement a plane can turn any amount (up to 180°) each step, unless it is in formation. Formations turn one-sixth of the maximum turn for the formation (or 20° times Maneuver Rating divided by six).

During stepped movement planes are limited to one-sixth of the climb or dive rates listed in the altitude change table.

An aircraft may declare a dogfight during stepped movement as well as normal movement, provided all the aircraft involved have completed the same step.

4.0.2. Wind Effects on Aircraft Movement. When an aircraft of any type takes off, it enters a fluid medium, which moves as the aircraft moves through it. In most cases, the movement can be compensated for without worrying about it in the game, but if aircraft speeds are slow, or the wind speed is high, it can significantly affect a plane's range, or even its ability to move in a particular direction.

If the wind speed is one-quarter or more of an aircraft's speed, the aircraft player must compensate for the wind in his movement orders. This may result in advantages as well as disadvantages.

Example 1: A plane flying north at 100 knots encounters a 30-knot head wind. Effectively, its ground speed is 70 knots.

Example 2: The plane commander cannot fulfil his mission in time if he has only a 70-knot ground speed. He must increase his air speed to 130 knots (his maximum speed), which he is able to do, but means that he risks possible engine failure (see 4.2)

Example 3: An airship with a maximum speed of 70 knots is escorting a convoy. The wind is from the northeast at 20 knots. If the airship places itself over the center of the convoy, it can move to the northeast at 50 knots. By stationing itself on the northeast side of the convoy, it shortens travel time to a threat on that side, and it can move to the southeast, with the wind, at 90 knots.

4.1 Dogfights. Aircraft may be plotted as participating in close-in air combat; the plotted order is "dogfight." If an air unit is plotted as dogfighting, and the other aircraft is not dogfighting as well, then the dogfighting aircraft unit is allowed to know what the other plane's movement orders are for the next movement phase. Possible candidates for this are bomber formations, or any air unit which for any reason, does not choose to maneuver as well.

4.2 Speeds. All aircraft have two throttle settings, or general speeds: Cruise or Full Power. These correspond to engine power settings made by the pilot. The exact speed in knots will vary with the load carried and of course the aircraft type. These speeds are listed in Annex B for each aircraft. A player can change a plane's speed by ordering it in the Plotting Phase. Speed changes take effect immediately, unless the planes are moving in 30-second air combat rounds. In this case the speed change takes place in the following step.

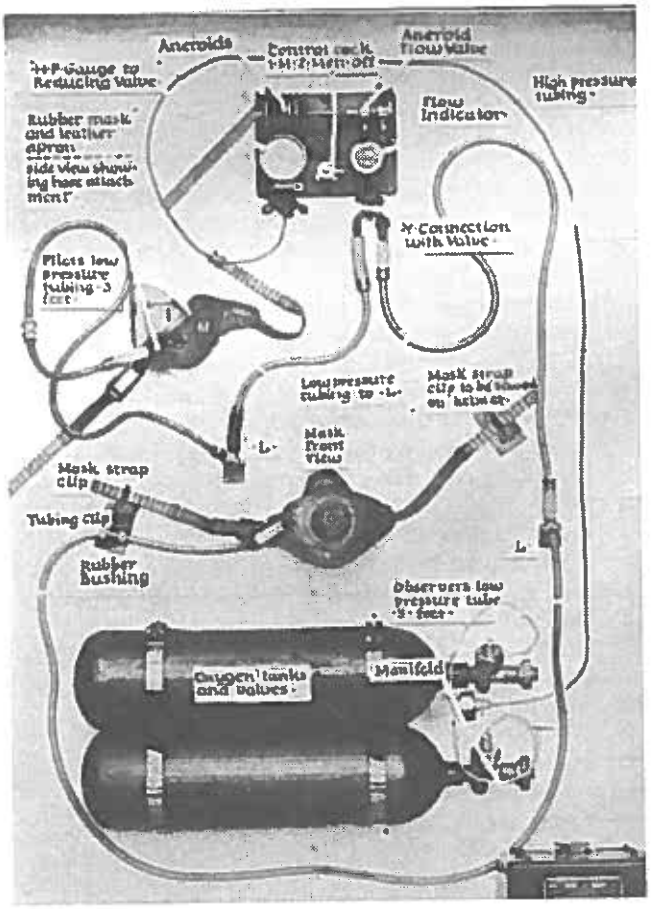
A plane may fly slower than the maximum speed for that throttle setting, but in the game this will not affect its range or endurance. For example, an aircraft that can cruise at 100 knots can also cruise at 90 knots. However, there is no change in the fuel consumption rate.

Planes will spend 95% of their time in flight at cruise speed. This is usually 70 - 80% of full power, and is the best setting for fuel consumption. Full power will be used to take off, climb quickly, during combat, and to escape an opponent. Full power burns more fuel per minute than cruise speed, but this is not too important in calculating range, since full power cannot be used for more than a few minutes at a time. Early 1900s metallurgy, manufacturing tolerances, and design meant that if the engine was run at 100% for too long, it would overheat, parts would fail, or it might even catch on fire from a fuel leak.

Each Tactical Turn that a plane spends at full power, it has a 5% chance of suffering an engine failure. This failure is an effective "kill." If the plane is in combat, roll every 30 seconds. The chance in one 30-second phase is 1%, which over six turns, is equal to 5%.

4.3 Course Changes and Turning. A single plane may change course by any amount in an aircraft Movement Phase.

Aircrew Breathing Mask (US Dept of War)



Aircrew Breathing Mask System (US Dept of War)

4.4 Altitudes and Altitude Changes. Aircraft can be at one of three altitude levels: Very Low, Low, Medium. The Altitude Bands and Changes Table shows the boundaries of the various altitude levels. Planes should record their exact altitude (normally in hundreds of meters). Aircraft can change altitude by climbing or descending. The Altitude Change Table shows the rate of climb and dive allowed for various types of aircraft.

Speeds when changing Altitude: Aircraft climbing more than 50% of maximum climb rate cannot accelerate at the same time. Planes diving more than 50% of the maximum dive rate can double their acceleration. They can also increase their speed over the normal maximum. The amount of increase is shown in the Max Dive Speed column of the Altitude Bands and Changes Table.

Minimum speeds: Heavier-than-air craft must move at least 20% of their maximum speed through the air.

4.4.1 Very Low Altitude. This altitude band is from sea level to 30 meters high. An aircraft flying this low is literally skimming the sea surface. Torpedo bombers may operate at this altitude when making attack runs. Aircraft risk colliding with ships and terrain if they approach within 250 yds (see section 3.4).

Altitude Bands and Changes

FG&DN Altitude Band	Meters above S/L	Feet above S/L	Rate of Climb =Man Rating x per 30 sec	Rate of Climb =Man Rating x per 3 min	Rate of Descent =Man Rating x per 30 sec	Rate of Descent =Man Rating x per 3 min	Max Dive Speed
Med II	5001-7500	16405-24606	x10 m	x60 m	20 m	120 m	1.33 Lvl Speed
Med I	2001-5000	6563-16404	x20 m	x120 m	40 m	240 m	1.33 Lvl Speed
Low II	1001-2000	3049-6562	x25 m	x150 m	50 m	300 m	1.33 Lvl Speed
Low I	101-1000	329-3048	x40 m	x260 m	80 m	520 m	1.33 Lvl Speed
Terrain-Following	31-100	99-328	Over land only, climb and dive same as Low I				
Very Low	0-30	0-98	Over water only, climb and dive same as Low I				

Example 1: A Sopwith Camel has a lightly loaded Maneuver rating of 4.0. In a three-minute Tactical Turn at Low I altitude it can climb 260 x 4 = 1040 meters, or dive 520 x 4 = 2080 meters. In a 30-second phase, it can climb 160 m and dive 320 m.

Example 2: A Gotha III has a fully loaded maneuver rating of 0.5. In a three-minute Tactical Turn at Medium I altitude it can climb 120 x .5 = 60 meters, or dive 240 x .5 = 120 meters. In a 30-second phase, it can climb 10 m and dive 20 m.

4.4.2 Low Altitude. This altitude band is from 31 to 2,000 meters high.

4.4.3 Medium Altitude. This altitude band is from 2,001 to 7,500 meters high.

4.4.4 Altitude Changes Over Land. Flight over land is affected by natural and man-made terrain features. Except for mountain ranges, all terrain is in the Low altitude band. There is no Very Low altitude band over land, except for beaches or other special areas. Some terrain, such as mountains, may extend into the Medium altitude bands. They will be shown on the game map, and planes must fly over or around them. Failure to do so results in a crash.

4.4.5 Nap-of-the-Earth Flight: Planes wishing to use terrain to conceal their movements must use Nap-of-the-Earth (NOE) flight. This consists of flying between 60 and 100 meters above ground level (AGL), following the terrain contours. Similar to flying at Very Low over the water, this is very hazardous and requires the pilot's full attention. Although the plane is moving in a straight line, it is constantly maneuvering to stay close to the ground. The plane is considered to be in the Low altitude band for speed considerations.

4.5 Flight Operations from Ships. Aircraft carriers in WW I differed radically as navies explored the best way to take aircraft with the fleet.

4.5.1 Seaplane Carriers. These ships carry floatplanes which are lowered into the water by cranes. Floatplanes can also be recovered the same way. To launch or recover floatplanes, the carrier must be dead in the water. It takes two Tactical Turns to lower a seaplane into the water. After that it takes off normally.

4.5.2. Flying-Off decks. These occupy the front of a ship only, and can be used to launch landplanes or floatplanes while the ship is moving.

Ships with fixed flying-off decks must steam directly into the wind the Tactical Turn they launch. The ship's speed plus the wind speed ("wind over the deck") must be at least 30 knots (see Annex K, Environment). Lightly loaded aircraft can be launched with a wind over the deck of 20 knots. Three planes can be launched each Tactical Turn. A flying-off deck must be free of all critical hits to allow aircraft launch.

Ships with flying-off decks mounted on turret platforms can launch provided the ship is steaming within 45° of the true wind and a speed of 30 knots or more over the deck.

4.5.3 Full-Length Flight Decks. A deck extending the length of the ship allow aircraft to land safely as well as takeoff. It also allows for more efficient aircraft handing. To land or launch aircraft, the ship must steam directly into the wind. The ship's speed plus the wind speed ("wind over the deck") must be at least 30 knots (see Annex K, Environment). Lightly loaded aircraft can be launched with a wind over the deck of 20 knots.

Carriers have three modes of operation: They are either landing aircraft, launching aircraft, or respotting the deck. They can only do one of these at a time.

4.5.3.1 Landing. During landing operations, as each plane landed, it was moved forward and struck below, using the forward elevator. This took time, one Tactical Turn per plane. It was also risky, even in clear weather. Aircraft frequently had accidents, which if they did not injure the pilot, at least bent the plane.

Planes should be ordered to land in the Plotting Phase. Landing aircraft must be at Low Altitude and within 2 kyds of the ship at the start of the Movement Phase in which they are plotted to land. This is called being "in the pattern" and once a plane reaches this point, it stays in the pattern until recovery. Its exact movements do not have to be tracked.

As each plane lands, roll D100. The chance of a successful landing is equal to the visibility or 90%, whichever is less.

If a plane has been in combat, even if it was not "officially" hit, subtract 10%. This represent slightly damaged aircraft or wounded pilots that fail to bring their planes aboard safely. Aircraft that are reconstructed "kills," in other words, with damage sufficient to force them to leave combat immediately, should subtract 20% from the chance of a successful landing.

Note: Historically, even normal operations depleted a carrier's aircraft complement through operational accidents. Battle-damaged aircraft were sometimes ordered to ditch alongside a friendly ship rather than risk fouling the flight deck.

If a large number of planes must be landed, the probability table on the last page of the Data Annex can be used to speed play by figuring the average number of aircraft that crash.

If a plane does crash, treat it as an aircraft critical hit (section 8.2.1).

Example: A Sopwith Pup attempts to land on *Argus* in 75% visibility. The chance of landing successfully is 75%. The player rolls a 56 and lands safely. The weather clears later, improving to 100%. A second plane attempts to land and rolls an 95. It crashes and is lost.

Another plane attempts to land in 100% visibility. It has been in combat, so 10% must be subtracted from the chance to safely land. The player must roll 90% or less.

If an aircraft crashes on landing, the deck is blocked ("fouled") for D6 Tactical Turns. If the crash results in a fire, the fire must be extinguished before the D6 roll is made and the deck can be cleared. No plane may land or take off until the deck is cleared. Subtract one from the die roll for the chance of reducing the fire, since a crash crew was always standing by.

4.5.3.2 Launch. A carrier with a full-length flight deck can launch nine planes per Tactical Turn. The deck must be clear of critical hits forward to launch aircraft.

During launch, the carrier's flight deck aft was packed with aircraft, loaded with ordnance and fuel. Until its aircraft were aloft, the carrier was incredibly vulnerable to attack. If a carrier is attacked during launch operations, each flight deck critical hit midships or aft also destroys D6 aircraft, with the possibility of fire or ordnance detonation as described in section 8.2.1. Any flight deck critical hit received during launch operations interrupts the launch.

No planes can land on a carrier in launch mode until all aircraft have taken off or they have been respotted for landing. If the launch is interrupted before it is finished, the unlaunched aircraft must be respotted before any landings can occur.

After launch (either in the Movement Phase or the Second Air Movement Phase), the aircraft is flying at 25% of maximum speed at 100 meters altitude into the wind.

The First Carriers

Naval officers were quick to see the potential of aircraft - for scouting, for intercepting the other side's aerial scouts, and for attacking ships and shore targets. The aircraft of 1914, primitive and unreliable, were still so useful that the idea of taking them to sea was pursued energetically.

The first aircraft carriers were not carriers as we describe them today. The early "carriers" did just that, just carried floatplanes. To launch their planes, the ships had to stop and lower them into the water using cranes. They would also have to stop to recover planes after they landed on the water.

While seaplanes gave flexibility for operating aboard ship, the added weight and drag of the floats reduced the performance of the planes themselves. This was critical for British fighters who were trying to catch the Zeppelins scouting for the High Seas Fleet.

Landplanes could take off from a "flying-off deck," nothing more than a planked-over forecastle. With the low takeoff speed of WW I aircraft, catapults were not required. Floatplanes could also take off from the deck, using a trolley under the floats that fell away after takeoff. To land, though, landplanes had to ditch and they were fitted with a floatation bag. At the low landing speeds of WW I aircraft, this was only risky, not hazardous, but it still involved the operational loss of a perfectly good aircraft. Even if the ditched aircraft was recovered, it would require repairs before it could be used again.

The flying-off deck could only be used for takeoffs. Even the slow, agile planes of WW I could not use a deck that only covered the forecastle. After *Furious* was fitted with a flying-off deck, Commander E.H. Dunning , RN tried. On 2 August 1917, in excellent conditions, he made it, neatly sideslipping around the superstructure and safely touching down. He tried it again on August 7th, damaging a plane on the first landing, then he tried again with a new plane. As he came in to land he attempted to go around, but his engine stalled and his plane went over the side. By the time rescuers had reached his plane, he had drowned. Commander Dunning was a veteran pilot and his landing success rate in ideal conditions was only 33%. The Royal Navy never tried again.

The logical step was to fit a "landing-on deck" to the stern of a ship. With the ship steaming at speed, combined with the wind, it should have been simple to bring a plane aboard. They discovered, though, that the turbulence caused by the ship's superstructure and the stack gases was too severe for safe landing.

The real answer was a full-length flight deck, which first appeared on HMS *Argus* in late 1917. This allowed landplanes to safely take off and land, although not at the same time. The basic configuration of the aircraft carrier was established and exists virtually unchanged at the beginning of the 21st Century.

4.5.3.3 Respot. To ready the deck for launching a strike or recovering aircraft, it must be respotted. This involves moving spare aircraft down into the hangar or to an unused section of the flight deck. Respotting for a launch could take a lot longer than for landing, but neither launch nor landing could be performed until the respotting was finished.

It takes 6+D6 Tactical Turns to respot a carrier's deck for landing.

The time needed to respot for takeoff depends on the number of planes to be launched. Each plane takes one Tactical Turn, plus 2 Tactical Turns for each group of 12 planes or less. Aircraft can be fueled and armed while the deck is respotted.

Example: A carrier intends to launch a 10-plane strike. It will take 10+2, or 12 Tactical Turns to ready the aircraft for launch. A strike of 14 planes would take 14+2 (one group of 12) + 2 (one group of two), or 18 Tactical Turns to prepare for takeoff.

Efficient respotting requires at least two functioning elevators. If only one is available it takes twice as long. If a carrier has a third elevator reduce respot times by a third.

Carriers can launch planes during respot by stopping the process and launching the aircraft that are ready. In addition, it takes 2D6 minutes to clear the flight deck so that the aircraft can be launched.

4.5.4 Aircraft Lighters. In the Summer of 1918, a scheme to deal with the Zeppelin threat was hatched. It involved towing a small 40-foot barge behind a fast destroyer. With the destroyer at full speed and a decent wind, a fighter on the barge would be able to take off successfully. Tests proved the concept, and it was used on 10 August 1918, off the Dutch coast. After seaplanes already aloft sighted a Zeppelin, Flight Sub-Lt Stuart Culley took off and managed to shoot down the Zeppelin. He was awarded a DSO.

Destroyers or larger ships may tow a lighter carrying a Sopwith Camel. The lighter has no effect on the ship's speed, but doubles the deceleration rate and increases the ship's effective size for turning by one size class.

At Sea States of two or less, if the towing ship can pull the lighter at 30 knots or more, the fighter can safely take off. It must either land ashore or ditch at sea. Once the decision is made to launch the aircraft, the towing ship must stop for 15 minutes while the pilot and mechanics are transferred by boat to the lighter and the boat returns. The destroyer can then accelerate to full speed normally. The destroyer must steam directly into the wind, with the total of the destroyer's speed and the wind equaling 40 knots or more.

After launch, the towing ship must stop again to recover the mechanics, this taking another 15 minutes. After that, the ship can either abandon the lighter or bring it back for reuse.

If the Sea State rises to five or higher, the waves may swamp the barge. Roll D10+Sea State each Intermediate Turn. If the result is a 0 (a 10), the barge is swamped. The towing ship can cut the towline at any time, and there is no hazard to the ship if the barge is swamped.

4.6 Land-Based Takeoffs and Landings. Flight operations from airfields and runways are much easier than from a carrier flight deck. Aircraft can take off and land without having to respot, and the landing rates are greatly

increased. The only restriction on takeoffs and landings from a runway is that planes cannot take off and land on a runway in the same Tactical Turn.

Planes may take off from a runway at the rate of four per minute, halved for multi-engine aircraft. An airplane may land once every minute.

Increase landing times by 25% if the visibility is 10 nm or less. Increase landing times by 50% if the visibility is 5 nm or less.

Airfields (literally grass fields) allow planes to take off and land at the same time, up to twelve at a time.

(Optional Rule) The type of runway could greatly affect landings and takeoffs. Paved runways or those covered by steel matting could be used in almost any weather. Many airfields had grass or dirt strips. Grass was fine in dry weather, but could become muddy in heavy rain or hard to plow in snow. Dirt strips were even worse. They would blow dust when dry and become quagmires in the rain.

If the scenario calls for intermediate or heavier precipitation, halve the takeoff and landing rates for a grass strip, and quarter them for a dirt strip. Paved strips are unaffected. These modifiers are in addition to those for visibility.

4.7 Floatplanes and Catapults. Floatplanes were useful for search, light attack, and long-range gunfire. Some battleships, cruisers and some destroyers and submarines were equipped with float planes launched from pivot catapults. Catapults were usually located on the fantail, amidships or on turret tops and swung outboard for launching.

It takes 15 minutes (five Tactical Turns) to place a plane on the catapult. Other steps, such as arming or fueling, cannot take place while the plane is being moved. This can be done either before or after the plane is placed on the catapult. Floatplanes are readied for flight like any other aircraft.

Floatplanes cannot be fueled, armed, or launched in the Tactical Turn a ship's main battery is being fired.

At launch, the catapult must be able to train around to within 20° of the wind, which must be at least 30 knots, including the speed of the ship. Midships catapults have a P/S arc, aft catapults have an after arc, and forward catapults have a forward arc. Catapults mounted on top of gun turrets have the same arc as the turret.

In the Movement Phase after launch, the aircraft will be moving at 25% of maximum speed at 100 meters altitude into the wind.

To recover a floatplane, it must land in the water and taxi over to the ship at 15 knots. Recovery can only take place in Sea State 3 or less. When landing, players should consider the collision rules (section 3.4). The 250-yard danger zone applies to aircraft landing in the water.

The ship must stop (Dead in the Water). Once the two units are adjacent (distance zero), the ship begins hoisting it aboard. The entire process takes 15 minutes (five Tactical Turns). Only one plane may be recovered at a time.

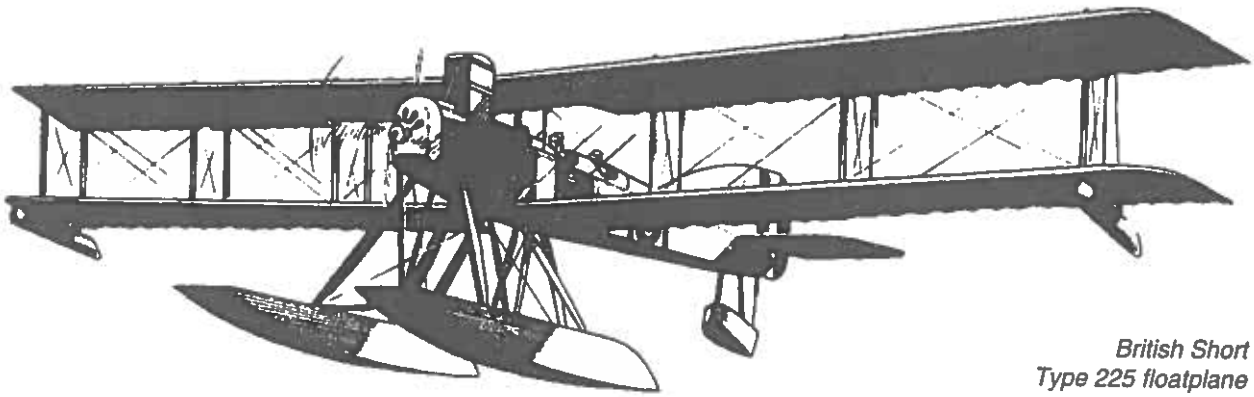
There are hazards associated with embarking planes on a surface ship. Filled with aviation gasoline as well as explosives, they were often launched at the beginning of a surface battle or simply jettisoned if there wasn't time to launch them, rather than risk a fire. Floatplanes can be damaged by enemy fire (see section 8.2.1 Aircraft Critical Hits) or even by their own ships' guns (see 6.1.7 Line of Fire Restrictions).

4.8 Flying Boats and Amphibians. Seaplanes, amphibians, and floatplanes can take off from the sea surface. On the turn of launch, the aircraft travels at 25% of its maximum speed into the wind. At the beginning of the next Tactical Turn, the plane is flying at 100 meters altitude at 25% of its maximum speed. There is a 20% chance of the seaplane crashing on takeoff for each Sea State above 3 for single-engine floatplanes and 4 for multi-engine amphibians and flying boats.

Example: A Felixstowe F.2A multi-engine floatplane will take off from open water in Sea State 6. The chance of it crashing is 40%. A single-engine Friedrichshafen FF.29 trying to take off would have a 60% chance of crashing on takeoff.

When landing, a seaplane must fly at 25% of its maximum speed at an altitude of 100 meters in the direction of the wind. At the end of the next Tactical Turn the seaplane has landed. The safe Sea State for landing on the sea surface is 2 except as modified by the Sea State Takeoff/Landing Table (section 4.4).

Any seaplane or aircraft equipped with floats sitting on the sea surface has a 10% chance of being swamped per Sea State above 3. A swamped aircraft sinks and is lost. This should be rolled in the Plotting Phase of every Tactical Turn that the plane is on the sea surface. Moored aircraft (either to a tender, buoy, or a pier) are exempt. Players should also remember that coastal waters, especially a lee shore, will be calmer than open ocean by one or two Sea



British Short Type 225 floatplane

States. The sheltering effect of a location will be described in the Environment Section of a scenario where it applies.

4.9 Effects of Sea State. Floatplanes can normally be launched safely from ships in Sea State 3 or less. There is a 30% chance per Sea State greater than 3 that the aircraft will crash into the water on takeoff. The safe Sea State can be increased by ship size as listed in the Sea State Takeoff/Landing Table.

Example: Barham is a size class A ship. She can safely launch a floatplane in Sea State 4. In Sea State 5, the floatplane would have a 30% chance of crashing while taking off.

SEA STATE TAKEOFF/LANDING TABLE

Ships: Aircraft may launch from or land on a ship safely in Sea State 3 or less.

If ship is Size class A	+1
If seaplane/amphibian is multi-engine	+1

Carrier flight operations are also affected by the Sea State. The chance of an operational accident (a plane crashing on landing) increases as the flight deck pitches and rolls.

Refer to the Sea State/Carrier Flight Operations Table. An "N" means that flight operations can be conducted normally. Using the optional rules, there is a 10% chance of a casualty on landing. A number represents the chance on D100 of an operational accident. A "-" means that landings are prohibited.

SEA STATE / CARRIER FLIGHT OPS TABLE

Sea State	Ship Size class A	B	C
1	N	N	N
2	N	N	N
3	N	05	10
4	05	10	20
5	10	20	-
6	-	-	-
7+	-	-	-

N = Normal flight operations allowed

- = Flight operations prohibited

Floatplanes and flying boats landing on the water have a 2% chance of crashing (suffering a mishap that makes them unflyable) up to Sea State 2. Above Sea State 2, refer to the Sea State Water Landing Table for the chance of a crash. For water landings at night, add 20% to the chance of a crash. Landings are prohibited at Sea State 6 and above.

SEA STATE WATER LANDING TABLE

Sea State	Single Engine	Multi-Engine
2	2%	2%
3	10%	5%
4	50%	30%
5	90%	80%
6	-	-

4.10 Ready Times. Aircraft must be prepared for flight before launch. Planes must be armed, fueled, and crewed to function.

An armed aircraft has bombs or other ordnance loaded on it. Aircraft which have no weaponry need not be armed. A fueled aircraft has its fuel tanks filled. An alerted aircraft has its basic preflight checks performed and its crew briefed. A crewed aircraft has its flight crew physically on board and prepared to operate the aircraft. Aircraft are normally in an uncrewed, unalerted, unfueled, unarmed condition. A ready aircraft is armed (if necessary), fueled, alerted, and crewed and is ready for launch in three minutes.

Arming, fueling, and alert operations may all be performed at the same time. They take 15 minutes each. They may also be performed while planes are being respotted on a carrier.

These times hold for groups of up to 12 aircraft. Each group of 12 aircraft takes another 15 minutes, so that a 24-plane strike takes half an hour to ready, a 36-plane strike 45 minutes, and so on.

4.11 Aircraft Endurance. Aircraft endurance in *FG&DN* is measured as time. For example, a Sopwith Camel has an endurance of 3 1/2 hours. Players should note the takeoff time of an aircraft or group of planes, and at that time calculate when they must land.

Although throttle setting affects an aircraft's fuel consumption rate, all endurance figures are given for cruise speed. WW I aircraft can spend very little time at full throttle because off the risk of engine failure.

A few aircraft during the Great War could be fitted with auxiliary internal fuel tanks. The effect of these on the plane's endurance will be listed in the remarks section for that plane in Annex B.

4.11.1 Mission Planning for Aircraft Formations. A group of aircraft uses the launch time of the first aircraft to determine the endurance. The first aircraft will have to loiter until the rest of the formation has joined up, and will have consumed the most fuel.

Example: A carrier with a full flight deck plans to launch a 20-plane strike. It will take 3 Tactical Turns to launch them (section 4.5.3.2). More importantly, it will take 20 Tactical Turns for them to land. The player must take into account the extra time aloft.

4.12 Barrage Balloons. Moored balloons were used for observation from the start of the Great War, but in 1916 they began to be used for air defense. Both London and Paris used balloons as part of their bomber defenses.

Quite simply, barrage balloons are large, tethered balloons that are deployed to heights up to a few thousand meters around some vital area. The balloons and the tethering cables were a collision hazard to low-flying aircraft, forcing them to maneuver and spoil their aim, or attack by another route where the defenses could be concentrated.

For example, a bridge might have half a dozen balloons tethered to it. Since aircraft must fly directly over the bridge to attack it with bombs, they must either accept the risk of collision or fly high enough to avoid the balloons with an increased chance of missing the target. Balloons might also be spread in a line down a valley, preventing aircraft from using the valley as a concealed approach route.

It takes three Tactical Turns to raise or lower a balloon.

In *FG&DN*, balloons may be deployed to protect a point target (like a building or a bridge), or they may be deployed in a line as a barrier to movement. They occupy the Very Low and Low altitude bands. Each aircraft which passes through a balloon field is subject to a chance of collision.

Each balloon in a square 300 meters on a side increases the chance of collision by 5%. The chance cannot be raised above 90%.

For example, a 150-meter-long bridge is defended by a field of three barrage balloons. This is the same as six balloons in 300 meters, so it has a 30% chance of entangling any plane which attacks the bridge (or just flies over it) at Low or Very Low Altitude.

Planes at Medium altitude or higher are unaffected by barrage balloons. Also, the balloons may only be deployed in winds of 30 knots or less. Above that, they must be reeled in to prevent the tethers from breaking.

Balloons are treated as Size Class D contacts. Sighting distances are of course reduced at night or in fog or rain (see 5.2.2.3).

Barrage balloons cannot be shot down unless the plane has incendiary ammunition, which appeared in 1917. Even the dozens of holes made by machine gun fire would not deflate a balloon quickly enough to affect a particular battle.

Although part of a nation's antiaircraft defenses, barrage balloons are included here because they affect a plane's movement.

4.13 Aircraft Maintenance. Any hit on an aircraft is considered enough to destroy it or force it to abort its mission. The following rules can be used to keep track of aircraft status from battle to battle in a campaign scenario.

Using the charts below, the players should keep track of aircraft availability. Even though a player will start with a given number of aircraft, this number will change as a result of combat operations with aircraft being destroyed and damaged.

Whenever aircraft are hit, note the fact so that after the battle the owning player can figure out whether the planes were destroyed or damaged. There is a 50% chance that a plane which was hit was actually killed, otherwise it was only damaged and may be able to return to base. If the damaged plane must fly over 50 nm to reach a friendly landing spot, it must roll again, with a 50% chance that it fails to make it back and crashes. At the referee's discretion, the enemy player may or may not know precisely how many hit planes were actually killed or how many damaged planes survived to reach base. As always, common sense is the ref's best guide.

Once home, the damaged aircraft must be repaired. There is also a chance that a safely returning, otherwise undamaged aircraft will develop some fault (gripe) that will prevent it from flying until it has been repaired. Once every 24 hours, roll D100 using the following table to see if aircraft have developed gripes or if they have been repaired.

AIRCRAFT MAINTENANCE TABLE

Event	First-Rank Country	Second-Rank Country
Undamaged aircraft developing gripe	30%	50%
Damaged aircraft being fully repaired	70%	60%

Countries may have first-rank or second-rank capabilities depending on the time and location.

4.14 Aircraft Availability. Due to limitations on aircraft use, a plane may fly only so many missions a day. The limiting factors are pilot fatigue and the minimum maintenance required to keep the airplane flying, as well as the time taken to actually perform the mission. Guidelines on possible combinations of missions are: Two long-duration missions including Combat Air Patrol (with no combat), attack missions over 100 nm (considering transit time), and patrol/reconnaissance missions, or four short-duration missions including Combat Air Patrol (with combat), intercept missions against hostile aircraft in the area, and attack missions under 100 nm.

4.15 Lighter-than-Air Craft. Airships were used from the beginning of World War I and performed well during that conflict. The Germans committed immense effort to their rigid Zeppelins, which not only bombed London but served as scouts for the High Seas Fleet. The bombing campaign of London in the Great War is still controversial, but there was no argument about their utility for naval reconnaissance.

The British concentrated on nonrigid airships, "blimps," which did yeoman work as coastal patrollers and convoy escorts. While the British made some late war experiments with rigids, they were unsuccessful and too late to take any part in the conflict.

Other nations, including Italy and France, used airships for antisubmarine patrol, and Russia and Japan had a few experimental types.

4.15.1 Airship Flight Control. Airships are controlled just like fixed-wing aircraft, with the following changes:

4.15.1.1 Airship Lift. Unlike a fixed-wing aircraft, which depends on its forward movement for lift, an airship can hover, motionless, and can even remain aloft if all of its engines fail. Its gas gives it lift, but it requires constant attention to keep the airship "trimmed." This is handled automatically in the game.

If the ship has more payload than lift, the ship is "heavy," and will descend until it reaches the ground or the trim is changed. If it has more lift than payload, it is "light" and will rise and will continue to do so until it reaches its operational ceiling, or until the trim is changed. If the ship is properly trimmed, it has "neutral" lift and will hover, motionless in still air.

Even if the air is still, the airship isn't. As it moves through the air an airship's envelope generates lift, called "dynamic" lift because it is caused by the ship's movement, and to distinguish it from "static" lift created by the gas.

Dynamic lift can be used to "hold down" a ship that is trimmed "light." It can even be used, to some extent, to compensate for the loss of gas due to battle damage.

Players can deliberately change an airship's trim by declaring it on the ship's log sheet during the Plotting Phase. Ballast can be dropped to lighten the trim, and gas can be vented to make the ship heavy. Players are allowed a maximum of one change of each type during a mission.

4.15.1.2 Airship Maneuver Ratings. All airships have a maneuver rating of 0.5.

4.15.1.3 Airship Speeds and Course Changes. Airships can change course up to 45° in a 30-second Air Combat Phase. They may change speeds up to 25% of their maximum speed each 30-second Air Combat Phase.

4.15.1.4 Airship Altitude Changes. Neutrally trimmed airships may change altitude as they choose up through their maximum ceiling. Their climb and dive rates are shown on the Altitude Bands and Changes Table (pg 4-2).

Airships which are heavy must descend at least 500 meters per Tactical Turn and they may descend up to 1000 meters per Tactical Turn. They cannot climb. Airships which are light must climb 500 meters per Tactical Turn and may climb up to 1000 m per Tactical Turn. They cannot descend.

4.15.1.5 Airship Ceilings. Airships neutrally trimmed may operate at any altitude level within the Low altitude band. If they wish to rise into the Medium altitude band, they must be trimmed "light."

4.15.2 Airship Ground Handling. Before launch, an airship must be brought out of its hangar. Similarly, after recovery (landing) it must be hangared as quickly as possible. Airships are handled on the ground either by gangs of men (manually) or with power-assisted machinery. In its most sophisticated form, handling lines are passed to powered trolleys that run on rails leading into the hangar. Manual handling works well enough for smaller ships, but can run into problems in high winds. Powered handling equipment can work in higher winds, but they also have their limits.

Manual ground handlers can walk an airship in or out of a hangar in 15 minutes for nonrigids, 30 minutes for rigid airships. The chance of the airship being damaged because of high winds is (Wind Speed in knots - 10) x 2%.

Powered ground handling gear can bring an airship in or out of a hangar in 9 minutes for nonrigids, 15 minutes for rigid airships. The chance of the airship being damaged because of high winds is (Wind Speed in knots - 15) x 2%.

Example: A ground crew is walking out a nonrigid airship in a 15-knot wind. The chance of the airship being damaged is (15-10) x 2% or 10%. If the wind speed is 10 knots or less, there is no chance for an accident.

When landed, airships must either be hangared or moored to a mast. Even if they have been trimmed "heavy" they are still subject to even light winds, and as was proved several times, are completely demolished by high winds or storms.

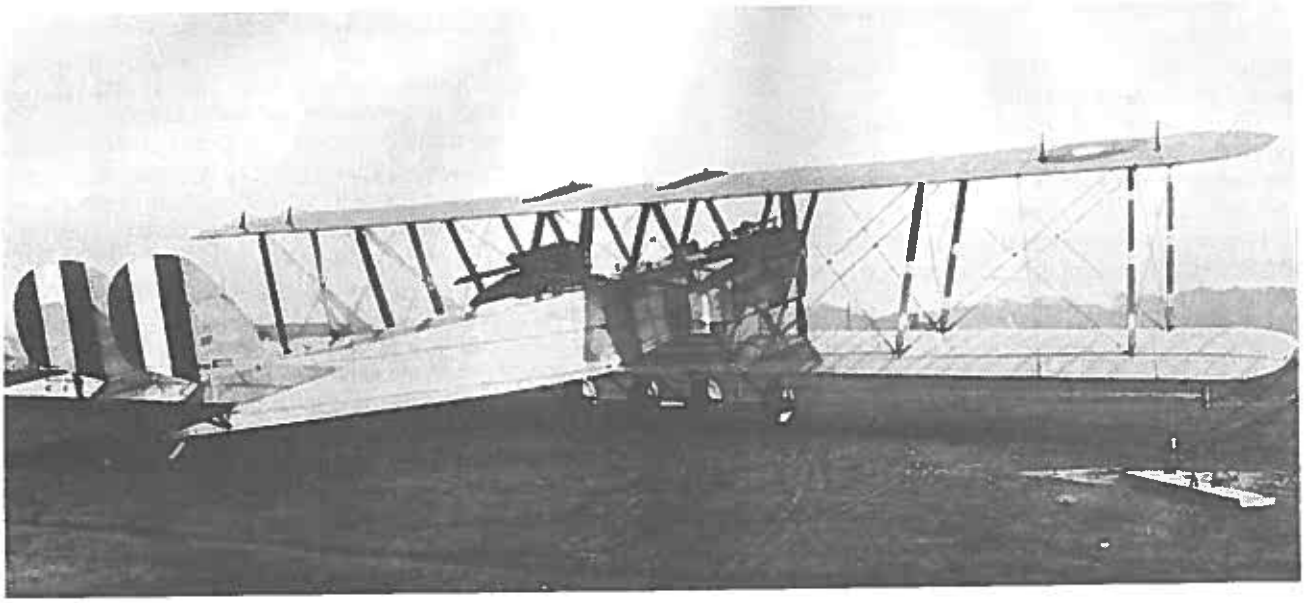
Airships could be moored at masts in all but the most violent storms. Early masts were "high", designed to allow the ship to fly while moored, but it took a great deal of effort to keep them at neutral trim through a day's temperature and wind changes.

4.15.3 Airship Launch. An airship is launched by ordering it in the plotting phase (The plotted order is "Up Ship!"). In the next Air Movement Phase the airship can begin to accelerate and climb, from a starting speed of zero and a starting altitude of zero. It always takes off into the wind, because of weathercocking.

4.15.4 Airship Recovery (Landing). Lighter-than-air craft had to be "landed" by flying them low and slow enough so that ground handlers could grasp the handling lines. Airships would fly into the wind, matching its speed so that it was stationary with respect to the ground, but the natural turbulence of the wind often created difficulties for the ground handlers.

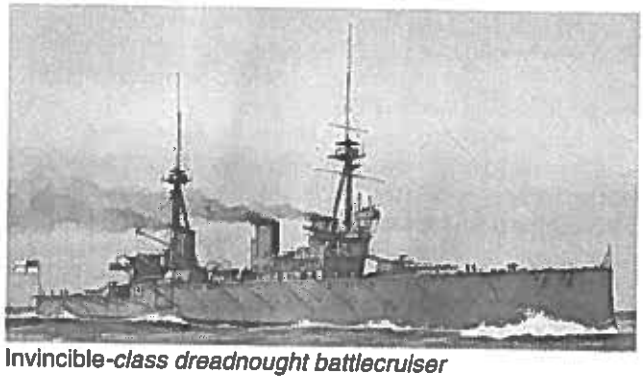
The time to recover an airship at a land base, either to a mast or by a ground handling crew, is D6 x (Wind Speed/10) Tactical Turns (round to the nearest whole number).

Example: An airship approaching in a 24-knot wind will need D6 x (24/10) Tactical Turns. If the player rolls a 3 on D6, then it will need 3 x 2.4 or 7.2 (rounded to 7) Tactical Turns to be recovered.



Glenn Martin Bomber

(US Dept of War)



Invincible-*class dreadnought battlecruiser*

Chapter Five - Detection

5.1 Sensor Basics. Sensors were extremely limited in capability and diversity during and after World War I. Even by 1924, most warships received virtually all of their information on potential targets from lookouts and optical range finders. Destroyers and other patrol craft usually had a crude sonar system for antisubmarine work, and a very few ships were equipped with an early radio direction-finding system.

Passive sensors detect energy (such as sound) given off by the potential contact. They will, at the very least, alert a ship to the presence of another vessel and could also give a direction, but not distance. An active sensor sends out energy, which is then reflected from the target back to the sensor. This provides the detecting ship with both direction and range to a target. Radar is a good example of an active sensor, as is active sonar. Throughout WW I, all sensors used by warships were passive.

5.1.1 Types of Sensors. Military sensors today use the full spectrum of electromagnetic and acoustic energy to gather information. This can be noise from a ship's screws (sound waves) or reflections of radar energy off a ship's hull (electromagnetic waves). In WW I, ship and submarine sensors were restricted to those portions of the electromagnetic and acoustic spectrums that the human senses were capable of seeing and hearing. This limitation, combined with the lack of electronics to amplify weak signals, resulted in restricted detection ranges to targets that were above or at the horizon.

5.1.2. Sharing Sensor Information. For game play purposes, information about a target's location gained in the Detection Phase of a Tactical Turn is known only by the detecting unit. In this early age of wireless, passing contact data on to other ships could take five minutes or more. While visual signalling was usually a little quicker, it was restricted to very short ranges.

Unlike *Command at Sea* and *Harpoon*[4], where these "command and control" issues are largely assumed to occur automatically, in *FG&DN* they must be accounted for. Section 2.6 Command and Control provides the procedures to prepare, send, and react to signals. The delays in sending and responding to signals determines the speed at which sensor information is passed.

5.2 Visual Detection. The human eye, aided and unaided, was the most widely used sensor in WW I.

5.2.1 Weather Effects. The distance someone can see is affected by the light (day or night) and the weather (haze, rain, or snow). The Sighting Conditions Table shows how range is reduced by various conditions.

5.2.1.1 Sighting Conditions. There are four categories: Clear Day, Clear Night, Day Precipitation, and Night Precipitation. Days and Clear Night are modified by weather, Clear Night is also modified by the phases of the moon. Night Precipitation is not modified by the moon since the clouds obscure it.

SIGHTING CONDITIONS TABLE

% Visibility	Clear Day Term	Clear Night Moon	Day Precip	Night Precip
100	Unlimited			
85	Unlimited			
75	V Clear			
60	V Clear			
50	Clear	Full		
40	Clear	3/4		
25	Lt Haze	1/2		
10	Haze/Lt Fog	1/4	Light	
5	Thick Fog	New	Interm	Light
2	Dense Fog		Heavy	Intm-Hvy

The sighting range will be provided in the scenario description, or can be determined based on the existing conditions. For example, on a clear night with a half moon (25% visibility), the average sighting distance to a darkened ship is 6-9 kyds. This will be reduced or increased by events during the battle. For example, gun flashes at night increase surface-to-surface and air-to-surface visibility by two tables (25% surface visibility would be increased to 50%). These modifiers are listed in the Visibility Variation Table on page 5-5.

Sighting ranges are further modified by a "sigma," or variation. This represents not only local variations in the sighting conditions, but differences in the performance of the lookouts themselves. The amount of variation changes depending on the sighting conditions and is shown at the top of each sighting range table (page 5-9). For example, with 100% surface visibility, the sigma is 6 kyds, meaning that the sighting range will actually vary by ±6 kyds from the value in the table. This is rolled on the Visibility Variation Table when a player attempts to detect something visually.

If a player is using more than one table (trying to detect both ships and aircraft in the same turn, for example) use the same D10 roll for the Sigma on both tables. The die roll represents the variation in sighting conditions immediately around the unit that Tactical Turn. It will vary from one turn to the next, and must be rerolled for each unit each turn it attempts detection.

The procedure for making a visual detection is described in section 5.2.2.

5.2.1.2 Sighting Through Clouds. Clouds block the visual line of sight from ships to aircraft, aircraft to ships, and aircraft to other aircraft. For the purposes of discussing visual detection, airships are considered to be included in the general term of aircraft. Annex K, Environment has rules for randomly generating cloud banks.

Clouds occur in layers, ranging from one to six thousand meters in thickness and from low to high altitude. Although sometimes solid (overcast), they can also be scattered (25% cloud coverage), intermittent (50%), and broken (75%).

Airplanes and airships actually in the clouds cannot see or be seen. Cloud layers block line of sight between aircraft on either side or between aircraft on one side and the sea surface. Spotting may still be possible, though, if the cloud cover is not solid overcast.

The chance of spotting through a cloud layer or spotting a plane in a cloud layer depends on the cloud coverage. Size or number of aircraft do not matter. A group of aircraft flying together is treated as a single object for spotting purposes.

A unit (ship or aircraft) searching visually for an aircraft in the clouds rolls D100, and if it rolls over the cloud coverage percentage, it is capable of seeing the aircraft. If the unit rolls the percentage of the cloud cover or less, the aircraft is hidden by the clouds and cannot be seen. A unit may search each three-minute Tactical Turn for planes within its sighting range and line of sight.

Sighting is mutual. A hole in the cloud layer works both ways. It will not last more than one Tactical Turn, though. The positions of the sighting units and the cloud layers are always changing.

Novice airplane pilots (see 7.6 Pilot Experience) have a 25% chance each Tactical Turn they are in the clouds of losing control, whether they are spotted or not. If they do lose control they are removed from play as crashed or lost and returned to base (Some may be reconstituted. See section 4.13).

Aircraft cannot maintain formation in a cloud bank.

Groups of aircraft (any number of aircraft greater than one flying together) risk collision every Tactical Turn that they are in a cloud layer, whether they are spotted or not. The risk is equal to 10% plus the number of aircraft in the group. If a hole in the clouds is found, the group can fly through the cloud layer safely.

Airplanes may deliberately hide in the clouds to evade attack or avoid detection. If a plane wants to hide in the clouds it may add 15% to the effective cloud coverage, since the pilot is assumed to be steering for the clouds and avoiding open spots. On the other hand, since he is concentrating on staying in the clouds, he only covers half his normal distance at that speed.

Airships are not able to deliberately hide because they are so huge in comparison to an airplane. Thus they do not receive the 15% bonus to their cloud cover spotting die roll.

To attack an enemy, a plane must see it during the Detection Phase. This can be done by moving out of the clouds in the First Aircraft Movement Phase, searching in the Detection Phase, then moving to attack in the Second Aircraft Movement Phase.

Example: A German Zeppelin is flying at 1,000 meters, 500 meters under an intermittent cloud bank 1,000 meters thick (1,500-2,500 meters altitude). A group of British SE.5a fighters is flying 1,000 meters above the cloud bank. Once they are in visual range, there is a 50% chance that the fighters will spot the Zeppelin. This chance is rolled in the Detection Phase of each Tactical Turn that they are in visual range.

The British formation sees the Zeppelin, and staying above the clouds, move so that they will approach it from behind. If they wish, the British fighters may even climb a little. When they are in position, they dive.

Timing the dive carefully, they spend one turn in the clear, gaining speed, then one turn in the cloud layer. They successfully avoid collisions in the clouds and emerge from the layer in the First Aircraft Movement Phase. The German Zeppelin is ahead, easily within visual range.

5.2.1.3 Squalls. Intense local rain or snow storms can block visibility. Visible from many miles away, they are a cluster of cumulus clouds with a solid curtain of rain or snow hanging beneath them. They can be present at any time of the day or night.

If squalls are present, represent them with circles of paper or plastic 6 kyds (3 nm) in diameter. Within the circle, because of heavy precipitation, the visibility will be either Intermediate (1-7 on D10) or Heavy precipitation values (8-0 on D10). Write the visibility distance on the circle, or use two different colors to represent the difference.

Normal squall activity can be represented by 3D6 circles. There will be 2D6 circles for light squalls, and 4D6 for heavy squall activity.

Scatter the circles randomly over the playing area (dropping them from about three feet over the table works well). As the game progresses, move them with the wind, at the same speed and in the same direction.

5.2.2 Making Detections. Players trying to see another unit must find out if it is in visual range. If it is, detection is automatic.

Visual sighting range depends on the sighting conditions (weather and light) and the type of units involved. There are four combinations of units, each with its own table: surface-to-surface, air-to surface, and air-to air and surface-to-air; the last two being rolled on the same table. Sighting ranges are either expressed in thousands of yards, or as a percentage of maximum. Maximum sighting range against a ship is 50 kyds (25 nm) for planes and 40 kyds (20 nm) for another ship.

Detection is checked from a unit to an enemy formation or group of units, not to each individual unit in a formation. The human eye, once cued to a location, can easily detect nearby units, and sighting conditions to each unit in the formation are usually identical.

Formations of aircraft are seen at twice the range of a single plane. If one plane is spotted, all planes in the formation within sighting range are spotted. For ship formations, test detection to the nearest ship of a formation. If it is spotted, all the ships within sighting range are seen. This may be all of the formation, or just part of it.

5.2.2.1 Sighting from Ships. The farthest sighting range for a ship is affected by its "height of eye," the distance of the observer above the water. The higher the observer, the greater the visual horizon.

This horizon is reduced by the sighting conditions to give the effective range in the existing sighting conditions. The Surface-to-Surface Sighting Range Table (page 5-4) includes the modified horizon distances.

In the Detection Phase of a Tactical Turn, when a player wants to have one ship or group of ships try to see another ship or group of ships, they should first find the maximum line of sight on the appropriate Surface-to-Surface Sighting Range Table for the existing conditions, then roll D10 for the variation and apply it to that sighting range.

Example: A battleship (size class A) attempts to see an armored cruiser (size class B) on a clear night with a half moon (25% visibility). On the Surface-to-Surface table for 25% visibility sighting conditions, base range between

two units of that size is 9,500 yds. The sigma for 25% visibility is ±2 kyds. Rolling D10 on the 2 kyd line, the player gets a 2, or -1 kyds, so the maximum range that the battleship can see the cruiser in that Tactical Turn is 8,500 yards. If the actual range is less than or equal to this, the battleship can see the armored cruiser and any other size class B ship or larger inside that radius.

If the armored cruiser was firing, increase the visibility by two tables (from 25% to 50%). This changes the base range from 9.5 kyds to 19.0 kyds and the sigma from ±2 to ±3 kyds.

5.2.2.2 Sighting from Aircraft to the Surface. Observers in planes or airships usually see a ship's wake or smoke before they detect the ship itself. Use the row on the Air-to-Surface Table for the sighting conditions and roll the D10 for the sigma that Tactical Turn. Add or subtract it from the range for the size class of the ship the aircraft is attempting to spot. If the range to the ship is less than or equal to the modified range, the aircraft sees it.

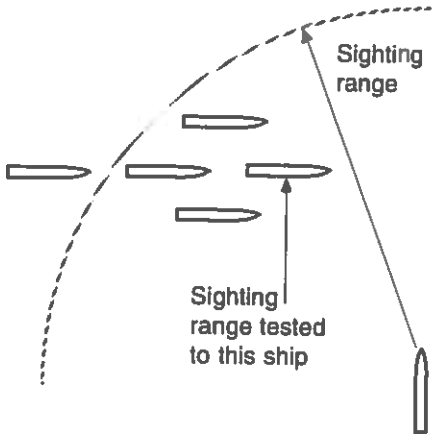
Example: A British seaplane attempts to spot a battlecruiser in 75% visibility conditions. The base range is 37.5 kyds for a size class A ship, and the sigma is ±8 kyds. Rolling on the Visibility Variation Table, the player gets a 9, or +6 kyds. The battlecruiser can actually be seen out to 43.5 kyds. If the seaplane's player wants to count the other ships in the formation, he must apply the same sigma to the other ships in the formation. Armored cruisers (size class B) could be seen out to 40.5 kyds (34.5 kyds plus 6 kyds sigma), destroyers (size class D) out to 28.5 kyds (22.5 kyds plus 6 kyds sigma), and so on.

5.2.2.3 Sighting Aircraft and Airships. Spotting attempts against airplanes from both ships and other planes are rolled on the same table. Use the row on the Air-to-Air and Surface-to-Air Table for the sighting conditions and roll D10 for the sigma that Tactical Turn. Check whether the plane in question is large or small (fighters and all single-engine aircraft are considered "small"). Roll D10 and add or subtract the range variation from the base range for those sighting conditions.

Example: In 10% visibility the base range to a large aircraft is 2 kyds, and the sigma is ±1 kyd. Rolling D10 on the Visibility Variation Table, the player gets a 9, a +1 kyd increase. This means that for that Tactical Turn, a large plane may be seen up to 3 kyds away.

If the player was attempting to spot a formation of large planes, the range would be doubled to 6 kyds.

Sighting to Formations



Airships, because of their tremendous size, are treated like surface ships without the telltale wake for visibility purposes - that is the sighting range from the appropriate Surface-to-Surface Table is halved. Large airships, such as the rigid Zeppelins, are about as big as dreadnoughts and can be seen from the air at considerable distances. Smaller non-rigid blimps, though still large by aircraft standards, are detected at somewhat shorter ranges.

For visual detection purposes, treat large rigid airships as size-class A targets and the smaller nonrigid blimps as size-class D targets. The observing unit for airship detection is always size class A. Using the Surface-to-Surface Tables, go to the correct table that matches the visibility conditions and determine the sighting range between "A" to "A" size ships (rigid airships) or "A" to "D" (nonrigid airships) and halve it. The visibility variation or sigma value is also halved.

Detection ranges against airships in formation are not doubled.

Example: In searching for a Zeppelin in 50% visibility, the group of British SE.5a fighters have a sighting range of only 10 kyds (half of the normal 20 kyds for "A" to "A" size ships in 50% visibility) and a sigma value of ±1.5 kyds.

5.2.2.4 Sighting Torpedo Launches. Players have a chance to see an enemy ship launching torpedoes, provided that they are launched from above water torpedo tubes. All above water ship-based torpedo launching mechanisms had a telltale signature that was identifiable from short range. Torpedo launches from submerged tubes are not detectable.

All above-water ship-launched torpedoes are detectable out to twice the sighting distance at which periscope can be detected, but with half the visibility variation. If the ship is also firing its main or secondary batteries, reduce the visibility table by two. Only one detection attempt is allowed by each enemy ship on the launching ship, regardless of how many torpedoes it fires in the Planned Fire Phase.

Example: A German *V25* class destroyer launches two torpedoes at a British light cruiser. The visibility is 60% and the torpedoes are launched at a range 4 kyds. The light cruiser can make only one attempt to detect the launch, even though the German destroyer fired two torpedoes. For 60% visibility, the torpedo launch could be seen out to 4.8 kyds (2x2.4) ±2kyds. This gives a range of 2.8 to 6.8 kyds.

If an above water torpedo launch is detected, the threatened ship(s) is allowed to disregard its plotted movement and maneuver freely in the Movement Phase of the next Tactical Turn.

5.2.2.5 Sighting Torpedo Wakes. Torpedo wakes could be detected by alert lookouts, sometimes in time for the ship to maneuver to 'comb the wake' of the incoming weapons. During WW I and into the early-1920s, this was the only way to detect an incoming torpedo attack if the launch was not spotted.

Torpedo wakes are detectable at the same distance as a periscope, but with no visibility variation. If the observing ship has seen the torpedo launch, increase the visibility by two tables.

SIGHTING RANGE TABLES

Surface-to-Surface (Distance in kyds)

100% Visibility Table (±6)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	40	38	36	33	28	20
B	38	36	34	32	27	18
C	36	35	32	30	25	16
D	34	33	30	28	23	12
E	30	28	26	23	19	6
Per	4	4	4	4	4	1

85% Visibility Table (±5)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	34	32.3	30.6	28.1	23.8	17.0
B	32.3	30.6	28.9	27.2	23	15.3
C	30.6	29.8	27.2	25.5	21.3	13.6
D	28.9	28.1	25.5	23.8	19.6	10.2
E	25.5	23.8	22.1	19.6	16.2	5.1
Per	3.4	3.4	3.4	3.4	3.4	0.9

75% Visibility Table (±4)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	30	28.5	27	24.8	21	15
B	28.5	27	25.5	24	20.3	13.5
C	27	26.3	24	22.5	18.8	12
D	25.5	24.8	22.5	21	17.3	9
E	22.5	21	19.5	17.3	14.3	4.5
Per	3	3	3	3	3	0.8

60% Visibility Table (±4)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	24	22.8	21.6	19.8	16.8	12
B	22.8	21.6	20.4	19.2	16.2	10.8
C	21.6	21	19.2	18	15	9.6
D	20.4	19.8	18	16.8	13.8	7.2
E	18	16.8	15.6	13.8	11.4	3.6
Per	2.4	2.4	2.4	2.4	2.4	0.6

50% Visibility Table (±3)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	20	19	18	16.5	14	10
B	19	18	17	16	13	9
C	18	17.5	16	15	12.5	8
D	17	16.5	15	14	11.5	6
E	15	14.0	13	11.5	9.5	3
Per	2	2	2	2	2	0.5

40% Visibility Table (±3)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	16	15.2	14.4	13.2	11.2	8.0
B	15.2	14.4	13.6	12.8	10.8	7.2
C	14.4	14	12.8	12	10	6.4
D	13.6	13.2	12.0	11.2	9.2	4.8
E	122	11.2	10.4	9.2	7.6	2.4
Per	1.6	1.6	1.6	1.6	1.6	0.4

25% Visibility Table (±2)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	10	9.5	9	8.3	7.0	5
B	9.5	9.0	8.5	8.0	6.8	4.5
C	9.0	8.8	8.0.	7.5	6.3	4
D	8.5	8.3	7.5	7.0	5.8	3
E	7.5	7.0	6.5	5.8	4.8	1.5
Per	1.0	1.0	1.0	1.0	1.0	0.3

10% Visibility Table (±2)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	4	3.8	3.6	3.3	2.8	2.0
B	3.8	3.6	3.4	3.2	2.7	1.8
C	3.6	3.5	3.2	3.0	2.5	1.6
D	3.4	3.3	3.0	2.8	1.3	1.2
E	3.0	2.8	2.6	2.3	1.9	0.6
Per	0.4	0.4	0.4	0.4	0.4	0.1

5% Visibility Table (±1)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	2.0	1.9	1.8	1.7	1.4	1.0
B	1.9	1.8	1.7	1.6	1.4	0.9
C	1.8	1.8	1.6	1.5	1.3	0.8
D	1.7	1.7	1.5	1.4	1.2	0.6
E	1.5	1.4	1.3	1.2	1.0	0.3
Per	0.2	0.2	0.2	0.2	0.2	0.1

2% Visibility Table (±0)

Target Unit	Observing Unit A	B	C	D	E	Per-isc.
A	0.8	0.8	0.7	0.7	0.6	0.4
B	0.8	0.7	0.7	0.6	0.5	0.4
C	0.7	0.7	0.6	0.6	0.5	0.3
D	0.7	0.7	0.6	0.6	0.5	0.2
E	0.6	0.6	0.5	0.5	0.4	0.1
Per	0.1	0.1	0.1	0.1	0.1	0.1

Air-To-Surface

Visibility %	Sigma (kyds)	A	B	C	D	E	Per-isc.
100	±10	50	46	38	30	26	6
85	±10	42.5	39.1	32.3	25.5	22.1	5.1
75	±8	37.5	34.5	28.5	22.5	19.5	4.5
60	±8	30	27.6	22.8	18	15.6	3.6
50	±6	25	23	19	15	13	3.0
40	±6	20	18.4	15.2	12	10.4	2.4
25	±4	12.5	11.5	9.5	7.5	6.5	1.5
10	±3	5	4.6	3.8	3	2.6	0.6
5	±2	2.5	2.3	1.9	1.5	1.3	0.3
2	±1	1	0.9	0.8	0.6	0.5	0.1

Air -to-Air & Surface-to-Air

Visibility (%)	Sigma (kyds)	Small A/C	Large A/C	Barr. & Kite Balloons
100	±4	4	8	32
85	±4	4	8	32
75	±3	3	6	24
60	±3	3	6	24
50	±3	3	6	24
40	±2	2	4	16
25	±2	2	3	12
10	±1	1	2	8
5	±1	1	1	4
2	±0	.5	.5	2

All Distances are in Thousands of Yards (kyds)

VISIBILITY VARIATION TABLE

Sigma (kyds)	D10 roll 1	2	3	4	5	6	7	8	9	10
10	-8	-6	-4	-2	0	2	4	6	8	10
8	-8	-6	-4	-2	0	0	2	4	6	8
6	-6	-4	-2	-1	0	0	1	2	4	6
5	-5	-3	-2	-1	0	0	1	2	3	5
4	-4	-3	-2	-1	0	0	1	2	3	4
3	-3	-2	-1	0	0	0	0	1	2	3
2	-2	-1	-1	0	0	0	0	1	1	2
1	-1	-1	0	0	0	0	0	0	1	1

Distances are in thousands of yards (kyds)

Modifiers

- Battle Smoke increases air-to-surface visibility by one table in good visibility conditions (75% or better)
- Ship stack smoke doubles normal surface to surface and air-to-surface ranges in good visibility conditions (75% or better). Ships emit large quantities of smoke when they are at 75%+ of maximum speed because of incomplete combustion. A group of six or more ships at any speed is also detected at twice normal range.
- Coal-burning ships at 75%+ of maximum speed at night increase their chance of being seen by one table. Sparks and glowing around the stack make it easier to spot a ship at high speed.
- Bioluminescence will cause a ship's wake to be more visible in clear night time conditions for air-to-surface sighting. Increase visibility by one table.
- Ship's wakes at high speed (over 20 knots) increase their chance of being seen by one table.
- Gun flashes increase night surface-to-surface and air-to-surface visibility by two tables. This includes not only main and secondary batteries, but AA fire and Light Battery guns as well.
- A cued visual search (told or knowing where to look) increases visibility by one table.
- Illuminated ships increase the air-to-surface and surface-to-surface visibility at night by two tables.
- Submarine periscope "feathers," or wakes, (speed 5 knots or more) are treated as size class E targets. See 5.2.3 for detection chance. Surfaced subs are treated as size class E for visibility.
- Halve the visibility variation against an exposed and non-feathering periscope.
- Formations of aircraft (3+ planes) are detected at twice normal range.
- Ships moving at less than 5 knots and all airships are detected at half normal range for both day and night.

Since all torpedoes in the dreadnought era used compressed air or steam propulsion, the chance of seeing it is:

In daylight:	20%
In morning or twilight:	15%
At night:	10%
Launch sighted	+50%
"Flaming Datum"	+35%

A "flaming datum" is the location of a ship that has just been torpedoed. Torpedo wakes cannot be visually detected in Sea States greater than four.

If an attacking torpedo is detected, the threatened ship is allowed to disregard its plotted movement and maneuver freely in the following Movement Phase.

See section 6.3 for the rules on attacking surface ships with torpedoes.

Aircraft torpedoes are considered to be automatically sighted and this is built into their attack table (see 7.4.2).

5.2.2.6 Sighting in Intermediate Turns *(optional rule).* If both players agree, when moving ships and planes in 30-minute Intermediate Turns, use unadjusted ranges only, without any die roll variation. This speeds play considerably and over the course of 10 Tactical Turns the die rolls average out.

5.2.2.7 Identifying Visual Contacts *(optional rule).* In normal play, ships that have been spotted visually are immediately identified by class. In reality, and especially in the heat of battle, ships were often misidentified by class, by type, and sometimes even by nationality. A full set of rules for classification would slow play, but as a quick test, roll D10. If the roll is:

2 or more: Correct type (Battleship, cruiser, etc.)
4 or more: Correct nationality
7 or more: Correct class.
Modifiers to the die roll:

Visibility less than 25%	-4
Visibility less than 40%	-2
Observer under fire	-2
Contact firing	+4
Distance to contact more than 50% Visibility Range	-2
Distance to contact less than 25% Visibility Range	+2
Aerial observer at Med altitude	-4
Aerial observer at Low altitude	-2

Example: A player detects a B-size ship approaching at night, in 25% visibility. The detecting player's ship is C-size and the range is 7.0 kyds. Neither ship is firing. Rolling D10, he gets a 5. The adjusted number is 5 -2 (visibility < 40%) -2 (7 kyds > 4.4 kyds: 50% visibility range) = 1. No identification is possible.

Next turn, the two ships close so that they are at a range of 4.2 kyds. The unknown ship also opens fire, at least confirming its identity as an enemy. The sighting player rolls D10 and again gets a 5. This time the adjusted roll is 5 -2 (visibility < 40%) +4 (contact firing) = 7. The ship is correctly identified by class.

5.2.2.8 Sighting Ships and Miniatures Play. Until a ship is sighted by the enemy, use a counter to mark its position. Dummy counters can be used to confuse the enemy about the number of units present. Once the ship is sighted, replace it with a counter showing the general type

of the ship, e.g., destroyer, battleship, or whatever. When a ship is correctly identified by class, replace the counter with a miniature, or a counter showing the actual ship.

5.2.3 Periscopes. Surfaced subs are seen and can see as size class E surface ships. Submerged submarines must use periscopes to get visual information. Using one requires that it be extended and thus be visible to others. It can be extended, used, and retracted in one Tactical Turn, during the Detection Phase. A periscope is also equipped with an optical rangefinding device, usually a stadimeter. The submarine player may measure the range to one contact per Tactical Turn using these devices.

The chance of sighting a periscope depends on the sea state and the sub's speed. If the periscope is within the sighting range, roll D100 using the value from the Periscope Visual Detection Table.

PERISCOPE VISUAL DETECTION TABLE

Sea State	Pd vs. Normal Periscope	Pd vs. Feathering Periscope
0	.75	.95
1	.50	.65
2	.35	.45
3	.25	.30
4	.15	.20
5	.05	.10
6+	-	-

Periscopes cannot be seen in Sea State 6 or greater. A periscope shows a "feather" or wake if the sub is moving at 5 knots or more.

5.2.4 Nighttime Illumination. A ship can be visually detected at night without any means of illumination, but it is still a poor target for gunnery purposes. Without a light source of some kind, a ship is only a shadow, with its size, shape, and even its direction uncertain. A target must be illuminated for visually-directed gunfire to be fully effective. During WW I, the primary means of illuminating a target was to use searchlights and starshells.

Searchlights, aircraft-dropped flares, and starshells are all limited by weather. If the weather conditions, that is precipitation or fog, reduce the sighting range to 10% visibility or lower, the maximum illumination range is equal to 1.5 times the sighting range for the target.

Example: A German and British destroyer (both D-size ships) are attempting to spot each other at night in poor visibility. With a light fog in the air, visibility of 5%, the visual detection range for two D-size ships is 1.4 kyds. If one were to activate a searchlight, that range would only be increased to 2.1 kyds.

Ships and land bases typically only used their searchlights when a target has been detected by some other means. Normal running lights and other nighttime illumination were usually kept off, "blacked out," if there was a chance of attack. While the use of lights will allow operations at night or poor weather, the units using them are illuminated.

Any ship which is illuminated by any means is treated as a normal daylight target for gunnery purposes, ignoring the visibility modifiers (less than 25% and less than 40% visibility. See Gunfire Hit Chance Modifiers Table, page 6-4 and 6-5).

5.2.4.1 Ship-Based Searchlights. Ships were equipped with searchlights in order to illuminate targets in night surface actions. The range of a searchlight depends on its diameter. The larger the diameter, the greater was the illumination range. In *FG&DN*, there are four basic sizes of searchlights: 60cm, 90cm, 110cm, and 150cm. Their illumination range, platforms, and arcs of coverage are shown in the table below.

SEARCHLIGHT CHARACTERISTICS TABLE

Searchlight Size	Range (kyds)	Usual Platforms	Area of Coverage
60 cm	3,000	Light Cruisers Destroyers Patrol Craft	Forward Aft
90 cm	4,000	German Light Cruisers and Destroyers built after 1914	Forward Aft
90 cm	4,000	Battleships Battlecruisers Pre-Dreadnoughts Cruisers	SB&S PB&P SQ&S PQ&P
110 cm	5,000	German Battleships and Battlecruisers	SB&S PB&P SQ&S PQ&P
150 cm	8,000-10,000	Land-based Only	Scenario-Dependent

The use of a searchlight for illumination is ordered during the Plotting Phase, and is available for targeting purposes in the Planned Fire Phase of that turn. A searchlight can only illuminate a target once it has been detected visually. Any new targets found in the Detection Phase cannot be illuminated until the following Planned Fire Phase. It takes a little time to coach the searchlight operator onto the target.

Any ship in the beam of a searchlight is treated as being illuminated. However, any ship using searchlights is also considered to be illuminated for gunfire purposes.

5.2.4.2 Antiaircraft Searchlights. These land-based searchlights are usually grouped into batteries and co-located with antiaircraft gun batteries. Once an aircraft is detected by other means (visually or by sound), the searchlights will try to pin the aircraft in their beams, allowing all antiaircraft guns within range to see and engage the intruder. The chance of searchlights pinning a detected aircraft in a beam is 50% each three-minute Tactical Turn with acoustic detectors (see 5.4), and 10% witrhout them. Once the aircraft is acquired, it remains in the beams until visual line of sight is broken, or it flies out of range (6 kyds). While illuminated, the aircraft may be attacked normally by AA guns.

5.2.4.3 Flares. Flares are dropped by aircraft in an attempt to illuminate ships or, at the very least, silhouette them. Any aircraft, usually seaplanes and airships, can carry flares. For airplanes, the flares are carried instead of other ordnance. Airships can carry both flares and bombs.

An aircraft with flares may plot to drop one or more flares at any point along its path during that Tactical Turn. It may also use the Second Aircraft Movement Phase to drop flares in response to units found in the Detection Phase.

A player does not have to roll dice for the flare's chance to hit. It automatically "hits" the desired location and immediately ignites. Flares last two Tactical Turns, including the turn they are dropped.

A unit within 1,000 yards of a flare is illuminated. Units between the flare and another ship are considered to be silhouetted out to a range of 6 kyds (3 nm) from the flare. Flares do not move after they are dropped and ships may move out of, or into, the flare light's range.

5.2.4.4. Firing Starshells. Starshells can also be used to illuminate or silhouette a surface target. They may be fired by a minor combatant's primary battery, a major combatant's secondary battery, or sometimes by a special-purpose gun or howitzer. Starshells were first deployed by the Germans in 1916, and are available for use by all other navies by 1918.

In the Plotting Phase, designate one mount (the gun must be able to fire in the desired direction) as firing illumination rounds (starshell). That mount may do nothing else that Tactical Turn, but the other mounts in the battery may fire normally.

In the Planned Fire Phase, resolve the effectiveness of starshell guns first and place a marker that the indicates the location of the fire. After that, the other guns can fire and will benefit from any illumination/silhouetting the starshells provide. Like other gun attacks, starshells are fired throughout the Tactical Turn, with no further resolution of their fire needed.

Starshells have a minimum range of 4,000 yards (2 nm). Inside that range, the shell is moving too fast for the chute to deploy without shredding. If a starshell misses its target and falls short, and the range ends up being less than 4,000 yards, the starshell will not work at all and will fall promptly into the sea (and go phsst).

Starshell illumination actually requires a series of shells, fired over the entire three-minute Tactical Turn. Individual starshells burn out quickly and if the mount ceases fire, the light quickly fades. If the mount stops at the end of a turn, or shifts to another target, the previous target ceases to be illuminated/silhouetted in the following Tactical Turn.

In the Planned Fire Phase, the player rolls D10 to find out where the starshells will fall. On a roll of 1-5, the fire lands 500 to 2000 yards short. On a 6 the starshells are over their intended target. And on a 7-10, they land 500-2000 yards long, or behind the intended target.

If a starshell falls within 1,000 yards of a ship, it is illuminated. For starshells that fall behind the target (long by more than 1,000 yards), the ship is silhouetted to a range of 6 kyds from the point of impact.

If starshell fire falls short by more than 1,000 yards, the intended target is masked by the intense light and cannot be seen. Thus on a roll of 4-7, the target is illuminated. A roll of 8-10 means that the target is silhouetted, while a roll of 1-3 has the target being masked by the starshells.

5.2.5. Smoke Effects. Smoke in WW I was both a blessing and a curse. It could be used defensively to obscure a target and reduce its chance of being hit during an attack. Dedicated smoke generators could be land-based as well, positioned around a valuable installation. Smoke from one's own guns could be just as much of a nuisance, depending on the wind. And finally, stack smoke often revealed a target's presence because of the vast quantities of smoke produced.

STARSHELL MISS TABLE

D10 roll	Miss distance
1	2000 short
2	1500 short
3	1500 short
4	1000 short
5	500 short
6	On Target
7	500 long
8	1000 long
9	1500 long
10	2000 long

Note: If the modified range is inside the minimum range of 4,000 yards, the starshells fail to function.

Visibility in or through a dense smoke screen is reduced to 1,000 yards (.5 nm) in the daytime and 500 yards (.25 nm) at night. On the last turn that the smoke exists, it is dissipating and the surface visibility is reduced to 1/4 of the unobstructed visibility. Gunfire spotting aircraft are not affected unless the target is actually in the smoke screen.

If a ship moves into smoke during the Movement Phase, and ends the phase within the smoke, it may still be fired on if it spent at least half of its movement outside the smoke. If the ship is obscured for more than half, but not all of the turn, all gunfire suffers a -20% dead reckoning penalty for that turn only. This is 2/3 of the normal blind fire modifier, since the ship's location was known before it became obscured. If the ship remains hidden on the following turns, it can't be fired on at all.

5.2.5.1. Shipboard Smoke Screens. These can be created in any Plotting Phase. In the Movement Phase of that turn, a ship will leave a smoke screen in its wake. The smoke screen can be turned on or off each Tactical Turn as the player desires. The screen extends only into the VLow altitude band. The smoke screen will remain for four Tactical Turns (in winds of less than 5 kts), then disperse.

Reduce this time by one turn for every 10 knots of wind. (e.g., If it is from 5 - 15 knots, it will last three turns. If the wind is 16 - 25 knots, the smoke screen will only last two turns). Smoke is removed in the Plotting Phase of the turn in which it disappears.

5.2.5.2. Land-Based Smoke Screens. These can be activated in any Plotting Phase. Unlike shipboard generators, they do not move. Instead, they build up an opaque haze over a fixed installation. They take two Tactical Turns to build up an effective overcast. This is increased by one Turn for every 10 knots of wind over four. (e.g., if the wind is 15-15 knots, the smoke screen takes three Tactical Turns to form). Sighting is blocked from the air and surface against the designated installation and anything within 4,000 yards of the generators to a height of 30 meters (VLow altitude). Sighting is also blocked in the same area from the ground to air units.

Smoke generator units assigned to cover a target will

usually surround the area, at a minimum covering the direction of the prevailing winds. Generators can also be moved, given a little time, so referees and scenario designers do not have to worry a lot about wind considerations when including smoke generators in a scenario. They can be placed on rafts and barges to screen shore installations if there is an offshore wind.

5.2.5.3 Using Smoke for Detection. On relatively calm days, ships can detect stack smoke from other ships beyond the horizon. Merchant ships were frequent "smokers." Warships, because of better training, equipment, and a desire to avoid detection, tended to emit less smoke, except at high speed.

If the wind is less than 20 knots, roll for each surface ship each 30-minute Intermediate Turn. A merchant ship has a 70% chance of emitting heavy smoke, and if at 75% or more of its maximum speed, it automatically does so. If there are several ships present, figure out the chance of one ship smoking, then use the CumulativeProbability Table in the back of the rules booklet to reduce them to a single die roll.

Warships have a 40% chance of emitting heavy smoke, and if at 75% or more of its maximum speed, it automatically does so.

Heavy stack smoke and smoke from burning ships, extends into the Medium Altitude band and can be seen at twice normal sighting range, as long as the wind is less than 20 knots.

5.2.5.4 Battle Smoke. Ships at at 75% or more of their maximum speed produce large amounts of smoke, and while the powder used in WW I guns was "smokeless" in comparison to the brown powder of the late 1800s, it certainly wasn't smoke free. Both of these factors had a significant effect on the visibility of nearby ships in the battle line.

The effects of battle smoke are checked at the beginning of the Detection Phase when one or both of the following conditions occur:

- Ships in the formation are at a speed of 75% of maximum or greater during the Movement Phase.
- There has been sustained gunfire for a specific period of time depending on gun size.

Large guns (11+ in)	2 Tac Turns of Fire
Medium guns (5.9-10 in)	4 Tac Turns of Fire
Small guns (<5.9 in)	6 Tac Turns of Fire

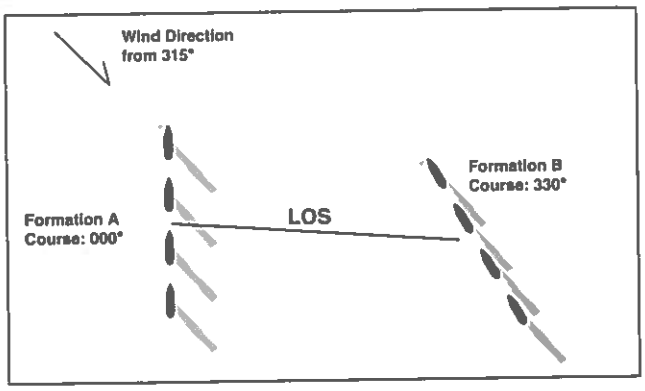
To find the effects of battle smoke, the players roll D10 and consult the following table taking into account any applicable modifiers.

Die Roll	Effect
1 - 5	No reductions in visibility.
6 - 8	Reduce visibility one table.
9 - 10	Visibility blocked by smoke.

Modifiers:

• Adjacent ship fired its guns in the previous turn	+1
• Ship ahead of sighting ship at 75% max speed	+1
• Wind blows the smoke between the LOS	+1
• Wind blows the smoke clear of the LOS	-2
• Wind speed is >20 knots	-1

Note: LOS = Line-of-sight.



Example: Two formations of ships have been engaged in battle long enough for battle smoke to become an issue. Both formations are at flank speed and are plotted to shoot their guns in the Planned Fire Phase. At the beginning of the Detection Phase every ship has to roll for the effects of battle smoke. Formation A, however, is at a disadvantage because the wind is blowing the smoke between them and Formation B. The wind speed is 15 knots. The resulting die modifiers for the ships in both formations are:

Formation A lead ship:
+1 for adjacent ship firing in previous turn
Formation A remaining ships:
+ 1 for adjacent ship firing in previous turn
+ 1 for ship ahead at 75% maximum speed
Formation B lead ship:
+1 for adjacent ship firing in previous turn
- 2 for wind blowing the smoke clear
Formation B remaining ships:
+ 1 for adjacent ship firing in previous turn
+ 1 for ship ahead at 75% maximum speed
- 2 for wind blowing the smoke clear

If a ship has its visibility blocked by smoke, it will not see the target it was intending to shoot at. On the first turn this occurs, the ship may still fire but the Blind Fire modifier of -30% is applied to the gunnery attack die roll. If there are subsequent consecutive turns where the ship is blinded by smoke, it must check fire as it has no idea as to the enemy's location.

In addition to the effect on gunnery, any ship that has its visibility blocked cannot see any visual (flag or light) signals and therefore, cannot respond to orders sent in this manner until the visibility clears.

5.2.6 Spotting Targets on Land. Locating a shore battery or other land installation is a different proposition from sighting a ship at sea. In addition to the inherent contrast and projection of a ship above the sea's surface, a ship's motion also helps to make it easier to spot.

Even an uncamouflaged coastal battery is hard to see, through natural problems of picking out objects against a background from a long distance. Clever camouflage can make it almost invisible, even at short range.

The Land Sighting Table supplements the standard Sighting Range Table for naval units and uses the same Visibility Variation Table found on page 5-5. The Land

Sighting Table has a section for spotting ships from land-based observation posts with varying heights of eye, and another for naval units attempting to spot land installations.

LAND SIGHTING TABLE
(Ranges in kyds)

Naval Target Size	Observation Post Height of Eye					
	10 ft	25 ft	50 ft	100 ft	150 ft	200 ft
A	25	29	34	41	46	50
B	24	28	33	39	44	49
C	22	26	31	38	43	47
D	20	24	29	36	41	45
E	16	20	25	31	36	41
Horizon	7	11	16	23	28	32
Perisc.	4	4	4	4	5	5

Land Target Size	Observing Naval Unit						
	A	B	C	D	E	Peris	Var -iation
C	24	24	24	24	22	10	±4
D	20	20	20	18	18	9	±3
E	16	16	16	16	14	8	±3
F	12	12	12	12	10	6	±2
G	8	8	8	8	6	4	±2
H	4	4	4	4	2	2	±1

All emplacements and other structures have a size class, provided in the battery description (see section 9.14). If only one structure is visible, such as a single gun emplacement, then the battery's size class is the size of that item. If there is more than one structure visible, the battery's size is one size greater than that of the largest structure.

Example: If a battery consists of one casemate the size of a house, size class E, the battery size class would be E. If it consisted of two or more casemates of this size, the size class would be D. If it consisted of several structures, size classes F, E, and D, the battery would be treated as size class C for spotting purposes.

This size class will also affect the ability of weapons to hit a land installation.

If a battery has a size class of D it may be seen at 23,000 to 17,000 yards in 100% visibility from a size class A vessel, depending on the Visibility Variation die roll. If a Coastal Motor Boat (size class E) was trying to make the detection, the battery would be spotted somewhere between 21,000 to 15,000 yards.

Note: These ranges are for 100% visibility. To find the detection ranges for other visibility conditions, multiply the range in the Land Sighting table by the percentage describing that visibility. Use the variation table on page 5-5 normally, with the Sigma for that visibility. For example, a B-sized ship attempting to spot a D-sized land target in 40% visibility (±3 kyd Sigma), has a base range of 20 x 40% or 8 kyds.

5.2.7 Camouflage. Land installations have four possible levels of camouflage:

• Sites with no camouflage are located normally on the visibility tables.

• Hasty camouflage implies that a minimum effort was made to break up the outline of the structures with paint or other disruptive materials. This reduces the visual detection range of a land-based structure to 1/2 of the range shown on the Land Sighting Table.

• Prepared camouflage consists of scaffolding and other elaborate measures that make the battery blend in with its background closely. A battery with prepared camouflage can be located at 1/4 of the listed ranges.

• A Concealed battery is so well-disguised that it can only be spotted after it fires. Once it has fired it is treated as having prepared camouflage. Examples of Concealed batteries include those hidden in false houses or in caves. For ships without aerial spotters or forward observers, mortar and disappearing batteries are Concealed.

Example: A size class D battery could be seen at 23 - 17 kyds, depending on the Visibility Variation die roll. This is the sighting distance if it has no camouflage. The same battery with Hasty camouflage would only be visible at 11.5 - 8.5 kyds, or 5.8 - 4.3 kyds yards if Prepared camouflage had been applied. The same penalties apply to aerial spotting.

5.2.8 Kite Balloons. These sixty- to eighty-foot craft were fitted to many ships during the Great War. First used by the British in 1915, they were carried fully inflated on the fantail of a ship, and then raised or lowered by winch. Observers would ride in a basket below the bag, and could communicate with the mother ship by telephone.

The balloon was usually carried aloft, at Low altitude, to reduce the fire risk to the ship. A pulley system allowed an observer to board the balloon without it actually toughing the deck. Observers also had parachutes, allthough bailing out into the ocean was not a welcome propsect.

The advantages for a ship or force with such a balloon were great, especially in a time before naval aviation made aerial observers more available. During WW I, kite balloons were used by naval units, but especially by escort forces and convoys to protect them from U-boat attacks, starting in 1917. They were also useful for gunfire spotting.

There were problems, as well. Since the balloon was filled with hydrogen, it presented a fire or explosion risk stowed or aloft. Several kite ballons were struck by lightning while aloft, but fortunately without fatalities.

If a kite balloon is destroyed or catches fire while aloft, it falls into the sea astern of the towing ship. If it catches fire while lowered, in inflicts a fire critical on the towing ship, with a +2 on the die roll for severity.

It takes six Tactical Turns to raise or lower a balloon. A kite balloon can be jettisoned by the towing ship by ordering it in the Plotting Phase of any turn. It is jettisoned in the following Movement Phase.

Also, although a kite balloon increased a ship's detection range, it also revealed the towing ship's presence. Ships or aircraft attempting to sight a kite balloon should use column on the Surface-to-Air and Air-to-Air Sighting Table for barrage and kite balloons.

Kite balloons also restricted the towing ship's maneuverability. The ship must keep the relative wind aft, or the balloon's cable may foul the mast or superstructure. If this happens, treat it as an aircraft critical hit and the ship may not engage in combat for D6 tactical turns.

If the ship must steer with the relative wind, then the balloon must to be stowed. The balloon cannot be towed at a relative wind and ship speed of more than 45 knots.

Ships capable of carrying kite balloons will have it listed in their Remarks sections in Annex A, and in the force listing for that scenario.

A ship with a kite balloon aloft can spot other units like an aircraft at Low altitude. The detection is immediately known by the towing unit, because of the observer's telephone link with the ship.

If a plane at V/Low altitude attacks a ship carrying a kite balloon, it has a 25% chance of striking the balloon or its cable and being destroyed.

Kite balloons cannot be shot down by an aircraft unless the plane has incendiary ammunition, which appeared in 1917. Even the dozens of holes made by machine gun fire would not deflate a balloon quickly enough to affect a particular battle. Surface ship AA fire is effective against balloons, which are treated as large aircraft.

5.3 Sonars. Prior to 1914, the use of underwater acoustic detection gear was limited to strictly navigational aids near the coast. Bells were mounted underwater near lighthouses or lightships and were timed to coincide with the foghorn signal. Hull mounted microphones, the first passive sonar, enabled a ship to steer clear of navigation hazards in very poor visibility. The experience gained from these listening systems was applied throughout WW I as they were the only underwater sensors available. Active sonar, although under research during the war, was not in actual service until 1922.

5.3.1 Sonar Specifications. There are two methods of sonar detection: active and passive. A passive sonar listens to the noise made by other vessels while an active sonar sends out sound pulses (commonly referred to as "pinging") into the water and listens for their return echoes.

Most early passive sonars were omnidirectional sensors and would only tell you that something was there, but not in what direction it lay. Later systems were modified to provide a rough bearing to a contact. Active sonar gave both bearing and range by measuring the time delay from the active pulse to the echo from a target. However, by broadcasting sound pulses into the water, the searching vessel is easier to detect.

5.3.2 Sonar Types. Sonars are classified by their main method of operation (active or passive) and by the way they are mounted on the ship.

5.3.2.1 Mounting Configurations. Hull sonars are fitted on submarines and surface ships and are mounted in three locations: the keel, the deck, or the flanks (side) of a ship. However, the most common method of deploying a passive sonar on a ship during this period was to simply lower it over the side.

A keel-mounted sonar is located in the forward portion of the vessel's lower bow, usually right under the bridge. On most escort vessels this placed the sonar dome about 25 - 35 feet back from the bow. The keel-mounted position was adopted for the new active sonar systems that were developed in the early-1920s.

A deck-mounted sonar is a rotatable passive array that was fitted to many different classes of submarines. These were located on the upper deck at the forward or after end of the submarine.

A flank array consisted of a set of passive hydrophones mounted along the side of the vessel, usually a submarine.

The last configuration, and the most numerous type by far, was the use of simple omnidirectional (no baffles) hydrophones that were lowered over the side of a ship that was dead-in-the-water. These "drifters" formed the bulk of the Allied antisubmarine effort in WW I.

All hull-mounted sonars have blind zones, caused by the noise generated by the ship's engines and propellers or because the ship's hull is between the sound source and the sonar. These zones, which are present even when the ship is dead in the water, are called "The Baffles." The size and shape of the baffles varies with sonar configuration. Any target (ship, submarine, or torpedo) within the baffles cannot be detected by the sonar. The baffles for each type of hull-mounted sonar configuration are presented in the following table and diagram. All baffle zones are defined by bearings relative to the ship's bow (i.e. ship's bow = 000°).

BAFFLE ARCS TABLE

Sonar Mounting	Baffle Zone(s)	Baffle Size
Keel mounted	060° - 300°	240°
Deck mounted (Fwd)	090° - 270°	180°
Flank mounted (Stbd)	000° - 045°	
	135° - 180°	90°
Flank mounted (Port)	315° - 000°	
	180° - 225°	90°

5.3.3 Active Sonar (Echo-Ranging) Detection. Unlike WW II, active sonar was not the most common method used by surface ships to search for submerged submarines in WW I. These sonars were in their very early stages of development and had limited capabilities. All active sonars during this period were keel-mounted and could only search the forward 120° sector. Because these sonars were mechanically trained and because their instrumentation was very crude, they could only search 60° each Tactical Turn. Therefore, before a detection roll is made, the searching player must declare whether the left or right half of the sector is being searched. Normally, ships alternated back and forth between the two sections such that the left side is searched one turn, the right the second turn and back to the left half on the third and so on.

Once the search sector is decided on, the submarine player (or referee in a blind game) determines the detection range of the sonar system on the ship. To calculate the active sonar search range, the player must look in Annex H for the listed range for the searching ship's active sonar. Within the annex there is a column which lists the range (in kyds—thousands of yards) at which that sonar has a 50% chance of detecting the submarine. All ranges are based on a 50% detection chance. The range may be modified up or down by various conditions. These modifiers are listed in Annex H.

To find the 50% detection range that is applicable for the existing conditions, the submarine player (or referee) multiples the annex range by all the modifiers that apply to the particular situation. The modifiers for active sonar

account for the searching ship's speed and the environmental conditions, such as sea state, rain, and the presence of a thermal layer.

After all the range modifiers have been determined, they are multiplied by the range listed in Annex H. This number is the 50% detection range of the sonar for that specific Tactical Turn. Beyond this range, a target can not be detected. For ranges less than half the 50% detection range, there is a +15% modifier to the detection roll.

Example: A Royal Navy patrol boat at 6 knots with a Type 114 sonar attempts to detect a submerged submarine that is above a weak layer in Sea State 3. The base 50% detection range for a Type 114 active sonar in Annex H is 600 yards. The applicable active sonar range modifiers (taken from the modifier table in Annex H) for this situation are:

RN PC speed mod (search speed of 6 knots) = 1.0
Environmental mods: Sea State 3 = 0.9
Weak layer = 0.7 (not applicable this Tactical Turn)

The final 50% detection range is determined to be 540 yards (600 x 1.0 x 0.9) after all modifiers are accounted for. Therefore, for target range out to 270 yds from the PC, there is a 65% chance of detecting the submarine. From 271 yards to 540 yards, there is a 50% chance of detection. Beyond 540 yards, the submarine cannot be detected with the Type 114 sonar under these conditions.

Note: if the submarine was below the weak layer the modified 50% detection range would have been 378 yards (600 x 1.0 x 0.9 x 0.7).

5.3.4 Passive Sonar Detection. Passive sonars are specifically designed to listen for the sounds generated by a target. The procedure to conduct a passive sonar search is very similar to the active case. The only difference is that the initial 50% detection range value also depends on whether the target is a surface ship or a submarine. The modified 50% detection range is calculated just as in the active case but this time, the passive modifier table is used.

Example: A German U-boat fitted with the UG passive flank array is attempting to detect a British warship making 15 knots. The U-boat is dead-in-the-water and above a strong thermal layer in Sea State 2. The base 50% detection range for a UG system against a surface ship is 1.5 Kyds or 1,500 yards as listed in Annex H. The applicable passive sonar modifiers are:

Submarine speed mod (DIW = 0 knots) = 1.0
Surface ship speed mod (15 kts) = 4.0
Environmental mods: Sea State 2 = 1.0
Strong layer = 0.5 (not applicable this Tactical Turn)

The final 50% detection range is determined to be 6,000 yards (1,500 x 1.0 x 4.0 x 1.0) after all modifiers are accounted for. Note: if the submarine was below the strong layer the modified 50% detection range would have been 3,000 yards (1,500 x 1.0 x 4.0 x 1.0 x 0.5). Therefore, for target range out to 3,000 yds from the U-boat, there is a 65% chance of detecting the warship. From 3,001 yards to 6,000 yards, there is a 50% chance of detection. Beyond 6,000 yards, the warship cannot be detected.

5.3.5 Maintaining Contact. Sound travels rather quickly through water, but due to the changing properties of seawater, it follows a varying path that is usually anything but a straight line. Therefore, players must check each Tactical Turn to see if they maintain contact on a target that had been detected earlier. The process of maintaining a sonar contact is the same as for initial detection except a +10% modifier for an alerted operator is applied to the probability of detection.

5.3.6 Sonar Information. Active sonar gives the detecting player exact information on the contact's bearing and range, just like radar. Passive sonar gives a bearing only if the system has a directional capability, plus whatever information can be deduced from the sounds heard. Extended analysis of these sounds will give information on the nature of the contact. These early sonar systems do not provide any depth information on the contact. Surface ships can detect other ships, actively or passively, just as ships can detect submarines or submarines can detect another submarine.

5.3.6.1 Active Sonar Fire Control Solution Ships using active sonar can attack a submerged submarine after enough data is gathered to allow the ship to accurately predict the submarine's course and speed. The chance that an active fire control solution is generated depends on the number of turns that a ship is in contact with the sub. The chance of a fire control solution after one Tactical Turn of contact is 40%. This increases to 75% if contact is held for two consecutive turns, and 90% after three consecutive turns. If contact is lost, the chance immediately drops to the 40% value.

5.3.6.2 Passive Sonar Fire Control Solution. Passive sonars during World War I do not have adequate bearing resolution for a single ship bearing-only approach

PASSIVE SONAR PRODUCED INFORMATION

The chance of getting information equals the number of times a detection has been made (consecutive or not) times 20%. If correlated with a DF signal, add 10%. Roll D100 immediately during the Detection Phase and compare with the reception chance.

If throw is equal to or less than	This information is received
Information chance	General propulsion plant type - Heavy (A or B) or Light (C, D, E)
Information chance +15	General ship type (merchant or warship)
Information chance +16	No information

Note: For a contact to be classified as a submarine, the general ship type (warship) must be known and there is no corresponding visual contact. If warships, particularly light warships, are detected acoustically and visually, a submerged submarine that has been detected acoustically will not be properly classified as a submarine.

on a target. Submarines cannot use only passive sonar to attack a ship; a periscope approach must be used when submerged. For surface ships, a passive fire control solution can only be achieved with multiple ships holding the same submarine on their passive sonars. By plotting the bearings from the ships, a submarine's position can be crudely determined.

The percent chance of a fire control solution depends on the number of ships holding contact on a submarine. If there are only two ships (the minimum number) there is a 30% chance of determining the submarine's location. For three ships, the probability increases to 50% and for four ships 60%. No additional benefit is gained by having more than four ships. If the contact is held by at least half the ships for two consecutive Tactical Turns, there is a +15% modifier to the fire control solution die roll. If contact is lost, or the ship player fails to determine the submarine's location for even a single Tactical Turn, the +15% modifier cannot be applied.

5.3.6.3 Passive Sonar Information *(optional rule).* The machinery noise that a ship or submarine emits can be analyzed by a sonar operator who can make some deductions based on these sounds. Since there was no electronic processing, all classification was done aurally.

The detecting vessel has a chance of finding out the contact's ship type based on the number of successful detections, whether or not they are consecutive. The chance is equal to the number of Tactical Turns that the target has been detected times 20%. If the contact can be correlated with a DF (see section 5.4) signal, add 10% to the chance. This information roll is made with D100 in the Detection Phase immediately after sonar detections rolls are made.

5.4 Acoustic Detection of Aircraft. Before radar appeared, early warning of approaching aircraft was often provided by acoustic detectors. These used three or four horns to collect and enhance any sound, and could also provide bearing and elevation information. These systems had a reasonable bearing accuracy, and could cue a searchlight onto an aircraft, but theyt were short-range sensors. Against a single aircraft in a typical environment, they had a range of 4,000 yards. In a quieter setting (no gunfire or artillery nearby and winds no more than 5 knots), this could be doubled to 8,000 yards. If a plane is in detection range, then chance of detection is 70%. Groups of four or more aircraft could be detected at 7,000/14,000 yards with an 80% chance of detection.

Without an acoustic detection system to cue a searchlight, the chance of ocating and poinning an aircraft in the beam (section 5.2.4.2) at night is reduced to 10%.

5.5 Magnetic Loops. A magnetic loop is an extremely short-range sensor used by coastal defenses to detect the presence of a ship within a minefield or in a narrow channel. The sensor is activated by the metal in the ships hull, which creates a current in the magnetic loop as the ship passes over it. The chance of detection depends on the size of the ship (see the table below). If the ship is made of wood, halve the channce of detection.

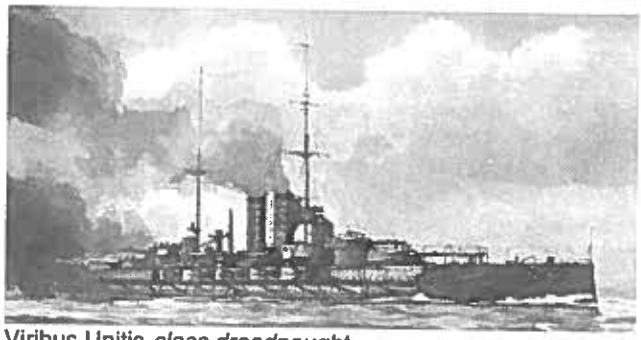
If a ship is detected, the location is generally known and meets the criteria for a cued visual search. Land-based searchlights autommatically find the target if it is within the searchlight's range. If the loop is part of a controlled minefield, the detection is accurate enough to allow an attack with mines.

MAGNETIC LOOP DETECTION TABLE

Size Class	A	B	C	D-E
Det. Chance	80%	75%	70%	60%

5.6 Direction Finding (DF). All electronic emitters, in this case wireless telegraphy (WT) or radio telephony (RT), send electromagnetic energy into space. This radiation can be detected by sensitive receivers designed for this purpose in the same way that a passive sonar can listen for an active one. During WW I and into the early 1920s, only U.S. and some Royal Navy destroyers were fitted with DF equipment.

The chance of detecting a WT or RT emission is 70%. The intercept range is 150% of the 100% visibility range for the two units involved. Aircraft are treated as size class A targets for DF purposes. A successful detection reveals the type of signal (WT or RT), and its rough bearing (±20°) from the detecting unit.



Viribus Unitis-*class dreadnought*

Chapter Six - Naval Combat

In general, a ship may only engage as many targets as it has directors. A ship equipped with one gunfire director and two gun mounts may only fire at one target, since the director controls both mounts. Weapons without directors, such as torpedo tubes and some rocket launchers, can engage only one target per turn per mount, although they may fire more than one weapon per turn at the target, if their rate of fire allows. Gun mounts or turrets in local control (i.e., without the director) can engage individual targets, but with a loss in accuracy (see 6.1.3 Gunfire in Local Control)

Refer to the annexes (or the completed ship or aircraft form) for information on each type of weapon to be fired. The listed chance to hit is sometimes modified by rules described in this chapter. The modified chance is then rolled for with two D10 as percentile dice (D100).

The number rolled must be equal to or less than the modified percentage chance in order to get a hit.

Unless stated otherwise in the remarks section for a ship class, each weapon (except guns) may only fire one round per tube or rail. Multiple-barreled weapons (such as torpedo tubes) may fire all of their tubes at once.

For gunfire, the number of shells fired is already included in the hit chance and damage values. If a hit is made, it means that measurable damage was inflicted in that three minutes of fire (one Tactical Turn).

Guns are assumed to have an infinite ammunition supply unless the scenario states otherwise. Unless reloads for torpedoes or other weapons are listed in the remarks section for a particular ship, it has available only the ammunition listed on the weapons line for each mount.

If the weapon is listed as being manually reloaded, assume that it takes two Tactical Turns to reload one mount. Several mounts can be reloaded at once.

6.1 Surface Gunnery. Surface ships and surfaced submarines can attack other surface targets with guns. Most ships carried several different calibers of guns. Large-bore, long-range guns were the principal ship-killing weapons of the day and ships were rated by the size of the guns they carried. Destroyers mounted guns smaller than 4.0 inch, light cruisers mounted 4.1 to 6.0-inch guns, armored cruisers 7.5 to 9.2-inch guns, and capital ships mounted guns of 11 inches and larger.

Larger ships also mounted a medium-caliber secondary battery, both for protection against smaller surface craft and later for antiaircraft defense, so as to not distract the main battery from its primary work of destroying capital ships. Also, small-bore automatic weapons were carried on many ships for antiaircraft protection. These could also be used against surface ships if they were close enough.

Ships of destroyer size and smaller will mount a small-caliber main battery.

6.1.1 Directors. Before about 1910, directors did not exist, although Captain Percy Scott, RN did most of his experiments on director-based fire during 1900 to 1909. Therefore, for Gunnery Standard 1, all guns are aimed and fired by the individual gun captains and the normal penalties for a gun being in "local control" are built into the base probability of hit. The remaining discussion on directors is thus applicable to Gunnery Standard 2 only.

Guns of three-inch caliber and higher on surface ships were usually aimed by a "director." Mounted high on a ship, directors used powerful optics and sometimes analog fire control computers to track a target. This is the device knocked out when a gun battery takes a fire control hit. Its loss reduces the guns to local control.

Main batteries on all combatants and some secondary batteries on major combatants are fitted with optical directors. The effective range of the optical rangefinder depends on its baseline, or length, and its magnification. The effective sighting range for all optical rangefinders is listed in Annex I, Optical Range Finders.

As the director tracked a target, guns that it controlled located all over the ship would automatically follow its movements, with corrections added to allow for such things as the range to the target, wind, distance between the director and the mount ("parallax"), and on large guns, even the rotation of the Earth.

Guns could be controlled "locally," at the mount or turret itself, but this was less effective than using the director. Rules for local control are in section 6.1.3.

Each gun type on a ship is controlled by a different director. However, this is not always the case as the Royal Navy did not incorporate directors for the secondary battery until after the start of the war. A single director can control many gun mounts, but a ship can only engage as many surface targets as it has gun directors, unless the individual gun mounts or turrets were in local control. All guns linked to a director fire as a group, rolling once to hit. All local control mounts firing at the same target roll together as well, but with a penalty on their chance to hit die roll.

6.1.2 Types of Fire Control. During the years immediately preceding World War I, the major navies of the world were involved in the development of analog computing devices to calculate the future position of a target based on optical rangefinder data. While several systems emerged, the most complete system was one that could accommodate rapid changes in range rate.

The first such system was developed for the Royal Navy by A.H. Pollen in 1909. Although the Royal Navy ultimately chose another system, Pollen's was superior to the vast majority of the fire control systems in use.

If a ship is fitted with a Pollen fire control system, or one that has a similar capability, it will be listed in the Remarks section of Annex A. The gunnery bonus is +10% to hit for Short and Medium range bands and +5% for Long and Extreme range bands.

A complete Pollen system also incorporated a gyro to act as a stable element from which own-ship's motion

could be removed from the fire control problem. If a ship is equipped with a stable element, it does not suffer the -15% penalty when it makes a turn of 45° or greater.

6.1.3 Gunfire In Local Control. Some guns may be fired without their director, in "Local Control," while others can only fire locally because no director is fitted. Any gun mount can be put in local control by ordering it in the Plotting Phase. In local control, the crew in the gun mount aim the gun themselves, instead of relying on an external director. This is the normal procedure when the director has been knocked out. There is a -15% modifier to the chance of a hit for surface targets when guns are fired in local control.

The gun director is located at one of the highest points on the ship, while the gun mounts and their sights are mounted much lower, usually on the main deck itself. This meant that if the gun crew depended only on the mount's sights, the visual horizon and spotting range was reduced. In local control, reduce the ship's size two classes for A and B size ships and one size class for smaller ships when sighting for firing purposes.

This does not apply to Gunnery Standard 1, because in the pre-dreadnought era, the maximum range of naval guns was such that an individual gun captain could usually see the target from his turret/casemate, visibility permitting.

Example: An armored cruiser (size class B) has its forward main battery director knocked out. Its after main battery director takes over. For the purposes of spotting targets for the main battery, treat the cruiser as size class D. In addition, it cannot engage targets forward unless those turrets drop into local control. If a second hit knocks out the after director, all turrets must now drop into local control. Furthermore, for the purpose of spotting targets for the main battery, treat the ship as size class D.

6.1.4 Gunnery Procedure. Gun ranges are divided into four range bands: Short, Medium, Long, and Extreme. Long range is often called "effective" range.

The ballistics of a shell in flight are the same from gun to gun. The only things that change are the size and shape of the shell, and muzzle velocity and elevation it is fired at. These parameter affect how far it will fly and what damage it will do if it hits something.

Since the exterior ballistics are essentially the same, the chance of a hit is the same for each range band.

The base chance to hit for the four range bands for Gunnery Standards 1 and 2 are:

Range Band	Gunnery Standard 1	Gunnery Standard 2
Short	40%	55%
Medium	20%	35%
Long	10%	15%
Extreme	5%	5%

The chance to hit cannot be raised over 90%, even with modifiers.

While the base hit chances are the same for each range band, the size of the band varies for each gun. For example, a Royal Navy 12 inch/45 MkX gun has a Short range of 3,800 yards, while a German 28cm SKL/45 has a short range of 4,400 yards. The terms Short, Medium, Long, and Extreme are relative, depending on the gun. Only the chance to hit remains unchanged.

To attack a surface ship with guns, measure the distance from the firing ship to the target and note the target's range and aspect. Find the proper range band (Short, Medium, Long, or Extreme) by comparing the measured range with the numbers for that gun in Annex C. Count the number of barrels firing. Be sure to consider arcs of fire (section 2.2.1.5) and check which guns can actually bear on the target.

Add up all applicable environmental, weapon system, and target modifiers using the Gunfire Modifiers Table for the Gunnery Standard in use. Divide the modifier total by 2 (round up as necessary) and add this number to the base chance to hit. This is the modified or adjusted chance to hit.

A modified chance to hit of less than 0% is still a valid shot for "ranging" purposes, and counts toward any consecutive turn gunfire modifiers.

Roll D100. If the roll is less than or equal to the adjusted chance to hit for that range band, the target has been hit. Note the number of damage points inflicted by the shell type in that range band (found in Annex C). Now, look on the Gun Damage Multiplier Table, cross-indexing the number of barrels that fired with the range band of the attack. This gives a multiplier for the damage inflicted by the shell type. Multiply the two numbers to get the number of damage points suffered by the target. *Guns that fire only in the Reaction Fire Phase (in response to a newly-detected target) have their damage halved.*

GUN DAMAGE MULTIPLIER TABLE

No. of Barrels Firing	Value Multiplied with Annex C1 and C3 Gun Damage			
	Short	Medium	Long	Extreme
1 - 2	1	1	1	1
3 - 4	2	1	1	1
5 - 6	3	2	2	1
7 - 8	4	3	2	1
9 - 10	5	3	3	2
11 - 12	6	4	3	2
13 - 14	7	5	4	2
15 - 16	8	5	4	3

Example: A RN *Weymouth*-class light cruiser is operating as part of a formation when the lookouts detect a German destroyer half-flotilla. The British cruiser opens fire with its 6-inch main battery. The target, a light cruiser, is at long range off the starboard beam of the RN cruiser. Five of the eight gun mounts of the British cruiser's main battery will bear (five barrels total). The German light cruiser's aspect is full broadside to the British ship and is steaming at 25 knots.

The base chance of a hit at Long range is 15% on a D100. The British player applies the following modifiers:

- Five barrels firing: +10%
- Target ship speed 25 knots: -10%
- Target size class C, broad aspect: +0%.

The modifier total is -10%. Dividing the total by two gives -0%, which is then added to the 15% base chance to hit to get the final adjusted chance to hit of 15%.

The player rolls D100 and gets an 08, resulting in a hit. The cruiser's guns (firing APC, which will penetrate the CL's armor) inflict 5 points. The multiplier for 5 guns at long

range is 2, so *Weymouth* inflicts 10 damage points on the German light cruiser.

Players do not have to keep track of gun ammunition. It is very rare for a naval gun mount to run out of ammunition during an engagement.

6.1.5 Overconcentration. Accurate shellfire required being able to see the shell splashes and correct the next salvo based on whether the previous ones were long or short of the target. These corrections were added manually, by the director officer.

If a second ship fires at the same target, the director officer will have a hard time telling which shell splashes belong to him and which belong to the other ship. A third ship makes the problem even worse, and so on.

The problem is most acute at longer ranges, when the extended time of flight makes it hard to link a salvo with its shell splashes.

For overconcentration to occur, the shell splashes must be of roughly the same size. No battleship would be confused by the splashes of a destroyer firing at the same target, but a battleship with 12-inch guns would certainly not be able to tell its splashes from those of 11-inch guns also firing at the same target.

For figuring overconcentration, large shells are 11 to 18 inches, medium shells are 5.9 to 10.9 inches, and small shells are less than 5.9 inch diameter.

If more than one ship fires at the same target, all the ships firing the same size guns at that target at Extreme range are subject to a gun hit chance modifier equal to the number of ships firing (N) at that target minus one times -5% or (N-1) x -5%.

It doesn't matter if some of the ships firing at the target are at Short, Medium or Long range. Those ships can easily link their shots with the splashes and adjust their fire, but their splashes will cause problems for ships firing at the same target from Extreme range.

Example: An armored cruiser is fired on by a battleship's main (13.5-inch) and secondary (6-inch) batteries, two light cruisers' main (6-inch) battery, and one destroyer (4-in). All 6-inch and 4-inch guns are firing at Extreme range. The battleship's main 13.5-inch battery is firing at Long range. The overconcentration penalties are:

- BB main battery: no overconcentration, the target is at Long range for this gun.
- CR main battery & BB secondary: Three ships firing medium-sized shells, penalty of (3-1) x -5% = -10%.
- DD main: no overconcentration, only one ship firing shells of that size.

6.1.6 Light Battery. A warship's light battery consists of all small caliber guns (90mm and smaller) that often made up the tertiary battery of dreadnoughts, pre-dreadnoughts and some armored cruisers. The light battery was carried as a defense against torpedo craft. However, as the effective range of torpedoes increased, the light battery became obsolete and many ships removed them in favor of antiaircraft guns.

Ships with a light battery will have it listed in Annex A, describing the composition of the battery and a number representing its strength.

For ships with a light battery rating, this represents the total firepower of all small caliber guns on board. The light battery has only two arcs of fire, port side (PS) and starboard side (SS), with each arc having half of the light battery rating. A ship's Light Battery can only attack one target on each side at a time. It cannot split its strength.

The light battery also has only three of the four gunnery range bands with the following lengths.

Range Band	Length (kyds)
Short	0.0 - 1.5
Medium	1.6 - 4.5
Long	4.5 - 7.5

To attack a surface ship with the light battery, measure the distance from the firing ship to the target and note the target's range and speed. Choose an ammunition type. Find the target's range band (Short, Medium or Long) by comparing the measured range with the lengths above.

Cross reference the light battery rating in the Light Battery Attack Table below to find the to hit modifier - remember that only half of the rating bears on any particular target. Add up the remaining applicable environmental, and target modifiers and apply them to the base chance to hit.

Roll D100. If the roll is less than or equal to the adjusted chance to hit for that range band, the target has been hit. A modified chance to hit of 0% or less means the attack automatically misses. Note the number of damage points inflicted in that range band.

The damage listed in the table is for base-fuze HE (BHE) and Common (CP) shells. If HE or nose- fuze HE (NHE) is fired, the damage is doubled. The armor penetration capability for base-fuze HE and Common shells is 2 for Short and Medium range, and 1 for Long range. Light Battery HE rounds cannot penetrate any armor at all.

Light battery guns are not counted when determining overconcentration penalties.

LIGHT BATTERY ATTACK TABLE

Light Battery Rating	To Hit Mod	Short DPs	Medium DPs	Long DPs
1.0	-2%	3	2	1
1.1 - 2.0	+0%	5	4	2
2.1 - 4.0	+2%	8	6	3
4.1 - 6.0	+4%	11	9	4
6.1 - 8.0	+6%	15	12	5
8.1 - 10.0	+8%	20	16	6
10.1 - 12.0	+10%	25	20	7

Base Chance to Hit:

Short Range:	40%
Medium Range:	20%
Long Range:	0%

Modifiers:

- Poor visibility (25%):	-5%
- Heavy seas (SS 5): (cannot fire in SS 6+)	-5%
- Target Speed 25 kts:	-5%
- Target Speed 10 kts:	+2%
- Target Stationary:	+5%
- Target Evasive:	-5%

Example: The German *Nassau*-class battleships have

GUNFIRE HIT CHANCE MODIFIERS TABLE
(GUNNERY STANDARD 1) - Pre-Dreadnought Era (1900-1909)

VISIBILITY/ENVIRONMENTAL MODIFIERS Condition				Modifier
• Visibility 25% (Ignore when target illuminated or silhouetted)				-20%
• Visibility 40% (Ignore when target illuminated or silhouetted)				-10%
• Target in line with sun - Target obscured. Must be ±10° of line from ship to sun.				-10%
• Target in line with twilight sun - Target silhouetted. Must be ±30° of line from ship to sun.				+5%
• Target silhouetted by fire.				-5%
• Target illuminated by fire or if ship is using a searchlight.				+0%
• Target illuminated by a searchlight.				+5%
• Dead Reckoning Fire - First turn of fire after a loss of visual contact on a target.				-20%
• Blind Fire - Firing at muzzle flashes. (Ignore visibility modifiers.)				-30%
• Sea State (Heavy seas make it very difficult to aim the guns properly.)	A&B	C&D	E	
SS 4	NA	-10%	-20%	
SS 5	-10%	-20%	-30%	
SS 6	-20%	-30%	NFP	
SS 7 (No Fire Possible (NFP) above Sea State 6.)	NFP	NFP	NFP	

FIRE CONTROL/GUN MODIFIERS Condition		Modifier
• First salvo on target. (Extreme range band only.)		
First salvo if new target is >15° in azimuth and 1 NM off of old target.		-10%
• Third or later salvo on target - (All range bands.)		+5%
• Overconcentration (Extreme range band only).		-5% per ship above limit
Too many ships firing at same target.		
• Firing beyond range finder capability.	Up to +2,000 yds	-5%
	+2,001 to 4,000 yds	-10%
	+4,001 to 8,000 yds	-20%
• Coincidence range finders in poor visibility (40%) - Extreme range band only.		-5%
• Ships at speeds >15 knots		-5%
• Ships that change course by 45°.		-15%
• Firing ship steering evasively. Takes precedence over course change modifier.		-20%
• Ship not engaged by larger vessel, vessel of same size, or one size class smaller		+5%
(Not applicable on the first turn of fire)		
• Number of barrels firing.		
1 - 2		+0%
3 - 4		+5%
5 - 7		+10%
8 - 10		+15%
11 +		+20%

TARGET MODIFIERS Condition	Modifier
• Target speed.	
Speed 20 knots	-10%
Speed 10 knots	+5%
Stationary ("Dead in the Water")	+10%
• Target steering evasively. (Requires min ship speed of 20 knots.)	
Size Classes C, D, E	-15%
• Target Aspect	Broad/Quarter/Narrow
Size Class A	+10% / +5% / +0%
Size Class B	+5% / +0% / -5%
Size Class C/D	+0% / -5% / -10%
Size Class E	-10% / -15% / -20%

GUNFIRE HIT CHANCE MODIFIERS TABLE
(GUNNERY STANDARD 2) - Dreadnought Era (1910-1924)

VISIBILITY/ENVIRONMENTAL MODIFIERS Condition	Modifier		
• Visibility 25% (Ignore when target illuminated or silhouetted)	-20%		
• Visibility 40% (Ignore when target illuminated or silhouetted)	-10%		
• Target in line with sun - Target obscured. Must be ±10° of line from ship to sun.	-10%		
• Target in line with twilight sun - Target silhouetted. Must be ±30° of line from ship to sun.	+5%		
• Target silhouetted by a starshell or fire.	-5%		
• Target illuminated by a starshell or fire or if ship is using a searchlight.	+0%		
• Target illuminated by a searchlight.	+5%		
• Dead Reckoning Fire - First turn of fire after a loss of visual contact on a target.	-20%		
• Blind Fire - Firing at muzzle flashes. (Ignore visibility modifiers.)	-30%		
• Sea State (Heavy seas make it very difficult to aim the guns properly.)	A&B	C&D	E
SS 4	NA	-10%	-20%
SS 5	-10%	-20%	-30%
SS 6	-20%	-30%	NFP
SS 7 (No Fire Possible (NFP) above Sea State 6.)	NFP	NFP	NFP

FIRE CONTROL/GUN MODIFIERS Condition	Modifier
• First salvo on target. (Extreme range band only.) First salvo if new target is >15° in azimuth and 1 NM off of old target.	-10%
• Third or later salvo on target - (All range bands.)	+5%
• Overconcentration (Extreme range band only). Too many ships firing at same target.	-5% per ship above limit
• Firing beyond range finder capability. Up to +5,000 yds	-5%
+5,001 to 10,000 yds	-10%
• Coincidence range finders in poor visibility (40%) - Extreme range band only.	-5%
• Pollen type fire control system (Short, Medium/Long, Extreme)	+10%/+5%
• Local Control	-15%
• Ships without a stable element that change course by 45°.	-15%
• Firing ship steering evasively. Takes precedence over course change modifier.	-20%
• Ship not engaged by larger vessel, vessel of same size, or one size class smaller (Not applicable on the first turn of fire)	+5%
• Spotter Aircraft 5 NM of the target and at Low or Medium altitude band. Calls fall of shot. (Extreme range band only.)	+5%
• Number of barrels firing.	
1 - 2	+0%
3 - 4	+5%
5 - 7	+10%
8 - 10	+15%
11 +	+20%

TARGET MODIFIERS Condition	Modifier
• Target speed.	
Speed 25 knots	-10%
Speed 10 knots	+5%
Stationary ("Dead in the Water")	+10%
• Target steering evasively. (Requires min ship speed of 20 knots.)	
Size Class B (Pre-Dreadnoughts cannot steer evasively.)	-10%
Size Classes C, D, E	-15%
• Target Aspect	Broad/Quarter/Narrow
Size Class A	+10% / +5% / +0%
Size Class B	+5% / +0% / -5%
Size Class C/D	+0% / -5% / -10%
Size Class E	-10% / -15% / -20%

a tertiary battery of 16 8.8cm SKL/45 guns. This is equivalent to a Light Battery rating of 18.3, of which 9.1 bears in the port side arc and 9.1 in the starboard side arc. A British DD at 25 knots and steering evasively is attempting to close for a torpedo attack. The chance to hit for the three range bands are:

Short: 40% + 8% - 5% - 5% = 38%
Medium: 20% + 8% - 5% - 5% = 18%
Long: 0% + 8 % - 5% - 5% = -2%

There is no attack in the Long Range band as the modified chance to hit is 0%.

If the attack was successful, then the light battery would inflict the following damage in the Short and Medium Range bands. Since German 8.8cm guns fire NHE shells, the damage is:

Short Range Damage = 2 x 20 = 40 DPs
Medium Range Damage = 2 x 16 = 32 DPs

6.1.7 Line of Fire Restrictions. A ship's line of fire to a target may be blocked. If another ship is in the gun's Short or Medium range band and is also within ±10° of the line of fire then the line of fire is blocked.

Land of 100 m elevation or more will block a ship's line of sight, although a plane can provide over-the-horizon spotting. Land of less than 100 meters elevation may still block line of sight. This will be specified in the scenario description.

6.2 Surface Ship Antiaircraft Fire. In stark contrast to the massive antiaircraft (AA) batteries on ships during WW II, there wasn't a gun capable of shooting at an aircraft until early 1909. By the beginning of WW I, most ships carried very small AA batteries, all manually aimed and without directors. By the end of the war there were more AA guns on ships, but they still lacked the ability to effectively target an aircraft outside of a few thousand yards. It wasn't until the early 1920s that the air threat was considered seriously and AA gun directors installed.

Large ships usually had two or three high angle AA guns that fired time-fuzed shells, and if they were lucky, a few machine guns. A number of destroyer classes had no AA armament at all. Given the few AA mounts and the lack of a director, ships will have very low Area and Light AA values in *FG&DN*.

There were two ways to get a hit on an attacking aircraft: either hit it directly with a shell or explode a shell nearby and hope a fragment hits the aircraft. A direct hit required a smaller shell, but more of them to get a hit. A mechanical time fuze needed a big shell, but that meant a slower rate of fire.

Most ships have two types of antiaircraft weapons. Small weapons, from 12.7mm (.50 cal.) to 65mm, fire a solid slug or impact-fuzed explosive shell. It must directly strike the aircraft to do any damage. These weapons are very short-ranged, and can only shoot at aircraft attacking the ship they are mounted on. In *FG&DN*, these are classed as "Light AA" weapons.

The second class of antiaircraft guns fired time-fuzed or proximity-fuzed shells that burst near the plane, hopefully peppering it with fragments. These shells were larger, all the way up to 120mm, and usually had directors after 1919. They had longer range, and could defend not only their own ship but others nearby. These are called "Area AA" guns.

The procedure for resolving both Area and Light AA fire is the same, and it is the same for both aircraft and airships. If there are eligible targets (described below for each type of weapon), take the AA value of a ship or land-based battery and modify it with any applicable modifiers. Roll D100 on the Antiaircraft Combat Results Table. If half or more of the aircraft being fired on meet one of the listed conditions, then apply that modifier.

The AA Modifiers table limits range to 4,000 yards. Even though many of the larger AA guns could shoot farther, they had virtually no chance of hitting an aircraft without a director. After 1919, when AA directors began to be installed on board ships, Area AA guns could be employed to the fullest extent of their range.

Exception: Airships, because of their very large size, can be engaged by AA guns at their maximum range even if the battery does not have an AA director.

One AA battery, whether it be on a ship or on land, can only engage <u>one</u> aircraft at a time. The only exception to this rule is if multiple batteries are conducting barrage fire on targets that are not visible to the gun crews. An AA battery will also only be composed of one type of gun. Thus if a ship has both 3 in/45 AA guns and Maxim MGs, they would be treated as two separate batteries for AA gun attacks.

Cross-index the modified AA value on the Antiaircraft Combat Results Table to get the chance of hitting a single aircraft. For example, if a ship has an Area AA value of 7.2 then 7.2/2 = 3.6, and it has a 2% base chance of hitting an aircraft.

If an aircraft is hit, it is either destroyed or so damaged that it must abort its mission (see section 4.13). Larger aircraft are harder to shoot down than smaller ones, thus large aircraft require two hits to shoot down.

Damage to airships from AA fire is handled differently because of their immense size. See section 8.6 on how to resolve damage on airships.

Because AA fire is abstracted and averaged over a three-minute Tactical Turn, there is no danger of AA fire accidentally striking nearby ships. While this danger would exist for a few moments in such circumstances, the gunners would cease fire for those few moments, with virtually no reduction in effective firepower, and no damage to other ships.

To fire at attacking aircraft at night, ship and land-based AA batteries must use their searchlights to illuminate the aircraft, thereby illuminating themselves, or conduct barrage fire which is much less effective.

Because of the short effective range of early AA guns, they can fire in both the Planned Fire and Reaction Fire phases without modification to the AA battery value.

Casemate guns can also be used against aircraft making torpedo attacks. Each gun used has an AA Battery rating of 0.25.

6.2.1 Antiaircraft Fire Modifiers. See the AA Battery Modifier Table for the list of circumstances which will adjust the AA battery value of a ship or land-based unit.

Example: A Gotha WD11 floatplane armed with a

ANTIAIRCRAFT BATTERY VALUE MODIFIER TABLE

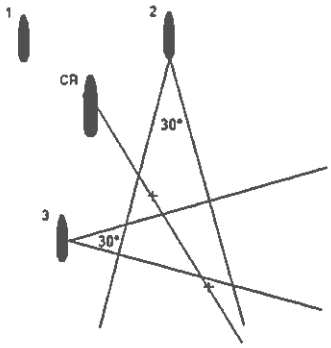
AA Gun Battery Modifiers	
AA Director	x2
- Available for land-based batteries in 1916	
- Available for sea-based batteries in 1919	
Firing ship maneuvering evasively	x0.5
Target not held visually (Barrage Fire)	x0.25
Altitude Modifiers	
Target altitude VLow/Low (0-200 m)	x2
Target altitude Low (201-1,000 m)	x1
Target altitude Medium (1,001-4,000 m)	x0.5
Target altitude Medium (4,001+ m)	x0.25
Range Modifiers (without AA Director)	
500 yards	x2
501 - 1,500 yards	x1
1,501 - 4,000 yards	x0.5
Range Modifiers (with AA Director)	
25% max range	x2
26% - 50% max range	x1
51% - 100% max range	x0.5
Target Speed Modifier	
Less than 81 knots	x2
Crossing target	x0.25
Target Size Modifiers	
Small aircraft	x1
Large aircraft	x2
Non-rigid airship	x5
Rigid airship	x10
Land-Based AA Proficiency Modifier	
1910-1915	x1
1916	x1.25
1917	x1.5
1918	x2
1919-1920	x2.5

Krupp 8.8cm antiaircraft gun *(Naval Annual 1915)*

ANTIAIRCRAFT COMBAT RESULTS TABLE

Modified AA Value	To Hit	Modified AA Value	To Hit	Modified AA Value	To Hit	Modified AA Value	To Hit
3.4	0.01	41.0-42.9	0.20	81.0-82.9	0.39	120.0-121.9	0.58
3.5-5.4	0.02	43.0-44.9	0.21	83.0-84.9	0.40	122.0-123.9	0.59
5.5-7.4	0.03	45.0-46.9	0.22	85.0-86.9	0.41	124.0-126.9	0.60
7.5-9.4	0.04	47.0-48.9	0.23	87.0-88.9	0.42	127.0-128.9	0.61
9.5-11.4	0.05	49.0-51.9	0.24	89.0-90.9	0.43	129.0-130.9	0.62
11.5-13.9	0.06	52.0-53.9	0.25	91.0-92.9	0.44	131.0-132.9	0.63
14.0-15.9	0.07	54.0-55.9	0.26	93.0-94.9	0.45	133.0-134.9	0.64
16.0-17.9	0.08	56.0-57.9	0.27	95.0-96.9	0.46	135.0-136.9	0.65
18.0-19.9	0.09	58.0-59.9	0.28	97.0-98.9	0.47	137.0-138.9	0.66
20.0-21.9	0.10	60.0-61.9	0.29	99.0-101.9	0.48	139.0-140.9	0.67
22.0-23.9	0.11	62.0-63.9	0.30	102.0-103.9	0.49	141.0-142.9	0.68
24.0-26.4	0.12	64.0-65.9	0.31	104.0-105.9	0.50	143.0-144.9	0.69
26.5-28.4	0.13	66.0-67.9	0.32	106.0-107.9	0.51	145.0-146.9	0.70
28.5-30.4	0.14	68.0-69.9	0.33	108.0-109.9	0.52	147.0-148.9	0.71
30.5-32.4	0.15	70.0-71.9	0.34	110.0-111.9	0.53	149.0-151.9	0.72
32.5-34.4	0.16	72.0-73.9	0.35	112.0-113.9	0.54	152.0-153.9	0.73
34.5-36.4	0.17	74.0-76.9	0.36	114.0-115.9	0.55	154.0-155.9	0.74
36.5-38.9	0.18	77.0-78.9	0.37	116.0-117.9	0.56	156.0+	0.75
39.0-40.9	0.19	79.0-80.9	0.38	118.0-119.9	0.57		

torpedo is making an attack run on a British battlecruiser. The floatplane is at VLow altitude and at its maximum speed of 65 knots. The BC has an AA Battery Value of 2.0 (remember only half bear) and does not have an AA director. The casemate guns will also be used to try and splash the floatplane. This increases the AA Battery rating by 2 (8 guns bearing x 0.25). The BC opens fire at a range of 1,400 yards. The modified AA value is:



- Fire Control:	NA
- A/C Speed Mod (80 kts):	x2
- A/C Size (small):	x1
- Altitude Mod (VLow):	x2
- Range Mod (.5 - 1.5 kyds):	x1

Final AA value = (1.0+2.0) x 2 x 1 x 2 x 1 = 12

Taking the final AA value and going to the Antiaircraft Combat Results Table gives a 6% chance to hit. The BC player then rolls D100. If the die roll is less than or equal to the chance to hit, the aircraft has been hit and is either shot down or has to abort the mission.

6.2.2. Small Arms Fire at Aircraft. If a ship has an embarked infantry unit (for example, a transport), they may use their personal weapons (rifles and machine guns) to fire at attacking aircraft. While not very effective, it tends to distract the pilot and improves the morale of the troops. Because of the light weapons, the fire is treated as an AA battery with a value of 1. The maximum range for small arms AA fire is 1,000 yards and for targets in the VLow/ Low band (200 m). In this instance, the range and altitude modifiers are ignored. Finally, small arms can only engage planes directly attacking their own ship.

6.2.3 Crossing Targets. If the aircraft crosses an arc of 30 degrees or more from the viewpoint of the firing ship in one Tactical Turn, the aircraft is a "crossing target". A crossing target does not present a steady bearing to the firing ship, making it virtually impossible to track and hit with these early systems. If an AA battery engages a crossing target, quarter the battery's AA value.

Example: A German cruiser is being attacked by a Short Admiralty Type 184 float plane. From the point of view of destroyer #3, the target covers more than 30° in one turn, so it is a crossing target. Destroyer #2, also covering the cruiser, however, sees a steady target. It has a better chance of shooting the Short Type 184 down, because from its point of view, the float plane does not cross 30° of arc.

6.2.4 Antiaircraft Fire and Dogfights. Dogfighting aircraft can be fired on by AA guns. This may happen if defending aircraft follow attackers into AA gun range, or if a dogfight "drifts" into AA range because of its random movement.

The ship's player must decide whether or not to fire his AA guns. If he does, he cannot pick only enemy aircraft as targets. AA gunners had enough trouble telling friend from foe under normal circumstances, but in a swirling melee, it is impossible to only shoot at enemy aircraft. His own friendly aircraft are also at risk.

The player firing his AA guns declares that he is engaging "the dogfight." If he hits, roll randomly to see which plane is shot down.

6.2.5 AA Fire Against Surface Ships. Since there were very few AA guns on a ship, and because their magazines were full of time-fuzed HE or shrapnel rounds, they were ineffective against surface targets. Therefore, because of their specialized nature, AA guns can not engage ships.

6.3 Surface-Launched Torpedoes. Destroyers, cruisers, and most capital ships carried torpedo tubes. These were the early equivalent of a cruise missile, an "equalizer," a way for a small ship to cripple or sink a larger one. Above water tubes, those on most ships, usually could not be reloaded until a ship reached port, so they were saved for a good target, then delivered at point-blank range or close to it. Internal torpedo tubes, usually on battleships and battlecruisers, could be reloaded.

Torpedoes must be fired against a target that has been visually detected. They cannot be fired in a barrage attack into a general area. In addition, they cannot hit small craft, such as coastal torpedo boats or barges (size class E).

Range for torpedoes is measured from the geographic point of firing to the torpedo's current position. If the distance traveled by the torpedo since its launch is greater than the listed range, the torpedo runs out of fuel and automatically misses.

The following rules apply to torpedo attacks from surface ships and submarines. All the torpedoes listed in *FG&DN* are straight-running torpedoes.

6.3.1 Straight-Running Torpedoes. Torpedoes of this era have no guidance systems and before 1900, they didn't even have internal gyros. The only necessary presets were running depth, speed and a course, which hopefully would intersect that of their targets. Once launched, torpedoes travel in a straight line until they hit something or run out of fuel and sink.

On board ships of this era, dedicated torpedo fire control equipment was very primitive, if fitted at all, and firing angles were estimated visually. With such meager means, it was extremely difficult to track a potential target and compute an intercept course for the torpedo. Thus, most successful attacks were made from very short range. In many cases, the speed of a torpedo was about twice that of its target, but this was only possible over a very short range. This means the "Deflection Angle," the amount

of lead, must be fairly large to even have a chance of hitting. *FG&DN* players can use the Torpedo Deflection Angle Table provided in the rules to compute their own "lead angle" and fire their spreads.

On the turn of launch, a ship or submarine must steer in a straight line. It is allowed to make one 45° turn (within normal maneuvering limits) at the beginning of the three-minute Tactical Turn, but afterwards must steer in a straight line. Surface ships launching torpedoes cannot use evasive steering, and submarines cannot evade depth charges.

Torpedoes must be set at the time of launch to run shallow or deep. Shallow weapons will hit any ship of Size Class D or larger, but will strike the belt armor of larger ships, which reduces their effectiveness. Deep torpedoes will run under smaller ships (size classes C and D) but will hit a larger ship under the belt armor.

Most torpedoes used in WW I and after can have their gyro "set" to run on a particular course, which need not be the same direction as the launching tube is facing. Most of them could have their "gyro angle" set up to ±45° off the axis of the torpedo tube.

There were still many earlier forms of straight-running torpedoes in use up until about 1915, which required that the launching tube be pointed directly along the intended course. These torpedoes are noted in Annex E as being "non-gyro" straight runners.

On the turn of launch, place a torpedo counter next to the firing ship, along with a Datum marker that will let the player measure the length of its run. The torpedo moves in the Movement Phase of the following turns. Record the torpedo's course, speed and the number of weapons in the spread on the firing ship's log sheet.

After a torpedo is launched on its preset course and speed, they cannot be changed. If a target maneuvers, changing either course or speed, the torpedo may miss, passing through the predicted point but with no ship there to meet it. Enemy ships may zig-zag to frustrate a torpedo shooter's aim, and if a ship sees an approaching torpedo, will almost certainly try to "comb the wake," turning bow or stern-on to the weapon to present the smallest target aspect possible.

Straight-running torpedoes set deep or shallow can attack surface ships or subs on the surface. Submarines at Periscope Depth can be attacked by torpedoes set to run deep. Shallow torpedoes will pass overhead. Straight-running torpedoes will never hit a submerged sub below Periscope Depth.

These early torpedoes had sensitive depth sensing systems, thus they were significantly affected by Sea State. For Sea States 1-4, there are no modifiers to the Torpedo Attack Tables chances to hit. In Sea State 5, there is a penalty, which is described in Section 6.3.2. At sea state 6 and higher, torpedoes will not function properly and will automatically miss the target.

Aiming Torpedoes: Measure the *target angle* of the enemy ship to be attacked by torpedoes. The target angle is measured from the bow of the target ship along its length and a line drawn to the firing ship. Target angle and target speed combine to create the target's apparent motion across your line of sight.

On the upper part of the Torpedo Deflection Angle Table, cross-reference the target angle and target speed. The resulting number is the target's apparent crossing speed, its speed across the firing unit's line of sight.

Next, on the lower part of the table, find the column that matches the torpedo's speed and go down it until you find the closest match to the apparent speed. In case of an even split, average the two values. Follow that row to the right and this is the deflection angle that you must use to hit the target. *This is the hard part: If the firer is on the target's starboard side, add this angle to the bearing to the target. If the firer is on the port side, subtract it from the bearing.*

The result is the torpedo course that will hit the target provided the target does not maneuver after the torpedoes are launched.

Often a spread of torpedoes, fanned out at slightly different angles, was fired to increase the chance of a hit. If a player wants to fire more than one torpedo, he just decides how many torpedoes are in the spread. This can be as many weapons as he wants, up to the number of tubes on an individual mount. The tables automatically assume that more than one weapon is fanned out.

Example: The German B 97 class destroyer has six 19.7in torpedo tubes. Two are single tube mounts forward, one to port and the other to starboard. The remaining four are in two mounts of two tubes each located on the ship's after centerline. The largest individual salvo size this destroyer can fire is a two torpedo salvo.

The exception to this rule are submarines, which can fire *all torpedo tubes that bear* on the target as a single salvo (up to four torpedoes) even though their tubes are split into two mounts (port and starboard nests).

Torpedo Movement to Target. In every Movement Phase the turn after they were fired, torpedoes move at their rated speed in a straight line on the course decided by the player (within the tubes' firing arc). Depending on the targets' maneuvers after launch, the torpedoes may or may not be at the expected point of intercept. In addition, another ship (friendly as well as enemy) may be struck by the torpedoes if it gets in the way.

If a torpedo spread comes within 500 yards (*Note:* See optional rule below) of an eligible target, that unit is attacked by the spread and the torpedo attack should be resolved against it.

Torpedoes move like any other surface ship or sub. If there appears to be a chance of a torpedo spread and a ship's path intersecting, use proportional movement to see if the torpedoes pass close enough to warrant an attack.

Torpedo Danger Zone Size *(optional rule).* As a spread of torpedoes moves away from the launch point, it fans out slightly, with the size of the danger zone depending on how many torpedoes were fired and how far they have moved. Instead of a 500-yard danger zone, use the distances listed in the Torpedo Danger Zone Table below.

Datum Marker. Use to mark torpedo launch point, lost sub contact, or other geographic point.

TORPEDO DANGER ZONE TABLE

Torp in Spread	*Range (kyds) 0.5-5.0*	*5.1-10.0*	*10.1-16.0*
6	500	1000	2000
5	500	1000	2000
4	500	1000	1000
3	500	500	1000
2 &1	500	500	500

6.3.2 Resolving Torpedo Attacks. When a salvo of torpedoes reaches a ship (the intended target or another that gets in the way) the attacking player must roll to see how many torpedoes actually hit.

This is based on the target's actual size (battleship, cruiser, destroyer, etc.) and the angle from which the torpedoes attack. A side shot on a destroyer stands a better chance of hitting than a bow-on attack on a battleship.

Find the target's *effective length* by using the Torpedo Aspect Table on page 6-11.

First, look at the diagram to see from what angle the torpedoes are attacking the ship. The degree numbers around the edges of the box refer to *relative* bearings, in other words, the bearing of the torpedo relative to the target ship's bow. A broad target aspect is the best, and a narrow target aspect is the worst.

Cross-index the ship's real size with its angle, the resulting Roman numeral is the table to use to resolve the attack. Combat Results Table I is the best, Table VI is the worst.

There are two sets of Torpedo Combat Results Tables. The first set is for torpedoes that came into service between 1900 and 1907. The other set covers the time period 1908 through 1924. Depending on the table used, there will be listings for salvo sizes up to a maximum of two or four weapons. Once the correct Torpedo Combat Results Table is selected, choose the appropriate chart for the number of torpedoes in the spread.

Now measure the distance from the impact point back to the firing point (where the datum marker was placed). *Note: torpedo run at impact is not necessarily the same as target range at time of fire.* The range that matters is not the range at the time of fire, but at impact. This is how far the torpedo has actually traveled, and this is what affects its chance to hit.

TORPEDO DEFLECTION ANGLE TABLE

Target Angle \ *Target Speed*	5	10	15	20	25	30	35	40
10	1	2	3	3	4	5	6	7
20	2	3	5	7	9	10	12	14
30	3	5	8	10	13	15	18	20
40	3	6	10	13	16	19	23	26
50	4	8	12	15	19	23	27	31
60	4	9	13	17	22	26	30	35
70	5	9	14	19	24	28	33	38
80	5	10	15	20	25	30	34	39
90	5	10	15	20	25	30	35	40

Torpedo Speed 15	20	25	30	35	40	45	50	*Deflection Angle*
3	3	4	5	6	7	8	9	10
5	7	9	10	12	14	15	17	20
8	10	13	15	18	20	23	25	30
10	13	16	19	23	26	29	32	40
12	15	19	23	27	31	35	38	50
13	17	22	26	30	35	39	43	60
14	19	24	28	33	38	42	47	70
15	20	25	30	34	39	44	49	80
15	20	25	30	35	40	45	50	90

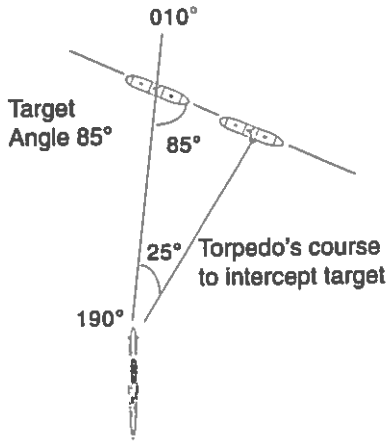
Unguided Torpedo Firing Example

1. Target ship's track. Course 105° T, speed 15 knots.

2. Line of Sight between firing ship and target 10° T.

3. Apparent target speed is 15 knots, torpedo speed is 35 knots

4. Deflection (lead) angle is 25°.



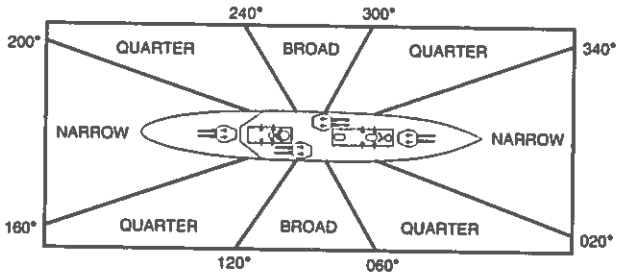
Look down the Range column for the range closest to the torpedo's run. Round even splits up, i.e., 3,700 yards becomes 4,000 yards.

Roll D100, and starting at the right, compare the result to the hit chances in the corresponding row. If the die roll is that value or less, the number at the top of the column is the number that have hit the target.

As the number rolled gets bigger, the number of torpedoes that hit the target get smaller. If the die roll is bigger than the number in the column with "1" at the top, all the torpedoes in the spread missed.

TORPEDO ASPECT TABLE

Aspect	Ship Size Class A	B	C	D & E
Broad	I	II	III	III
Quarter	II	III	IV	IV
Narrow	IV	V	VI	VI



Example: An Austrian *U 7*-class sub fires a spread of four C/06 AV torpedoes at a medium (size class C) merchant ship. At the time of impact the merchant had a broad aspect and the torpedo run was 1,400 yards. Looking on the **Torpedo Aspect Table** we find that a medium merchant with a broad aspect is resolved on **1908-1924 Torpedo Combat Result Table III.** Finding the **Spread Size =4** section and cross referencing a torpedo run of 1,500 yards (closest to 1,400 yards) we get the following probability of hit values:

Range	1	2	3	4
1,500	0.40	0.07	0.01	-

This means:

Die roll of 41 - 00	no hits
Die roll of 08 - 40	1 hit
Die roll of 02 - 07	2 hits
Die roll of 01	3 hits

No chance for 4 hits.

Rolling D100, the result is 22 which is less than 40 but more than 07 thus the merchant was hit by one C\06 AV torpedo.

Any torpedoes in the spread that miss the intended target may hit other targets, if they are in their path and in range. Treat the remaining torpedoes as a salvo with the appropriate number of weapons.

If the target ship is stationary (speed zero, "dead in the water"), move four lines up on the torpedo attack table.

Example: A single torpedo is fired at a stationary ship. At the end of its run, it has covered 4,000 yards. Instead of using the 4,000 yard line, use the 2,000 yard line. This compensates for the difficulty in estimating a target's exact speed, which does not exist with a stationary ship.

If a torpedo is not equipped with an internal gyro, listed in Annex E as a "non-gyro" straight runner, move three lines down on the torpedo attack table.

If a torpedo is fired in Sea State 5, move two lines down on the torpedo attack table. Torpedoes fired in Sea States of 6 or higher automatically miss.

6.3.3 Torpedo Depths. Torpedoes can be set to attack either shallow-draft or deep-draft targets. Torpedoes set deep will not hit light cruisers, destroyers or smaller craft (size class C or D), but will hit larger ships below the armor belt. If they are set shallow, they will hit any ship, but if they hit a cruiser or larger vessel (Size class A or B) with armor, it will hit the main armor belt and will have a reduced effectiveness. The effect of armor on torpedoes is described in section 8.1.7.

6.3.4 Torpedo Nets. Because of the significant damage potential of torpedoes, navies added anti-torpedo nets to provide protection to capital ships. Unfortunately, these nets proved to be worthless when the ship travelled a any significant speed. By 1916, they were all but removed and torpedo defense was only provided in harbor by dedicated defensive nets and booms.

The effectiveness of an anti-torpedo net depended on the speed of the torpedo and the speed of the ship, with the latter having the greatest effect. To a certain extent, torpedo size also played a role. The base chance of a net intercepting a torpedo is determined by the torpedo's speed and is modified by the size of the torpedo and the target's speed. If a torpedo is successfully intercepted it does no damage to the target.

It takes D6/2 Tactical Turns to deploy a ship's torpedo netting and D6 Tactical Turns to stow it. With the netting deployed, a ship's maximum speed is reduced by 25% because of the extra drag. It takes ten Tactical Turns to deploy or retrieve harbor-based torpedo defense nets.

Torpedo Net Base Intercept Probability

Ship Net Defense
Torpedo speed 30 kts: 20% per torpedo
Torpedo speed <30 kts: 40% per torpedo

Harbor Net Defense
Torpedo speed 30 kts: 60% per torpedo
Torpedo speed <30 kts: 80% per torpedo

Modifiers:
Torpedo size - 17.7in (450mm) in diameter: +10%
Ship speeds >5 kts: -10%/knot

Example: A battleship with its torpedo nets deployed is traveling at 8 knots when it is attacked by a submarine firing 17.7in torpedoes. The torpedoes are at a speed of 27 knots. The chance of intercept by the torpedo net is:

Base Chance: 40% (torpedo speed <30 kts)
Torpedo Size: +10% (torpedo 17.7in in diameter)
Ship Speed: - 30% (-10% x (8 kts - 5 kts)

Final Interception Chance = 40% + 10% - 30% = 20%

6.4 Surface Ship Attacks on Submarines. Antisubmarine Warfare (ASW) is the duel between surface and subsurface vessels. In WW I, the submarine was at a severe disadvantage against surface combatants, with short endurance, slow speeds, and only a limited ability to defend itself if cornered. The submarine's only advantage lay in its inherent stealth, which allowed them to execute a surprise attack and hopefully, a covert withdrawal.

1900 - 1907 TORPEDO COMBAT RESULTS TABLES

TORPEDO CRT I

Salvo Size = 1		Salvo Size = 2		
Torp Run (Yards)	1 (Ph)	Torp Run (Yards)	1 (Ph)	2 (Ph)
500	0.48	500	0.73	0.23
750	0.33	750	0.55	0.11
1000	0.25	1000	0.44	0.06
1500	0.17	1500	0.31	0.03
2000	0.13	2000	0.24	0.02
2500	0.10	2500	0.19	0.01
3000	0.08	3000	0.16	0.01
3500	0.07	3500	0.14	0.01
4000	0.06	4000	0.12	-
4500	0.06	4500	0.11	-
5000	0.05	5000	0.10	-
5500	0.05	5500	0.09	-
6000	0.04	6000	0.08	-
6500	0.04	6500	0.07	-
7000	0.03	7000	0.06	-
8000	0.03	8000	0.05	-
9000	0.02	9000	0.04	-
10000	0.02	10000	0.03	-
11000	0.01	11000	0.02	-
12000	0.01	12000	0.02	-

TORPEDO CRT II

Salvo Size = 1		Salvo Size = 2		
Torp Run (Yards)	1 (Ph)	Torp Run (Yards)	1 (Ph)	2 (Ph)
500	0.37	500	0.60	0.13
750	0.25	750	0.44	0.06
1000	0.19	1000	0.34	0.04
1500	0.13	1500	0.24	0.02
2000	0.10	2000	0.18	0.01
2500	0.08	2500	0.15	0.01
3000	0.06	3000	0.12	-
3500	0.05	3500	0.11	-
4000	0.05	4000	0.09	-
4500	0.04	4500	0.08	-
5000	0.04	5000	0.07	-
5500	0.03	5500	0.07	-
6000	0.03	6000	0.06	-
6500	0.02	6500	0.05	-
7000	0.02	7000	0.04	-
8000	0.01	8000	0.03	-
9000	0.01	9000	0.03	-
10000	0.01	10000	0.02	-
11000	-	11000	0.02	-
12000	-	12000	0.01	-

TORPEDO CRT III

Salvo Size = 1		Salvo Size = 2		
Torp Run (Yards)	1 (Ph)	Torp Run (Yards)	1 (Ph)	2 (Ph)
500	0.25	500	0.44	0.06
750	0.17	750	0.31	0.03
1000	0.13	1000	0.24	0.02
1500	0.08	1500	0.16	0.01
2000	0.06	2000	0.12	-
2500	0.05	2500	0.10	-
3000	0.05	3000	0.09	-
3500	0.04	3500	0.08	-
4000	0.04	4000	0.07	-
4500	0.03	4500	0.06	-
5000	0.03	5000	0.05	-
5500	0.02	5500	0.04	-
6000	0.02	6000	0.04	-
6500	0.02	6500	0.03	-
7000	0.01	7000	0.02	-
8000	0.01	8000	0.02	-
9000	0.01	9000	0.01	-
10000	-	10000	0.01	-

TORPEDO CRT IV

Salvo Size = 1		Salvo Size = 2		
Torp Run (Yards)	1 (Ph)	Torp Run (Yards)	1 (Ph)	2 (Ph)
500	0.19	500	0.34	0.04
750	0.13	750	0.24	0.02
1000	0.10	1000	0.18	0.01
1500	0.06	1500	0.12	-
2000	0.05	2000	0.09	-
2500	0.04	2500	0.08	-
3000	0.04	3000	0.07	-
3500	0.03	3500	0.06	-
4000	0.03	4000	0.05	-
4500	0.02	4500	0.04	-
5000	0.02	5000	0.04	-
5500	0.02	5500	0.03	-
6000	0.01	6000	0.02	-
6500	0.01	6500	0.02	-
7000	0.01	7000	0.02	-
8000	-	8000	0.01	-
9000	-	9000	0.01	-
10000	-	10000	-	-

1900 - 1907 TORPEDO COMBAT RESULTS TABLES (cont.)

TORPEDO CRT V

Salvo Size = 1		Salvo Size = 2		
Torp Run (Yards)	1 (Ph)	Torp Run (Yards)	1 (Ph)	2 (Ph)
500	0.13	500	0.24	0.02
750	0.08	750	0.16	0.01
1000	0.06	1000	0.12	-
1500	0.05	1500	0.10	-
2000	0.04	2000	0.08	-
2500	0.03	2500	0.05	-
3000	0.03	3000	0.06	-
3500	0.02	3500	0.04	-
4000	0.02	4000	0.03	-
4500	0.01	4500	0.03	-
5000	0.01	5000	0.02	-
5500	0.01	5500	0.02	-
6000	-	6000	0.01	-
6500	-	6500	0.01	-

TORPEDO CRT VI

Salvo Size = 1		Salvo Size = 2		
Torp Run (Yards)	1 (Ph)	Torp Run (Yards)	1 (Ph)	2 (Ph)
500	0.08	500	0.15	0.01
750	0.05	750	0.10	-
1000	0.04	1000	0.07	-
1500	0.03	1500	0.06	-
2000	0.03	2000	0.05	-
2500	0.02	2500	0.04	-
3000	0.02	3000	0.03	-
3500	0.01	3500	0.03	-
4000	0.01	4000	0.02	-
4500	0.01	4500	0.02	-
5000	-	5000	0.01	-
5500	-	5500	0.01	-
6000	-	6000	-	-
6500	-	6500	-	-

Submarines in WW I were just in their infancy, and while most were well-designed vessels, the technologies used in their construction had never been tested in combat. Fortunately for the submarine, until the middle part of WW I there was virtually no means to counter them. During the war, however, major strides were made both in the design and construction of submarines and the means to locate and destroy them, although, for the first part of the war the most effective ASW tactic was ramming the submarine as it tried to submerge.

Surfaced submarines may be attacked by torpedoes, guns, bombs, or other weapons as a normal surface ship target. They are classed as minor combatants for Critical Hit purposes. Regular gunfire and aerial ordnance are largely ineffective against submarines at Periscope depth, although, some specialized guns and bombs were developed to counter this threat.

Subs may be attacked at Periscope depth by unguided torpedoes if their exact position is known (from a periscope sighting, for instance). A submarine at Periscope depth is only just submerged and will stop an unguided torpedo just like any other surface vessel. It can be hit by torpedoes set to run deep; shallow weapons will pass over the sub.

There are two weapons used by ships to attack a submerged sub at any depth: depth charges and the towed explosive paravane. Each type is handled differently.

6.4.1 Depth Charges. Surface ships can attack submarines with depth charges dropped from rails mounted on the deck or fired from projectors. Initially, ships would only have two to four depth charges on deck-mounted racks. By the end of the war, most ASW ships had depth charge rails and a "Y" gun or a pair of "K" guns.

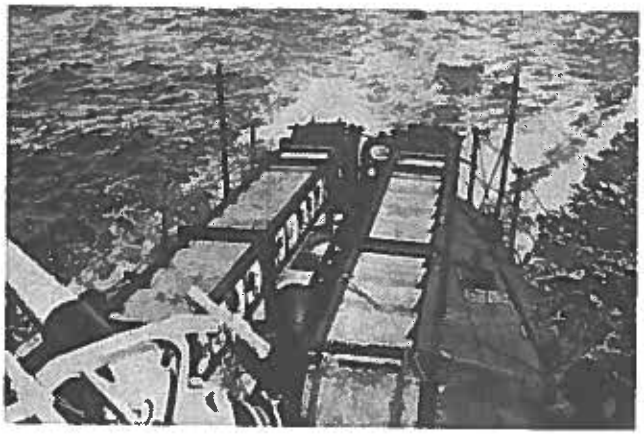
A depth charge usually had 150 to 300 pounds of explosive in a cylindrical casing with either a mechanical timer or a hydrostatic fuze. When the timer ran down or the water pressure at a certain level matched the preset depth, the charge would detonate. If the charge went off close enough to the sub, the shock from the exploding charge would damage the boat. If the charge went off really close, it would rupture the pressure hull and sink the submarine.

A surface ship that detected a submarine would drive directly over the sub's position, rolling depth charges off its stern and using projectors, or throwers, to lob them about 60 yards away from the ship. The charges were set (hopefully) to detonate at the same depth as the sub.

6.4.1.1 DC Launcher Types. Depth charges (DC) could be laid by several types of devices. The simplest was the DC rack, which held one charge, which could be dropped off the stern.

The next type was the Rail, which held as many as 13 charges or as few as three. Some rails have two capacities, depending on the size of depth charge loaded. A device on the stern released one charge at a time, on command. A rail can drop as many charges per Tactical Turn as is required for a pattern.

Rails by themselves can only lay charges in a line behind the ship. To widen the size of a pattern, projectors were developed which used a small explosive charge to



US Navy Mk I Mod DC rails *(US Navy)*

1908 - 1924 TORPEDO COMBAT RESULTS TABLES

TORPEDO CRT I

Salvo Size = 1		Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run 1		Torp Run 1		2	Torp Run 1		2	3	Torp Run 1		2	3	4
(Yards)	(Ph)	(Yards)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Ph)
500	0.64	500	0.85	0.41	500	0.85	0.70	0.26	500	0.85	0.78	0.55	0.17
750	0.46	750	0.71	0.21	750	0.84	0.44	0.10	750	0.85	0.63	0.26	0.04
1000	0.35	1000	0.58	0.12	1000	0.73	0.28	0.04	1000	0.82	0.44	0.13	0.02
1500	0.24	1500	0.42	0.06	1500	0.56	0.15	0.01	1500	0.67	0.24	0.05	0.01
2000	0.18	2000	0.33	0.03	2000	0.45	0.09	0.01	2000	0.55	0.15	0.02	-
2500	0.15	2500	0.26	0.02	2500	0.39	0.06	-	2500	0.48	0.11	0.01	-
3000	0.12	3000	0.23	0.01	3000	0.32	0.04	-	3000	0.40	0.07	0.01	-
3500	0.10	3500	0.19	0.01	3500	0.27	0.03	-	3500	0.34	0.05	-	-
4000	0.09	4000	0.17	0.01	4000	0.25	0.02	-	4000	0.31	0.04	-	-
4500	0.08	4500	0.15	-	4500	0.22	0.02	-	4500	0.28	0.03	-	-
5000	0.07	5000	0.14	-	5000	0.20	0.01	-	5000	0.25	0.03	-	-
6000	0.06	6000	0.12	-	6000	0.17	0.01	-	6000	0.22	0.02	-	-
7000	0.05	7000	0.10	-	7000	0.14	0.01	-	7000	0.19	0.01	-	-
8000	0.05	8000	0.09	-	8000	0.14	-	-	8000	0.19	0.01	-	-
9000	0.04	9000	0.08	-	9000	0.12	-	-	9000	0.15	0.01	-	-
10000	0.04	10000	0.07	-	10000	0.12	-	-	10000	0.15	-	-	-
11000	0.03	11000	0.06	-	11000	0.09	-	-	11000	0.11	-	-	-
12000	0.03	12000	0.05	-	12000	0.09	-	-	12000	0.11	-	-	-
13000	0.02	13000	0.04	-	13000	0.06	-	-	13000	0.08	-	-	-
14000	0.02	14000	0.03	-	14000	0.06	-	-	14000	0.08	-	-	-
15000	0.01	15000	0.02	-	15000	0.03	-	-	15000	0.04	-	-	-
16000	0.01	16000	0.02	-	16000	0.03	-	-	16000	0.04	-	-	-

TORPEDO CRT II

Salvo Size = 1		Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run 1		Torp Run 1		2	Torp Run 1		2	3	Torp Run 1		2	3	4
(Yards)	(Ph)	(Yards)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Ph)
500	0.51	500	0.76	0.26	500	0.85	0.51	0.13	500	0.94	0.70	0.33	0.07
750	0.35	750	0.58	0.12	750	0.73	0.28	0.04	750	0.82	0.44	0.13	0.02
1000	0.27	1000	0.47	0.07	1000	0.61	0.18	0.02	1000	0.72	0.30	0.06	0.01
1500	0.18	1500	0.33	0.03	1500	0.45	0.09	0.01	1500	0.55	0.15	0.02	-
2000	0.14	2000	0.26	0.02	2000	0.36	0.05	-	2000	0.45	0.10	0.01	-
2500	0.11	2500	0.21	0.01	2500	0.30	0.03	-	2500	0.37	0.06	-	-
3000	0.09	3000	0.17	0.01	3000	0.25	0.02	-	3000	0.31	0.04	-	-
3500	0.08	3500	0.15	0.01	3500	0.22	0.02	-	3500	0.28	0.03	-	-
4000	0.07	4000	0.14	-	4000	0.20	0.01	-	4000	0.25	0.03	-	-
4500	0.06	4500	0.12	-	4500	0.17	0.01	-	4500	0.22	0.02	-	-
5000	0.05	5000	0.10	-	5000	0.14	0.01	-	5000	0.19	0.01	-	-
6000	0.05	6000	0.10	-	6000	0.14	-	-	6000	0.19	0.01	-	-
7000	0.04	7000	0.08	-	7000	0.12	-	-	7000	0.15	0.01	-	-
8000	0.04	8000	0.09	-	8000	0.12	-	-	8000	0.15	-	-	-
9000	0.03	9000	0.06	-	9000	0.09	-	-	9000	0.11	-	-	-
10000	0.03	10000	0.07	-	10000	0.09	-	-	10000	0.11	-	-	-
11000	0.02	11000	0.04	-	11000	0.06	-	-	11000	0.08	-	-	-
12000	0.02	12000	0.05	-	12000	0.06	-	-	12000	0.08	-	-	-
13000	0.02	13000	0.04	-	13000	0.06	-	-	13000	0.05	-	-	-
14000	0.01	14000	0.03	-	14000	0.03	-	-	14000	0.04	-	-	-
15000	0.01	15000	0.02	-	15000	0.02	-	-	15000	0.03	-	-	-
16000	-	16000	0.01	-	16000	0.02	-	-	16000	0.03	-	-	-

1908 - 1924 TORPEDO COMBAT RESULTS TABLES (cont.)

TORPEDO CRT III

Salvo Size = 1		Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run 1		Torp Run 1		2	Torp Run 1		2	3	Torp Run 1		2	3	4
(Yards)	(Ph)	(Yards)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Ph)
500	0.35	500	0.58	0.12	500	0.73	0.28	0.04	500	0.82	0.44	0.13	0.02
750	0.24	750	0.42	0.06	750	0.56	0.15	0.02	750	0.67	0.24	0.05	0.01
1000	0.18	1000	0.33	0.03	1000	0.45	0.09	0.01	1000	0.55	0.15	0.02	-
1500	0.12	1500	0.23	0.01	1500	0.32	0.04	-	1500	0.40	0.07	0.01	-
2000	0.09	2000	0.17	0.01	2000	0.25	0.02	-	2000	0.31	0.04	-	-
2500	0.07	2500	0.14	-	2500	0.20	0.01	-	2500	0.25	0.03	-	-
3000	0.06	3000	0.12	-	3000	0.17	0.01	-	3000	0.22	0.02	-	-
3500	0.05	3500	0.11	-	3500	0.14	0.01	-	3500	0.19	0.01	-	-
4000	0.05	4000	0.10	-	4000	0.14	0.01	-	4000	0.19	0.01	-	-
4500	0.04	4500	0.09	-	4500	0.12	-	-	4500	0.15	0.01	-	-
5000	0.04	5000	0.08	-	5000	0.12	-	-	5000	0.15	-	-	-
6000	0.03	6000	0.07	-	6000	0.09	-	-	6000	0.11	-	-	-
7000	0.03	7000	0.06	-	7000	0.09	-	-	7000	0.11	-	-	-
8000	0.02	8000	0.05	-	8000	0.06	-	-	8000	0.08	-	-	-
9000	0.02	9000	0.04	-	9000	0.06	-	-	9000	0.08	-	-	-
10000	0.02	10000	0.04	-	10000	0.06	-	-	10000	0.08	-	-	-
11000	0.01	11000	0.03	-	11000	0.03	-	-	11000	0.04	-	-	-
12000	0.01	12000	0.02	-	12000	0.03	-	-	12000	0.04	-	-	-
13000	0.01	13000	0.02	-	13000	0.03	-	-	13000	0.04	-	-	-
14000	-	14000	0.01	-	14000	0.02	-	-	14000	0.03	-	-	-
15000	-	15000	0.01	-	15000	0.02	-	-	15000	0.03	-	-	-
16000	-	16000	-	-	16000	0.01	-	-	16000	0.02	-	-	-

TORPEDO CRT IV

Salvo Size = 1		Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run 1		Torp Run 1		2	Torp Run 1		2	3	Torp Run 1		2	3	4
(Yards)	(Ph)	(Yards)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Ph)
500	0.27	500	0.47	0.07	500	0.61	0.18	0.02	500	0.72	0.30	0.06	0.01
750	0.18	750	0.33	0.03	750	0.45	0.09	0.01	750	0.55	0.15	0.02	-
1000	0.14	1000	0.26	0.02	1000	0.36	0.05	-	1000	0.45	0.10	0.01	-
1500	0.09	1500	0.17	0.01	1500	0.25	0.02	-	1500	0.31	0.04	-	-
2000	0.07	2000	0.14	-	2000	0.20	0.01	-	2000	0.25	0.03	-	-
2500	0.06	2500	0.12	-	2500	0.17	0.01	-	2500	0.22	0.02	-	-
3000	0.05	3000	0.10	-	3000	0.14	0.01	-	3000	0.19	0.01	-	-
3500	0.04	3500	0.08	-	3500	0.12	-	-	3500	0.15	0.01	-	-
4000	0.03	4000	0.07	-	4000	0.09	-	-	4000	0.11	0.01	-	-
4500	0.03	4500	0.06	-	4500	0.09	-	-	4500	0.11	-	-	-
5000	0.02	5000	0.05	-	5000	0.06	-	-	5000	0.08	-	-	-
6000	0.02	6000	0.04	-	6000	0.06	-	-	6000	0.08	-	-	-
7000	0.02	7000	0.03	-	7000	0.06	-	-	7000	0.08	-	-	-
8000	0.01	8000	0.02	-	8000	0.03	-	-	8000	0.04	-	-	-
9000	0.01	9000	0.02	-	9000	0.03	-	-	9000	0.04	-	-	-
10000	0.01	10000	0.02	-	10000	0.03	-	-	10000	0.04	-	-	-
11000	-	11000	0.01	-	11000	0.02	-	-	11000	0.03	-	-	-
12000	-	12000	0.01	-	12000	0.02	-	-	12000	0.03	-	-	-
13000	-	13000	-	-	13000	0.01	-	-	13000	0.02	-	-	-
14000	-	14000	-	-	14000	0.01	-	-	14000	0.01	-	-	-
15000	-	15000	-	-	15000	-	-	-	15000	0.01	-	-	-

1908 - 1924 TORPEDO COMBAT RESULTS TABLES (cont.)

TORPEDO CRT V

Salvo Size = 1		Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run 1		Torp Run 1		2	Torp Run 1		2	3	Torp Run 1		2	3	4
(Yards)	(Ph)	(Yards)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Ph)
500	0.18	500	0.33	0.03	500	0.45	0.09	0.01	500	0.55	0.15	0.02	0.01
750	0.12	750	0.23	0.01	750	0.32	0.04	-	750	0.40	0.07	0.01	-
1000	0.09	1000	0.17	0.01	1000	0.25	0.02	-	1000	0.31	0.04	-	-
1500	0.06	1500	0.12	-	1500	0.17	0.01	-	1500	0.22	0.02	-	-
2000	0.05	2000	0.10	-	2000	0.14	0.01	-	2000	0.19	0.01	-	-
2500	0.04	2500	0.08	-	2500	0.12	-	-	2500	0.15	0.01	-	-
3000	0.03	3000	0.06	-	3000	0.09	-	-	3000	0.11	0.01	-	-
3500	0.03	3500	0.06	-	3500	0.09	-	-	3500	0.11	-	-	-
4000	0.02	4000	0.04	-	4000	0.06	-	-	4000	0.08	-	-	-
4500	0.02	4500	0.04	-	4500	0.06	-	-	4500	0.08	-	-	-
5000	0.02	5000	0.04	-	5000	0.06	-	-	5000	0.08	-	-	-
6000	0.01	6000	0.02	-	6000	0.03	-	-	6000	0.04	-	-	-
7000	0.01	7000	0.02	-	7000	0.03	-	-	7000	0.04	-	-	-
8000	0.01	8000	0.02	-	8000	0.03	-	-	8000	0.04	-	-	-
9000	-	9000	0.01	-	9000	0.02	-	-	9000	0.03	-	-	-
10000	-	10000	0.01	-	10000	0.02	-	-	10000	0.03	-	-	-
11000	-	11000	0.01	-	11000	0.02	-	-	11000	0.02	-	-	-
12000	-	12000	-	-	12000	0.01	-	-	12000	0.02	-	-	-
13000	-	13000	-	-	13000	0.01	-	-	13000	0.01	-	-	-
14000	-	14000	-	-	14000	-	-	-	14000	0.01	-	-	-

TORPEDO CRT VI

Salvo Size = 1		Salvo Size = 2			Salvo Size = 3				Salvo Size = 4				
Torp Run 1		Torp Run 1		2	Torp Run 1		2	3	Torp Run 1		2	3	4
(Yards)	(Ph)	(Yards)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Yards)	(Ph)	(Ph)	(Ph)	(Ph)
500	0.11	500	0.21	0.01	500	0.30	0.03	-	500	0.37	0.06	0.01	-
750	0.07	750	0.14	-	750	0.20	0.01	-	750	0.25	0.03	-	-
1000	0.05	1000	0.10	-	1000	0.14	0.01	-	1000	0.19	0.01	-	-
1500	0.04	1500	0.08	-	1500	0.12	-	-	1500	0.15	0.01	-	-
2000	0.03	2000	0.06	-	2000	0.09	-	-	2000	0.11	0.01	-	-
2500	0.02	2500	0.05	-	2500	0.06	-	-	2500	0.08	-	-	-
3000	0.02	3000	0.04	-	3000	0.06	-	-	3000	0.08	-	-	-
3500	0.02	3500	0.04	-	3500	0.06	-	-	3500	0.08	-	-	-
4000	0.01	4000	0.03	-	4000	0.03	-	-	4000	0.04	-	-	-
4500	0.01	4500	0.02	-	4500	0.03	-	-	4500	0.04	-	-	-
5000	0.01	5000	0.02	-	5000	0.03	-	-	5000	0.04	-	-	-
6000	-	6000	0.02	-	6000	0.02	-	-	6000	0.03	-	-	-
7000	-	7000	0.01	-	7000	0.02	-	-	7000	0.03	-	-	-
8000	-	8000	0.01	-	8000	0.02	-	-	8000	0.03	-	-	-
9000	-	9000	0.01	-	9000	0.01	-	-	9000	0.02	-	-	-
10000	-	10000	-	-	10000	0.01	-	-	10000	0.02	-	-	-
11000	-	11000	-	-	11000	0.01	-	-	11000	0.02	-	-	-
12000	-	12000	-	-	12000	-	-	-	12000	0.01	-	-	-
13000	-	13000	-	-	13000	-	-	-	13000	0.01	-	-	-

US Navy single tube, above water torpedo mount.

(US Navy)

throw a DC a short distance from the ship.

The first type of projector developed was the Y-gun, named after its shape. It could throw one depth charge to either side, but had to be mounted on the ship's centerline and was large and heavy. Each Y-gun can contribute one pair of depth charges to a pattern. Y-guns can fire only once in a three-minute Tactical Turn.

The K-gun, again named after its shape, can throw a depth charge to only one side of the ship. Smaller and lighter, it could be mounted on the ship's side and usually in pairs. Early K-guns (the Thornycroft MkII thrower) could fire once in a Tactical Turn. Both Y-guns and K-guns were introduced in late 1917.

Rails, K-guns, and Y-guns all have a specific DC capacity, listed in Annex A for each weapon. The player can only use as many charges as are listed. For example, a ship has 2 DC rails each with 8 charges and 2 K-guns, each with 4 charges. After it has dropped the eight charges in each rail and fired the four charges from each K-gun, it must return to port to reload.

6.4.1.2 DC Patterns. The chance of an individual depth charge hitting a sub is very, very small. Because of this poor performance, patterns started to be used to increase the effective kill area.

A pattern is described by the number of charges making it up and the depth band it detonates in. For example, the Pattern 5A consists of 5 charges that will detonate in depth zone A (Shallow Depth). A player chooses how many DCs are in the pattern during the Plotting Phase, but does not have to pick the depth until he actually makes his attack.

All ships could not lay all patterns. Some classes carried only a few DC racks or lacked projectors, while late war escort ships carried a relatively large number of DCs in multiple rails and projectors. Ships with DC racks or rails can only lay straight-line patterns. Ships with both DC rails and projectors can lay full "dispersed" patterns of varying sizes. Straight-line patterns are simply a series of charges dropped in a line behind the ship as it moves through the water. A dispersed pattern lays charges in an oval, which has a better chance of hitting the sub.

Players should find each ship they are controlling in Annex A and note the DC equipment fit. If the ship has only racks, then it can only drop the 2, and possibly the 3 charge straight patterns. Ships with DC rails and projectors can lay any of the patterns listed in the Depth Charge Attack Tables. For example, a British ship with two rails with 8 DC each and two MkII K-guns can lay all 2, 3, 5, or 7-charge patterns. In any dispersed pattern, only two charges will come from the projectors. The remainder will come from the rails.

The loss of DC weapons from combat damage will affect the pattern size a ship can lay. A ship can lose one rail without affecting the pattern capability, assuming it had more than one to start with. Loss of one K-gun or the Y-gun, restricts the ship to dropping only the straight 2, 3, 5, and 7-charge patterns (depending on the number of charges stored on the rails). If all rails are lost, then only 2 DCs can be launched from the projectors. Treat this attack as a straight 2 charge pattern.

If a DC rail or projector is lost and the casualty does not set off the charges, the stored depth charges can be transferred to a functioning launcher.

6.4.1.3 Sub Maneuvers During DC Attack. Because a DC attack must be delivered at close range, the last-minute maneuvers of the sub and attacking ship are critical to placing the depth charges accurately. As the surface ship approached, the sub would do its best to evade.

In *FG&DN*, it is assumed that the sub's captain is doing his best to evade the attack, and that the attacking ship's captain is also doing his best to track and follow the sub's movements. The tables and hit chances already take into account the sub's evasive maneuvers. If this is not the case for some reason, a die roll modifier (see below) increases the chance of the pattern hitting.

After the attack, the sub's captain rolls on the DC Evasions Diagram to see in which direction and to what depth his sub has evaded. The movements of the sub are randomized because they are based on exact positions, which cannot be accurately measured in a tabletop miniatures game. Instead, the ship passes overhead and drops the charges while the submarine darts out of the swirl at some new course and depth. If the player wishes, he may exert some control by ordering the course change to port or starboard, or he can let a D6 roll determine the direction.

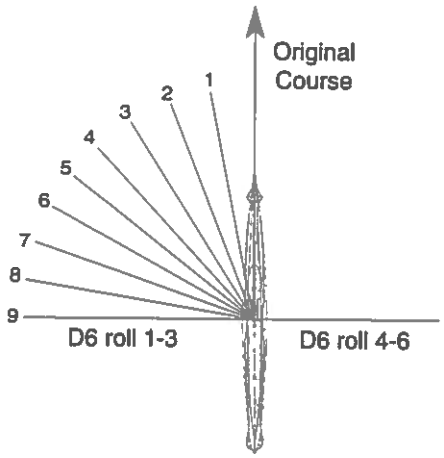
Note: An *evading submarine cannot launch torpedoes* (see section 6.3.1) since a vessel cannot change course, speed, or depth in the turn it fires torpedoes.

6.4.2 DC Attack Procedure. In the Plotting Phase, the surface ship player must write down the size of the DC pattern he intends to drop. This will be specified for each ship class in Annex A, and depends on the number of DC rails and projectors the class is fitted with. The pattern size can be changed in each Plotting Phase.

In the Movement Phase, the surface ship must pass within 250 yards of the submerged submarine. It may have detected the submarine itself, or be directed over the spot

SUBMARINE DEPTH CHARGE EVASION

D10 roll for Course Change
(D10-1) times 10° for the amount, D6 roll or sub player decides for the direction.



D6 roll for Depth Change
1 Shallower (if at Shallow, the sub broaches)
2-5 Same depth zone
6 Deeper (if already at max depth, the sub suffers a hull deformation critical)

by another friendly unit that has contact. (Note: If a surface ship passes over a submarine at periscope depth, there is a risk of collision, see section 3.4). Since the vast majority of ASW ships did not have a sonar system, the only means of detecting a submarine was visual. This could be the sighting of an exposed periscope or the submarine itself. If the attacking ship is not within 1,500 yards of the submarine when visual contact is lost, and the ship doesn't have a sonar system that provides at least a passive bearing, the DC attack will automatically miss.

As the ship makes its approach, the ship player must declare that he is making an attack. The sub player is not required to provide any information on the submarine's location unless it is held visually, by an active sonar, or if two (or more) passive directional sonar systems hold contact simultaneously. Depth information is not provided to the attacking ship player. The only exception is if the submarine is spotted visually, such as an exposed periscope is sighted, or an aircraft visually detects the submarine at periscope depth.

Once the submarine player has provided the necessary location information, if any is required, the attacking ship player picks the exact pattern he will use. An attacking ship can only drop one pattern in a Tactical Turn. Depth charge patterns in *FG&DN* will only be effective in their listed depth zone.

The submarine player must also declare whether or not he is attempting to evade (he almost always will). If he does not (or cannot), subtract 10% from the attacking player's D100 roll (in this case, negative modifiers are good).

If the pattern was not set to the same depth as the submarine player (a simple "yes" or "no" from the submarine player) the pattern will have no effect. If it does match the sub's depth, the surface ship's player resolves the attack in the Planned Fire Phase. Regardless of whether the charges are at the right depth, they will detonate, and if the sub has declared his intent to evade, he must do so.

Annex A will list the type and number of depth charges that the ship carries. Referring to Annex D1, the attacking player looks up the warhead class (Roman numeral I through IV). The higher the warhead class, the more powerful the charge.

Using the warhead class, find the appropriate Depth Charge Attack Table. In the left-hand column, find the pattern designation (for example, 5B), the next three numbers on that row are the chance of the sub suffering Lethal, Major, or Minor damage. Roll D100. The lower the roll, the greater the chance of damage.

Finally, in the Planned Fire Phase, if the submarine player declared that he was evading the attack, he rolls D10 and D6, using the Sub DC Evasion diagram, to see what course and depth the sub ends up on after the attack. This new movement replaces any previously ordered movement. If the sub player follows his plotted movement, he is not "evading" and the attacking player gets a -10% die roll modifier to the DC attack.

Example: A British "V" Class DD spots a periscope belonging to a German U-boat at a range of 1,300 yards. In the Plotting Phase of the next turn, the destroyer player plots to turn towards the last known position of the periscope, accelerate to 25 knots, and plans to lay a seven charge pattern. The destroyer is fitted with two DC rails and two MkII K-gun projectors holding a total of 24 Type D depth charges (Warhead Class IV).

The DD player maneuvers his ship to pass 200 yards ahead of the last known position of the periscope and announces that he will be laying a 7A DC pattern. The submarine player declares that the pattern is in the same depth band as his boat and that he is evading. The DD player rolls D100 and gets a 21. The results are then compared with the 7A pattern line on DC Attack Table - Warhead Class IV, which has the following chances to hit.

Pattern Designation	Lethal Damage	Major Damage	Minor Damage
Straight 7C	0.01	0.03	0.04
7A	0.08	0.15	0.27
7B	0.05	0.09	0.16

A roll of 21 with a 7A pattern results in the submarine taking minor damage from the attack.

6.4.2.1 DC Attack Restrictions. Ships dropping depth charges into Shallow (depth zone A) and Intermediate I (depth zone B) depth bands must be at a speed of at least 10 knots or automatically take damage from the depth charges' blast equal to the Major damage points of one charge, with any criticals resolved on the torpedo table.

For depth charge attacks in depth zone C a ship can be at speeds as low as 5 knots, and will not suffer any damage from its own charges.

Only one ship may attack a sub with depth charges in each Tactical Turn. If more than one escort attacks the target, the second and following ships will be caught in the blast area when the charges from the first ship detonate. These ships will automatically suffer damage equal to the Major damage points of a single charge with any criticals rolled on the torpedo critical hit table.

6.4.2.2 Urgent DC Attacks. If a submarine is first detected at a range of 500 yards or less, then the only way an escort player can attack the sub is with an "urgent" DC attack. This attack is designed to spoil a potential torpedo attack by forcing the submarine to evade.

At any time during the Movement Phase of the turn following detection, an ASW ship commander can declare an urgent DC attack with the pattern size indicated in his log (see 6.4.1.2). If he has not prepared a DC pattern size, then he cannot make an urgent attack. Resolve the attack immediately, before movement is completed, and apply damage to the sub. All normal restrictions apply to the urgent attack.

In an urgent DC attack only the following patterns can be used: Straight 2A, Straight 3A and Straight 5A.

6.4.2.3 Towed ASW Paravanes. Many trawlers and destroyers were fitted with a towed paravane system that functioned as a sort of reusable depth charge. These paravanes were similar to the ones used in mine sweeping, only they were filled with explosives. The paravanes were towed behind the ship, in pairs on destroyers and a single for trawlers, at depths as deep as 300 ft. If a paravane collided with a solid object, a contact fuze would detonate the warhead. While the odds of hitting a submarine were not very good, a hit on a sub would kill it.

The order to deploy or retrieve paravanes is made in the Plotting Phase and it takes four Tactical Turns to complete. The ship's maximum speed while deploying the

DEPTH CHARGE ATTACK TABLES

DC ATTACK TABLE - WARHEAD CLASS I

Pattern Designation	Lethal Damage	Major Damage	Minor Damage
Straight 2A	0.01	0.02	0.03
Straight 2B	NA	0.01	0.02
Straight 3A	0.01	0.02	0.03
Straight 3B	0.01	0.02	0.03
Straight 5A	0.01	0.03	0.04
Straight 5B	0.01	0.02	0.03
5A	0.02	0.04	0.07
5B	0.01	0.03	0.04
5C	0.01	0.02	0.03

DC ATTACK TABLE - WARHEAD CLASS II

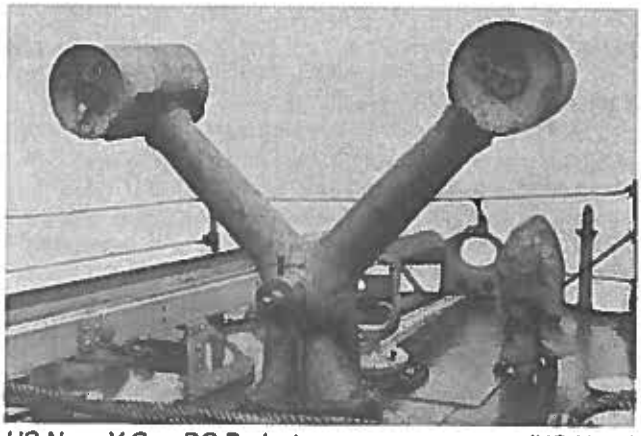
Pattern Designation	Lethal Damage	Major Damage	Minor Damage
Straight 2A	0.01	0.02	0.03
Straight 2B	NA	0.01	0.02
Straight 3A	0.01	0.03	0.04
Straight 3B	0.01	0.02	0.03
Straight 5A	0.02	0.04	0.07
Straight 5B	0.01	0.03	0.04
Straight 5C	0.01	0.02	0.03
5A	0.04	0.06	0.11
5B	0.02	0.04	0.07
5C	0.01	0.02	0.03
Straight 7A	0.03	0.05	0.10
Straight 7B	0.01	0.03	0.04
Straight 7C	0.01	0.02	0.03
7A	0.05	0.09	0.16
7B	0.02	0.04	0.07
7C	0.01	0.02	0.03

DC ATTACK TABLE - WARHEAD CLASS III

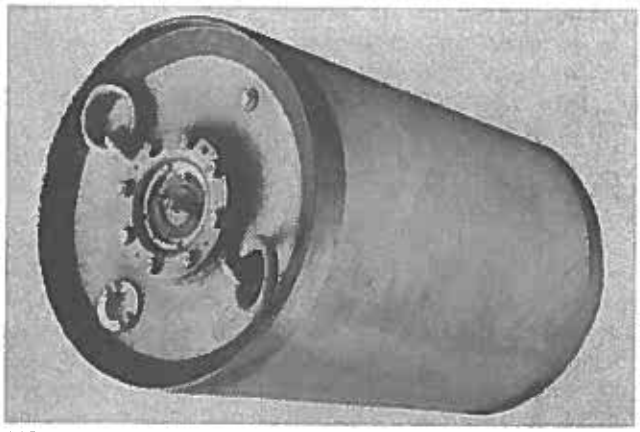
Pattern Designation	Lethal Damage	Major Damage	Minor Damage
Straight 2A	0.01	0.03	0.04
Straight 2B	0.01	0.02	0.03
Straight 3A	0.02	0.04	0.07
Straight 3B	0.01	0.03	0.04
Straight 5A	0.03	0.05	0.10
Straight 5B	0.02	0.04	0.07
Straight 5C	0.01	0.02	0.03
5A	0.06	0.10	0.18
5B	0.03	0.05	0.10
5C	0.01	0.03	0.04
Straight 7A	0.04	0.08	0.14
Straight 7B	0.02	0.04	0.07
Straight 7C	0.01	0.03	0.04
7A	0.07	0.13	0.22
7B	0.04	0.08	0.14
7C	0.02	0.04	0.07

DC ATTACK TABLE - WARHEAD CLASS IV

Pattern Designation	Lethal Damage	Major Damage	Minor Damage
Straight 2A	0.02	0.04	0.07
Straight 2B	0.01	0.03	0.04
Straight 3A	0.03	0.05	0.10
Straight 3B	0.01	0.03	0.04
Straight 5A	0.04	0.08	0.14
Straight 5B	0.02	0.04	0.07
Straight 5C	0.01	0.02	0.03
5A	0.07	0.13	0.22
5B	0.04	0.06	0.11
5C	0.02	0.04	0.07
Straight 7A	0.05	0.09	0.16
Straight 7B	0.03	0.05	0.10
Straight 7C	0.01	0.03	0.04
7A	0.08	0.15	0.27
7B	0.05	0.09	0.16
7C	0.03	0.05	0.10



US Navy Y-Gun DC Projector *(US Navy)*



US Navy Mk III DC *(US Navy)*

paravane is limited to six knots. The ship must slow to four knots to retrieve it.

Once deployed, the ship's player must write down the depth band at which the paravane(s) are being towed. Depending on the type of paravane, it can be towed at Shallow or Intermediate I. It takes one Tactical Turn to change a paravane's depth. The maximum speed that a paravane can be towed is determined by the system's cable strength. Fast paravanes, fitted to destroyers, can survive tow speeds up to 25 knots. Slow paravanes, fitted to trawlers and motor launches, are limited to a maximum speed of 10 knots. If the tow ship exceeds these maximum speeds, the cable breaks and the paravane sinks.

For an attack against a submarine with an ASW paravane to be possible, the surface ship must pass within 250 yards of the submerged submarine in the Movement Phase when the attack takes place. The ship player then declares he is making an attack with an ASW paravane that is in the plotted depth band. If the ASW paravane passes above the submarine, e.g. the sub is at Intermediate I and the paravane is in the Shallow depth band, the attack automatically misses. However, if the paravane is deployed below the submarine, the attack is still possible but the chance to hit is halved. As with DC attacks, if the submarine doesn't evade the attack, subtract 10% from the ship player's D100 roll.

To resolve an ASW paravane attack, the ship player notes the range to the submarine when it was last detected - this will usually be by visual means. If the range is greater than 1,500 yards, the attack will automatically miss. The ship player then plots that he intends to make an attack and provides the necessary ship course and speed changes needed and the depth of the towed paravane. If the ship passes within 250 yards of the submarine's position, the ship player rolls D100 and compares the die roll with the results from the appropriate range entry in the ASW Paravane Attack Table.

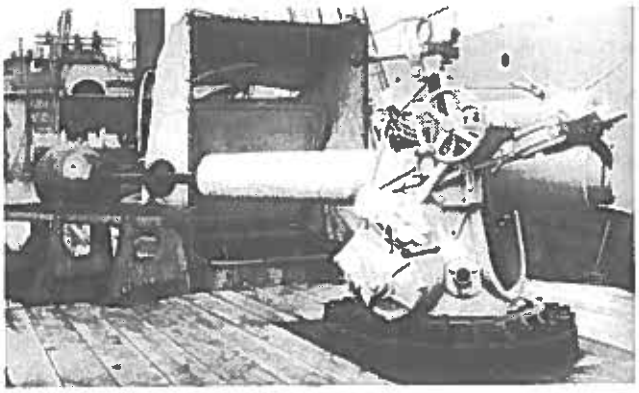
If the sub and the paravane are both in the Shallow depth band, the table results are not modified. If the paravane is in the Intermediate I depth band, regardless of the submarine's depth, halve the chances to hit.

Depth charge attacks can also be made with ASW paravanes deployed. Should a ship player attempt to do both a DC and a paravane attack, both will be resolved but the paravane(s) are automatically lost because of the blast of the DCs.

ASW PARAVANE ATTACK TABLE

Range (yards)	Fast Paravane	Slow Paravane
250	0.15	0.05
500	0.07	0.02
750	0.05	0.02
1,000	0.04	0.01
1,250	0.02	0.01
1,500	0.01	-

Note: The results in the ASW Paravane Attack Table are for the Shallow depth band. Paravane attacks at Intermediate I have their chance to hit halved.



Mortar-based 3.5 inch ASW Gun (Imperial War Museum)

6.4.3 Anti-Submarine Guns. These guns, more correctly modified howitzers and trench mortars, were the early ancestors of the ahead throwing weapons (Hedgehog and Squid) of WW II. The ASW gun became operational in July 1917 and was fitted largely to merchants ships to provide them some measure of defense against a submarine at periscope depth. These guns have very short range, maximum of 2,600 yards, and basically fire a bomb attached to the end of a stick.

To attack a submarine with an ASW gun, the ship must have visual detection on the target. Resolve the attack using the same gunnery procedure described in section 6.1.4. All ASW gun attacks are treated as being in Medium range band regardless of the actual range. Apply all necessary modifiers as provided in the Gunnery Standard 2 Gunfire Hit Chance Modifiers Table. An exposed periscope is treated as a narrow aspect E-size target. If the target is hit, apply the damage as specified for the gun type in Annex D3.

Attacks by ASW guns in the Reaction Fire Phase do not have their damaged halved.

Example: A British merchant ship spots a U-boat periscope at a range of 1,000 yards. The merchant is armed with a 3.5in ASW gun that has a maximum range of 1,200 yards. In the Reaction Fire Phase, the merchant fires the gun at the submarine. The visibility is 50% and the Sea State is 3. The base chance of a hit at medium range is 35% on a D100. The merchant player applies the following modifiers:

- Local Control: -15%
- One barrel firing: +0%
- Target ship speed 10 knots: +5%
- Target size class E, narrow aspect: -20%.

The modifier total is -30%. Dividing the total by two gives -15%, which is then added to the 35% base chance to hit to get the final adjusted chance to hit of 20%.

6.5 Submarine Attacks. Submarines aim torpedoes as do surface ships (section 6.3). Subs can, however, fire all their tubes in one turn.

Torpedo tubes can be reloaded at the rate of 6 minutes (two Tactical Turns) per tube. The torpedo room crew can only reload one tube at a time because of the very cramped conditions (it's crowded).

A submarine cannot change course, speed or depth on the turn that it fires a torpedo.

Submarines can also fire deck guns against surface ships. This was not the weapon of choice for a submariner, but could be used against unarmed or small surface vessels, or as a last-ditch weapon if it was forced to the surface. Submarines fire their guns as surface vessels (section 6.1.4). A submarine cannot use its deck gun on the Tactical Turn it is ordered to submerge or when it is submerged.

6.5.1 Plotting Secret Torpedo Fire *(optional rule).* The surprise nature of torpedo attacks is hard to reproduce in a two-player game. If both players agree to secret attacks, though, this can be simulated to some degree.

First, mark some spot on the playing surface as a common, fixed, reference point. Also mark the point on graph paper, and plot the locations of all the ships involved. As the game progresses, the sub's player can update the ship's positions on the graph paper.

When a sub player wishes to fire torpedoes, he calculates and records the fire normally, but does not announce it. Instead, he just tracks the position of the torpedo on paper until the wakes are sighted (section 5.2.2.5) or they reach a target.

6.6 Coastal Defenses. Ships can be attacked from the shore by dedicated gun and/or torpedo batteries, similar to their naval counterparts, or infantry or mobile guns located near the shore.

6.6.1 Coastal Defense Fortresses. Coastal defense fortresses are shore installations made up of coastal defense batteries armed with guns, torpedo tubes and minefields. Their purpose is to defend harbors, cities and vulnerable coastal areas from direct bombardment or amphibious invasion. Of all the coastal defense systems, coastal defense guns are the most glamorous and the most dangerous. The ability of a coastal defense gun to successfully engage the enemy depends on the gun's size, type of emplacement and associated fire control systems.

6.6.1.1 Battery Types.

Fixed Batteries

Fixed batteries are the most sophisticated of all coastal defense systems. The guns, which range from 37mm to 410mm (1.5 to 16.1 inches) in size, are permanently mounted in reinforced concrete structures and are usually heavily armored. The gun positions are surveyed with the highest level of accuracy possible at their time of construction. Thus, the gun's location is known to within a fraction of a foot and the geography is carefully chosen to provide the greatest degree of stability and field of fire for the gun mount. Fixed batteries are supported by a number of redundant sensor systems and a host of auxiliary structures to allow them to be manned 24 hours a day. Because the gun mount's location is known precisely and the rigid structure provides excellent stability, a fixed battery has a +5% to hit for all range bands.

Semi-Fixed Batteries

Semi-fixed guns are capable of strategic movement but are tactically immobile. Accurately surveyed permanent concrete emplacements and other structures, such as magazines and crew shelters, are constructed along the coast. Access to the fire control network, other communication systems and electrical power are provided. These weapons are not quite as accurate as fixed guns and they often did not have the armor protection, however, being mobile they did provide a degree of flexibility to respond to an enemy's impending attack. Railway guns fall into this category as do some American Panama Mounted 155 mm GPF batteries. Large railway guns, 12 inch and greater, are emplaced on massive platforms which provide sufficient stability to enable these guns to have the same +5% to hit and damage modifiers as a fixed gun.

Mortars

Mortars are short, low velocity cannons that use high elevation angles to achieve plunging shellfire at a closer range than a large caliber gun. The heavy projectiles have a rather large explosive charge in comparison to a standard shell and with their almost vertical descent, mortar rounds always attack the deck armor of a warship. Before the early 1920s they were the only coastal defense weapons that could successfully attack the relatively thin deck armor of the surface combatants of that era.

Because of their slow rate of fire, mortars have their own set of hit chances for the standard range bands that are much lower than a regular gun. However, because mortars are low velocity, high elevation angle weapons, their dispersion patterns are somewhat tighter than a conventional gun battery. Thus, mortars have an advantage in the to hit modifier as the number of barrels firing increases. Unfortunately, the high elevation angle also prevents a mortar from firing into the Short Range band. When a mortar hits, the attack is always against the target's deck armor. The damage multiplier is taken from the same table on page 6-2.

Because of their high angle of fire, mortar batteries always fire over intervening ships and terrain features.

Range Band	Ph	No of barrels	Ph Modifier
Short	NA	1 - 2	0%
Medium	25%	3 - 4	+10%
Long	10%	5 - 6	+20%
Extreme	5%	7 - 8	+30%

Field Artillery Batteries

Field artillery has often been called on to attack ships that are underway. However, they are not very effective since they lack rigidly mounted, surveyed positions, effective armor piercing ammunition and accurate fire control systems. Since field artillery pieces are not designed to engage a moving naval target, their chances to hit are worse than a similar naval gun in local control. In addition, because a field artillery battery is not trained to attack naval targets, the benefit gained by greater numbers of tubes firing is also reduced. The base chance to hit and the modifier for the number of barrels firing follow. The remaining modifiers are the same as those listed in the Gunfire Hit Chance Modifiers Tables (page 6-4, 6-5), with the exception that the Local Control modifier is not applicable to field artillery.

Range Band	Ph	No of barrels	Ph Modifier
Short	20%	1 - 3	0%
Medium	15%	4 - 7	+5%
Long	10%	8+	+10%
Extreme	5%		

Mk I 14in/50 Railroad Gun *(US Navy)*

6.6.1.2 Coastal Defense Battery Sensors. One of the major advantages of a coastal defense site was the multitude of sensors available to it and the real-estate to put them in the best possible location—a distinct luxury that a ship could never have. Essentially, all the various means of detection and tracking were used by coastal defense forces, including high precision optical systems, standard optical range finders, HF/DF and passive acoustic sensors. Coastal artillery fire control systems, however, tended to lag behind their naval counterparts and wasted some of the precise tracking data provided by the superior optical sensors.

6.6.1.3 Horizontal-Base Position-Finding System. The horizontal-base position finding system is a ranging system that is unique in coastal gunnery. While initially tried on board major surface combatants before WW I, the ship's length was insufficient to allow accurate ranges to be generated. However, since land-based systems are not restricted to a mere 200 yards, very long baselines (up to 15,000 yards) could be used to generate high quality range data. The horizontal-base range finders used by coastal batteries consisted of a series of high precision optical bearing-plotting instruments placed in carefully surveyed positions. These positions were known as base end stations and served as endpoints of carefully measured baselines, or "bases." By knowing the length of the base and determining the bearing from each end station, any two stations could provide very accurate range data. Information from these devices was then fed to large mechanical plotting boards that determined the firing data for the guns.

Horizontal-Base with Manual Plotting Boards

This combination was used throughout WW I by most countries that had dedicated coastal defense batteries. Since target detection is done visually, the horizontal-base system is limited by the sighting conditions. Once a target is detected, the fire control team begins plotting the ship's position based on the base stations' bearing data. Because the manual plotting boards do not generate a continuous solution, it takes one Tactical Turn of plotting following the turn of detection to calculate a firing solution. Thus, if a target was detected on Turn 3, the coastal defense gun battery would not be able to engage until the Planned Fire Phase of Turn 5. However, both base stations must be in visual contact with the target during the Tactical Turn that the solution is being derived, otherwise the plotting turn doesn't count. Another disadvantage of this system is that it could not handle a maneuvering target well and even a battleship could make use of the evasion tactic of chasing shell splashes. The following are the hit chance modifiers, in addition to those in section 6.1, for this sensor/fire control combination:

Horizontal-Base Modifiers:

- +5% to hit in the Short and Medium and Long range bands

Manual Plotting Board Modifiers:

- Target steering evasively: -10% for Size Class A, -20% for Size Class B, -30% for Size Class C and smaller.

6.6.1.4 Vertical-Base Position Finding System. The vertical-base, or depression range finder, was an optical instrument mounted at a known height above the water and used that height as the base of the triangle for a trigonometric calculation of target range. A similar device used by the Royal Artillery was known as an autosight and was mounted directly on the gun. All the gun layer had to do was place the crosshairs on the target and the autosight computed the range and adjusted the carriage elevation to hit the target at that range.

The advantages of the vertical-base system over the horizontal-base were that only one observing station was required and that both bearing and range information were provided during the observation; however, three disadvantages relegated the vertical-base system to a secondary or backup role. First, the vertical-base system is not as accurate as the horizontal-base system since the baseline is significantly shorter. Second, the vertical-base system requires that a ship's entire hull to be above the horizon. This meant that the observation station had to be on a high sighting position if long-range gunfire was to be supported. Finally, because the vertical-base system had to "waterline" the target, it had poor performance in bad visibility and at night. Thus, the maximum range of a vertical-base system in reduced visibility is 10 kyds, although it could be much less depending on the sighting conditions. Vertical-base systems provided targeting inputs to the manual plotting board in the same way as the horizontal-base system.

Vertical-Base Modifiers:

- Target Hull Down: -30% to hit.
- Visibility 25% (applicable even if the target is illuminated): -30%
- Max possible range at 25% visibility or less = 10 kyds.

6.6.1.5 Optical Range Finders. These systems were identical to those on board surface ships and follow standard *FG&DN* gunnery rules and modifiers. Optical range finders also send the targeting data to the central manual plotting board.

6.6.1.6 Local Control. Almost all coastal weapons capable of direct fire were fitted with some form of sight for use in emergencies or for battery defense direct lay firing. Many beach batteries were equipped to fire using only local control.

A coastal gun firing in local control suffers the same penalty as a ship's battery listed in the Gunfire Hit Chance Modifiers Table for the applicable Gunnery Standard.

6.6.1.7 Searchlights. As mentioned earlier, one of the major weaknesses of coastal defense systems was the

possibility that ships might sneak by them under cover of foul weather or darkness. Little could be done about an aggressive commander risking his ships in fog or rain but efforts were made to take back the night. The initial solution was a searchlight similar to those mounted on warships. However, whereas a sea-based searchlight might be 90 cm to 110 cm in diameter, a shore-based device would usually be around 150 cm. Both were arc lights, where a piece of pure carbon was electrified, just like a tungsten filament in an incandescent light bulb, to give off massive amounts of light. Shore-based searchlights function in all ways like their naval counterparts with the exception that they have a longer illumination range of 8 to 10 kyds (see section 5.2.4.1).

6.6.2 Land-Based Antiaircraft Fire. Land-based AA batteries are similar to their ship-based counterpart except that they are organized in batteries of four or six guns. Additionally, land-based systems evolved much more rapidly than naval AA batteries and this is reflected in the proficiency modifier in the Antiaircraft Battery Value Modifier Table (see page 6-7). Several batteries can be sited to defend a target. Each land-based AA battery will have an AA value just like ship-based weapons, and each land battery can only attack one aircraft at a time.

6.6.3 Shore-Based Torpedo Launchers. Torpedoes were sometimes mounted in coastal fortifications. In narrow waters they could be devastatingly effective. Shore-based torpedoes are fired in the same manner as shipboard mountings. Shore-based torpedo tubes can be reloaded in three Tactical Turns, with all tubes on the mount reloaded simultaneously.

6.6.4 Controlled Minefields and Mining Casemates. One important part of prepared coastal defenses was minefields. Controlled mines are moored contact mines connected by wires to a mine control station, known in United States Coastal Artillery parlance as a "mining casemate." This was a bunker connected by land line communications to observation stations, searchlight positions and covering gun batteries.

A mining casemate monitored and, if necessary, command-detonated mines in the controlled field via a hardwired communications system connected to each individual mine in a group of mines. This allowed a harbor to be used by friendly forces, but at the same time to be protected from incursion by the enemy. The mines could also be set to detonate as uncontrolled or independent mines, that is like regular contact mines. However, in this mode the mines would attack friends and foes alike. The ability to set mines for contact allowed a fortress under attack to arm its minefield and prevent unseen attackers from passing the field at times of limited visibility. Unfortunately, since the electrical power to detonate a controlled mine, even in the "uncontrolled" setting, came from the mine casemate, if power was lost, then the minefield is automatically neutralized.

To detonate a mine on command, the defending player must have a functional mining casemate, must be able to see the target from the casemate, or he must have blind fire sensors such as magnetic loops or hydrophones. If the mining casemate is not equipped with blind fire sensors and cannot see the target because of weather or other conditions, it may not attack with any mines, even blindly. To resolve a controlled minefield attack, see section 11.2.3.

6.6.5 Infantry Fire Against Ships. Infantry can fire on ships within 0.25 nm of the infantry position. A hit causes one critical hit on the target. Roll D10 on the critical hit table. If the result is Flooding, Main Battery, Engineering, Rudder, Flight Deck, or Pressure Hull they are treated as no damage.

6.7 Combat Considerations. Combat is restricted by the following considerations.

6.7.1 Weapons Danger Space. Surface ships may not fire their guns at other surface targets if friendly ships are in the line of fire. The danger area lies ten degrees to either side of the line of fire in the gun's Short and Medium range band. By the time a shell has passed into the Long range band it is high enough so that it will pass over any friendly ships.

For a friendly ship to be included in the weapons danger space surrounding an enemy ship, it must be inside the space for at least half of the enemy ship's Movement Phase.

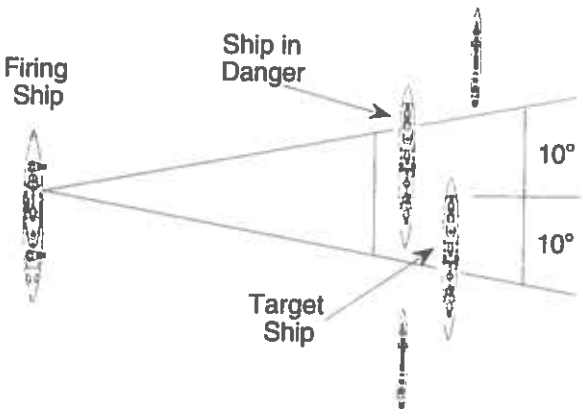
There is a second danger space directly around the target. It lies within five degrees of the line of fire and ten percent of the range between the firer and the target.

If a friendly or enemy ship passes through either danger space, it is also subject to an attack at half the modified chance to hit and if hit, half the damage for that range band.

This danger space represents the occasional shell that does not follow a predicted ballistic path, an unexpected roll that a stabilization system cannot account for, or aiming errors by the director. Such errors would usually just include a single shell or a single salvo, but the damage values in Annex C actually represent only a few shells out of the many fired actually striking an intended target. If two ships collide and remain in close proximity to each other, within 100 yards, then both ships are attacked as a single target without additional modifiers.

6.7.2 Rates of Fire: If a weapon does not have a rate of fire listed in the remarks section of Annex A for that ship, it may fire once per rail or tube per turn. Guns may be firing many rounds, depending on their bore, and multiple-barreled weapons, like the Y gun, will fire all their tubes in one "salvo" or pattern.

WEAPONS DANGER SPACE



Aircraft may drop any amount of unguided ordnance in the same Planned Fire or Reaction Fire Phase. Any number of rockets may be fired in each Planned Fire or Reaction Fire Phase, as long as they are fired at the same target.

Submarines may fire as many weapons as they have torpedo tubes in a single Tactical Turn. They do not have to be fired at the same target.

6.7.3 Shipboard Readiness for Combat. Most scenarios assume that all ships are full manned, alerted, and prepared for battle. There were some circumstances when they were not, however. A surprise air attack on ships in harbor, or on a ship transiting in open ocean, might catch them unawares.

Ships can be at one of three Readiness Conditions:

• **Condition X-Ray** - Minimum readiness. Many watertight doors are open to allow easy access throughout the ship. This condition is often set in port. Weapons, sensors, and propulsion are unmanned while the crew rests and performs maintenance. In this status, they may fire only their AA armament at 1/4 of its normal value.

Flooding criticals inflicted while the ship is at Condition X-Ray have a +3 modifier to their severity. All damage control rolls made while the ship is at condition X-Ray (Fire and Flooding) have a +3 modifier to their effectiveness.

It takes D6 Tactical Turns to go to battle stations (except propulsion, see 3.7 Getting Underway) once the player orders it.

• **Condition Yoke** - Partial readiness. This condition is set when the ship is steaming in wartime but battle is not immediately expected. Watertight doors to little-used compartments are closed, but ones that allow easy movement through the ship are left open.

Ships with steam propulsion may maneuver at up to three-quarters of their maximum speed. This is because steam-powered ships in transit usually had only half their boilers lit off to save fuel and allow for maintenance. They need the other half of their engine power to gain that upper 25% of their speed. Ships with other propulsion types may maneuver at any speed.

Flooding criticals inflicted while the ship is at Condition Yoke have a +2 modifier to their severity. All damage control rolls made while the ship is at condition Yoke (Fire and Flooding) have a +2 modifier to their effectiveness.

The ship cannot launch torpedoes or aircraft, and cruisers and above cannot fire their main batteries. AA guns can fire at half strength.

It takes D6/2 Tactical Turns to go to General Quarters once the player orders it.

• **Condition Zebra** - This condition is set during battle stations, or "General Quarters." Virtually every watertight door on the ship is closed. This inhibits easy movement through the ship, but personnel are supposed to already be at their battle stations.

A ship at General Quarters can perform all operations normally.

Danton-*class predreadnought*

Chapter Seven - Air Combat

7.1 Aircraft Ratings. To rank a plane's maneuverability, each aircraft in *FG&DN* has a **Maneuver Rating.** This number describes its ability to turn quickly in a dogfight or to evade attack. The higher the rating, the more agile the plane.

For example, a German Gotha has a rating of .5, while a Sopwith Pup has a rating of 3.5. Modern aircraft are measured on the same scale. A B-52 Stratofortress is still a .5, while a F-4 Phantom II is a 3.5. Even though modern aircraft are faster, many are no more agile than their WW I ancestors. Some are, though. Because of improved technology and advanced design, an F-16 Falcon has a Maneuver Rating of 5.0.

An aircraft's ability to turn changes with its payload. Bombs slow a plane by making it heavier and increasing drag. The more it carries, the less agile it is. Each aircraft's Maneuver Rating is divided into two parts: Lightly Loaded and Fully Loaded. A lightly loaded aircraft carries little or no ordnance. A fully loaded aircraft is carrying its maximum payload or near to it, and is much less maneuverable because of it.

Example: A Sopwith Camel has a Maneuver Rating of 3.5/2.5. This means that it is a 3.5 when lightly loaded, and 2.5 when fully loaded. A Gotha is .5/.5. In other words, it is so unmaneuverable that its load status is unimportant.

If a plane carries air-to-ground ordnance or other payloads, it is considered to be fully loaded.

Example: A Sopwith Camel has a Maneuver Rating of 2.5 when carrying four 20-pound Cooper bombs. If it is attacked, it can jettison its load, increasing its rating to 3.5, and it stands a much better chance of winning the fight. However, it cannot complete its bombing mission.

Aircraft also have a **Damage Rating**, which represents the ability to resist damage from enemy weapons. The rating is a single number, which depends on the aircraft's size, number of engines, and design. The higher it is, the tougher the aircraft.

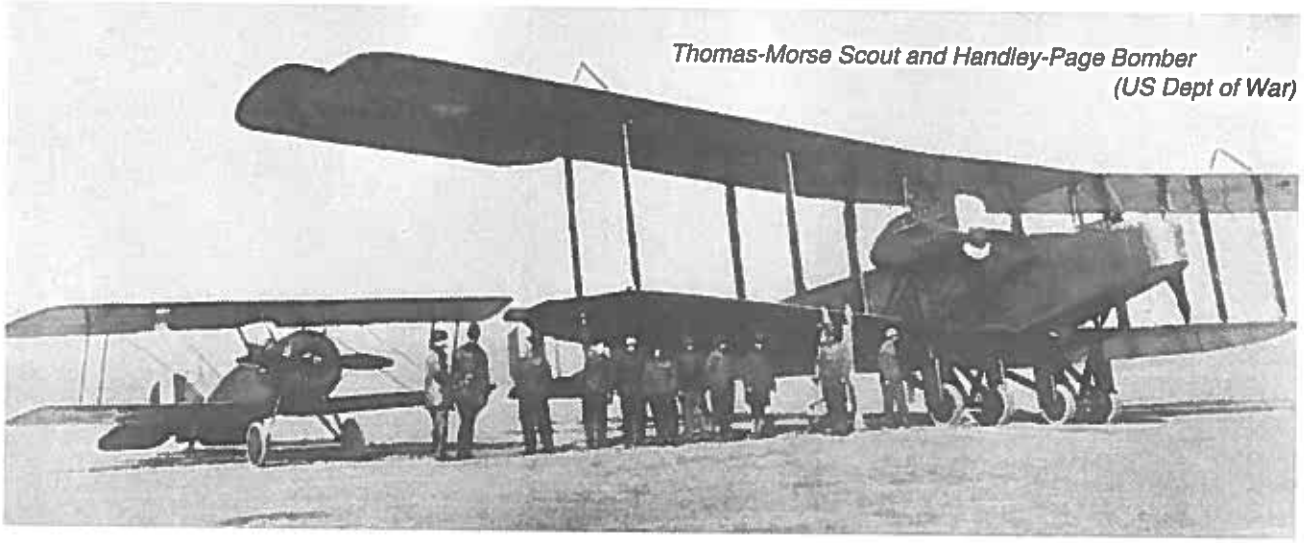
A single air-cooled-engine fighter like a Camel has a Damage Rating of 4. The larger Hannover or tougher SPAD XIII have ratings of 6. A twin-engine aircraft like the Handley-Page or Gotha bombers have a rating of 8.

Any time a plane is attacked, the Maneuver and Damage Ratings will be used to see whether the aircraft is hit and affected. This includes attacks by air-to-air guns and air-to-air rockets. These weapons all have an air-to-air Attack Rating, whose use will be described in the appropriate section. An antiair weapon's attack rating is based mostly on its chance of a hit and its lethality given a hit.

7.2 Aircraft Ordnance Loads. Typical ordnance loads for each aircraft are provided in Annex B. These loadouts are not exclusive. If players want to have an aircraft carry a load different from the ones listed in Annex B, they should find a photograph or other reference to verify it. Be careful that the load is appropriate to the country using that aircraft.

(Optional rule) Since any airplane carries a limited number of weapons, players must keep careful track of the number expended as combat continues. For game purposes, assume that all aircraft guns, whether fixed or flexibly mounted, have four shots. For the sake of simplicity, planes in formation are assumed to have an unlimited number of shots for their defensive guns. If the players are using the optional pilot experience rules, planes may have more or less than four shots, depending on the pilot's rating.

Defensive guns may be fired any time an attacking aircraft is in position to make a gun attack on the defending plane. Exceptions to the number or bursts or to firing combinations will be listed in the remarks section for that aircraft in Annex B.



Thomas-Morse Scout and Handley-Page Bomber (US Dept of War)

The Aircraft Damage System

The point values for each plane's damage rating are based on its construction, the number and type of engines, and any special protective measures it carried.

Virtually all planes in the Great War were built the same way: a wood frame covered with fabric. Portions of the fuselage around the engine had metal panels. Armor and self-sealing fuel tanks lay far in the future, although some pilots sat on a steel plate.

Aircraft engines, after the crew, are the most important and vulnerable component. The number of engines obviously affects a plane's ability to stay aloft. The type is also important. Inline, or liquid-cooled engines, are vulnerable to hits in their cooling systems. A fragment or stray bullet in the radiator is all that's needed to make it seize up.

A radial, or air-cooled engine, on the other hand, is very sturdy. Not only is the complex and vulnerable cooling system eliminated, but the design itself is resistant to damage. Radials have been known to keep on running with cylinders shot off.

The only reason radials were not universally used in military aircraft is that they create a great deal of drag, reducing a plane's performance. That effect is handled elsewhere in the game. For the purposes of modeling a plane's resistance to damage, radials are better than inline engines, and the more engines, the better.

7.3 Air-to-Air Combat. Dogfighting involves maneuvering aircraft using guns and close-range rockets to destroy each other. Rather than try to model the twists and turns of a violently maneuvering aircraft, all dogfighting in *FG&DN* takes place inside an imaginary one-nm circle. Any number of aircraft can maneuver within this area. Their exact position inside the circle is undefined. They are simply "dogfighting."

A dogfight consists of as few as two and as many aircraft as can be imagined swirling about in a small volume of air. It is a fast-moving, chaotic situation, with pilots attacking enemy aircraft while trying to keep their own tails clear. The chance of getting into position to take a shot depends on the maneuverability of your aircraft and that of your opponent.

While dogfighting, even though at full throttle, an aircraft does not fly at its maximum speed. Radical maneuvering quickly bleeds off speed. In addition, slower aircraft can also turn more quickly, an advantage in a melee. All aircraft maneuvering in a dogfight are considered to be at their cruise speed. This is important for gaining attack position and breaking off combat.

Example: A French Nieuport 17 fighter has a maximum speed of 89 knots and a cruise speed of 70 knots. While it dogfights, its speed will be 70 knots.

Any aircraft within one nautical mile of an opposing plane at any time in either player's movement phase may declare that it is in a dogfight with that aircraft. The plane declaring must be no more than 1,000 meters above the defender, or 500 meters below him. If both sides wish to dogfight, use the 1,000-meter limit for both sides.

British SE.5a Pursuit Plane

(US Dept of War)

It is possible to have large, multiple-aircraft dogfights: aircraft A engages B, while C and D engage A, and E engages C. The only restrictions on dogfighting are the one nm starting range and the altitude difference.

Air combat *rounds* are 30 seconds long, so there are six rounds in a three-minute Tactical Turn. Three happen in the Planned Fire Phase and the other three in the Reaction Fire Phase. The six air combat rounds are identical. Aircraft movement is divided into one and a half-minute segments, and they move as described in Chapter 4.

7.3.1 Air Combat Restrictions. Aircraft can attack with guns or rockets, but not both. An aircraft may attack with guns or rockets and fire its defensive guns simultaneously. Defensive weapons are always controlled by a separate crew member, and any number of targets can be engaged by an airplane's defensive guns.

An aircraft can attack only one air target in a dogfight with its offensive guns each round, although it may switch targets each round if there is more than one enemy plane within the dogfight circle.

7.3.2 Declaring a Dogfight. When a dogfight starts, place a counter on the board centered between the aircraft taking part. Remove those aircraft from the board. They are maneuvering violently in a one nm-wide area centered on the counter. Their exact position is irrelevant and is changing rapidly with respect to both friend and foe. All range measurements to the dogfighting aircraft should be made to the counter instead.

If all the planes in the dogfight are maneuvering, the dogfight counter is moved randomly D6/2 nm each Tactical Turn in a direction of D6 times 60 degrees. The amount and direction of movement is determined during the Movement Phase.

If one of the aircraft is not dogfighting (moving normally, e.g., a bomber formation), the counter is moved with that aircraft.

If an aircraft is attacked, it has several choices. This is declared at the time of attack, and can be changed in any Plotting Phase afterward.

- First, it may elect to stay in the dogfight. It can use its offensive guns or rockets, its defensive guns (if it has any) and the maneuver rating that matches its load status.
- Second, if it is alone, or has broken formation, it can maneuver defensively. This adds 0.5 to its maneuver rating (it's harder to hit), but it cannot attack with its offensive guns or rockets.
- Third and last, it may not maneuver at all, but trying to either reach some destination or to break off and run. It may not attack, but may use its defensive guns. The plane's maneuver rating is zero.

Planes in formation (see 7.3.6) are not dogfighting, and depend on their massed defensive guns for survival. Aircraft attacking a surface target, landing, taking off, or other aircraft operations are also classed as "flying normally" for dogfight purposes. Planes flying normally cannot attack with their offensive guns.

7.3.3 Dogfight Procedure: In a dogfight, each aircraft must make two rolls: First, it has to see if it can get an enemy plane in its sights. This involves matching the opposing planes' maneuverability. Then if it gets in position, it can shoot. This matches the plane's gun armament against the target plane's damage value.

Each aircraft must pick an opponent to maneuver against. While some choice is possible, the targets presented are often a matter of chance. The side with more aircraft, however, has more freedom to choose. Aircraft that are maneuvering defensively, or are not maneuvering at all (e.g., formations) cannot choose to attack, of course, but are valid targets.

First, each plane in a dogfight should be represented by a counter. A formation can be represented by a single counter, as long as it does not break up.

Second, planes in a dogfight make their rolls for position and attack in order of Maneuver Rating. This rating is adjusted to include pilot experience (section 7.6) if that rule is being used.

Example: If a dogfight involved German Albatros D IIIs (3.5) and Hannover CL IIs (2.0) and SPAD XIIIs (3.0), the order of attack would be the Albatroses, SPADs, and then the Hannovers last. If an aircraft with a lower Maneuver Rating is shot down before it has had its turn, it loses the opportunity to retaliate. If opposing aircraft have an equal Maneuver Rating, then roll randomly to see which group goes first. The next turn, the other group goes first.

Third, Place all the enemy aircraft counters, except formations, in a cup or other container. In order of Maneuver Rating, the attacking player should declare if he is attacking a formation (if present), or the dogfighting enemy aircraft. If he chooses to attack the other dogfighting planes, randomly draw two enemy aircraft counters out of the cup. The attacking plane may choose either of these two aircraft as his target.

If there are enemy formations present, the attacker can always choose to attack them (since they are not maneuvering, their path is much more predictable and they are easier to attack).

Fourth, roll to see if the attacker gets into position. This matches the two planes' maneuverability and their energy. The plane with a higher maneuverability has an advantage, but the plane with a higher speed has an advantage as well.

Maneuver ratings depend on the plane's load status, modifiers for pilot experience and the plane's declared actions during the dogfight (see 7.3.2 above).

Use each plane's cruising speed as its speed in the dogfight, unless it has chosen not to maneuver (e.g., a formation), or it is the first turn, when the plane's actual speeds should be used. Each 50-knot advantage in speed that the attacker has over the defender adds 0.5 to the attacker's maneuver rating. If the attacker is 50 knots slower than the defender, he suffers a -0.5 modifier to his Maneuver rating.

Calculate the chance of getting in position and roll D100.

Attack Position Formula:

(3 + Atk + Speed Modifier - Def) x 10%

Planes attacking with a differential less than -2.5 cannot gain position or make an attack.

Example: A fighter with an Maneuver Rating of 3.0 is in a dogfight with a bomber with an rating of 0.5. The fighter's chance of getting in position for a shot is (3+3-0.5) x 10%= 55%.

AIR-to-AIR GUN ATTACK TABLE

Target's Damage Value

Gun Atk	4	6	8	10	12	14	16	18	20
0.05	6	4	2	1	1	1	1	1	1
0.1	8	6	4	2	1	1	1	1	1
0.2	10	8	6	4	2	1	1	1	1
0.3	12	10	8	6	4	2	1	1	1
0.4	14	12	10	8	6	4	2	1	1
0.5	16	14	12	10	8	6	4	2	1
0.6	18	16	14	12	10	8	6	4	2
0.7	20	18	16	14	12	10	8	6	4
0.8	22	20	18	16	14	12	10	8	6
0.9	24	22	20	18	16	14	12	10	8
1.0	26	24	22	20	18	16	14	12	10

The numbers in the table are the percent chance (rolled on D100) of shooting down the target.

If the bomber had forward-firing guns, and wanted to attempt to get in position for a shot, its chance would be (3+0.5-3)x10% or 5%.

If he gains position, he immediately attacks. If he fails to gain position, his turn is over and the next attacking plane takes his turn.

Place the unengaged enemy aircraft back in the cup. Take the enemy aircraft counter that was rolled against and place it to one side. It cannot be attacked again until all the other aircraft on its side have been chosen once. Do not place any engaged aircraft back in the cup until it is empty. If there are fewer attackers than defenders, the cup will not be emptied. If there are more attackers than defenders, put all the defending counters back in and some aircraft will be attacked more than once.

Fifth, resolve the actual attack on the Air-to-Air Gun Attack Table. If an aircraft is equipped with offensive or defensive guns, it will be listed in Annex B under the Gun Attack listing. For example, the Bristol Fighter has a Gun Attack value of 0.5(0.3). This means an offensive value of 0.5 and a defensive value of 0.3. Offensive and defensive guns are measured on the same scale.

[Note: Defensive armament will usually be weak compared to a plane's offensive firepower. A defensive gunner cannot easily cope with a rapidly-moving target. This is one of the reasons that bombers often flew in formation, so that several aircraft could combine their fire.]

If an aircraft gains firing position on a plane equipped with defensive guns, the defending guns automatically get a shot back. The exchange of fire between the defending and attacking aircraft is simultaneous.

Aircraft equipped with *only* defensive guns may maneuver offensively in a dogfight, and if they gain attack position they may fire their defensive guns at their rated strength. In this case, they are trying to get into a position so that their defensive guns bear on an enemy aircraft. Only aircraft without any offensive guns may use their defensive guns for attack purposes.

This rule allows large planes, such as reconnaissance or patrol aircraft, to attack similar planes. In the Great War, large patrol aircraft from opposing sides sometimes fought each other, even though they did not mount fixed forward-firing guns. Against a real fighter, their best chance of success is to maneuver defensively or just run.

If the enemy aircraft is hit as a result of the attack, it is destroyed, or so badly damaged that it aborts and flees with no further part in the battle (spirals down, smoking, out of control, etc.). It is removed from play.

Because of the way this system is arranged, aircraft with higher Maneuver Ratings will always attack before a less maneuverable aircraft, and in fact some less maneuverable aircraft may be killed before they can take their turn in the battle.

Example of air-to-air combat: Three Albatros C III reconnaissance aircraft, loaded with bombs, escorted by four Pfalz D III fighters, are attacked by a group of two SE.5 and two SE.5a fighters. The Albatros C IIIs must use the fully loaded maneuver rating of 0.5 (Annex B). The Pfalzes are lightly loaded (rating of 3.0). The SE.5s and SE.5a are lightly loaded as well, with ratings of 3.5 and 4.0.

For the purposes of this example, the Albatros will not be in formation. Before the first dogfight round begins, though, the German player announces that the bombers will be maneuvering defensively. This means they will not be able to attack, but will add 0.5 to their Maneuver Rating. They still get to fire their defensive armament if they are attacked.

In the first Planned Fire Phase, the four SE.5as attack first, since both versions have a higher maneuver rating than the Pfalzes. Each of the fighters, in turn, randomly draws a pair from the cup and chooses one. The two SE.5as go first, since they have a higher ATA rating.

The first SE.5a draws one Albatros C.III and one Pfalz D.III. He chooses to attack the C III and the Pfalz goes back in the cup.

The second SE.5a draws two Pfalz D.IIIs and picks one, returning the other to the cup.

The third fighter, an SE.5 now, draws one Albatros and one Pfalz. He chooses to attack the Albatros, and returns the Pfalz to the cup.

The final attacker draws two Pfalz fighters, and picks one, returning the other to the cup.

Each British fighter now rolls to gain position on his opponent, using the attack position formula.

SE.5a (#1) engages a Albatros C III. (3+4.0-(0.5+0.5)) x 10%, or 6.5 x 10% or 60%

SE.5a (#2) engages a Pfalz D III (3+4.0-3.0) x 10%, or 4.0 x 10% or 40%

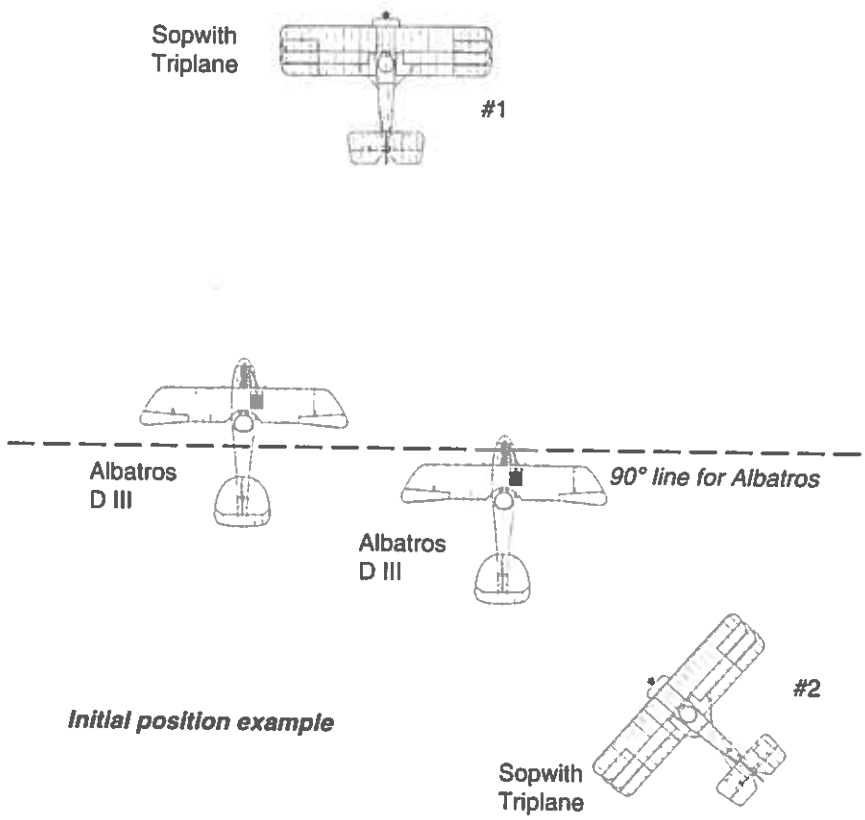
SE.5 (#3) engages a Albatros C III (3+3.5-(0.5+0.5)) x 10%, or 6.0 x 10% or 55%

SE.5 (#4) engages a Pfalz D III (3+3.5-3.0) x 10%, or 3.5 x 10% or 35%

One of the Albatros bombers and two of the Pfalz fighters are not engaged. The British player rolls, and #1 and #2 both gain position. They can now attack. Because the Albatros has a defensive gun, it automatically is in position to fire at its attacker (#1).

The two British fighters and the German rear-seat gunner take their shots. Comparing their gun attack strengths (0.2) to the targets' Damage Value (6 for both the Albatros and the Pfalz), the SE.5as have an 8% chance of shooting down the German aircraft. Neither aircraft makes its roll.

The German defensive gunner has an attack strength of 0.1, and the SE.5a a Damage Value of 6, meaning a 6% chance of shooting down the British fighter. He also



Initial position example

misses.

The four Pfalz D IIIs now have their turn to attack. (The Albatros C IIIs do not have a chance since they maneuvered defensively.)

The British have now finished their turn, and the procedure is repeated for the Germans. The four Pfalz fighters each have a chance to draw from the cup for a SE.5 or SE.5a. The procedure can be simplified since there are four of each aircraft, unless there is some difference between the German fighters (pilot experience, for example).

The Germans roll to gain position on the British fighters:

Pfalz D III (#1) engages an SE.5 (3+3.0-3.5) x 10%, or 2.5 x 10% or 25%

Pfalz D III (#2) engages an SE.5 (3+3.0-3.5) x 10%, or 2.5 x 10% or 25%

Pfalz D III (#3) engages an SE.5a (3+3.0-4.0) x 10%, or 2.0 x 10% or 20%

Pfalz D III (#4) engages an SE.5a (3+3.0-4.0) x 10%, or 2.0 x 10% or 20%

Pfalz #1 and #4 both gain position on SE.5 fighters. Their attack is also 0.2 against the SE.5/5a's Damage Value of 6, so there is an 8% chance of success. One of the German pilots rolls low and shoots down an SE.5a.

The aircraft will fight again in the next round, with one SE.5a and two SE.5, three Albatros C III and three Pfalz D IIIs.

Remember that every time a plane gets into attack position on a plane with defensive guns, the defensive gun gets a shot, regardless of whether or not the attacker hits.

7.3.4 Ending a Dogfight. A dogfight lasts until all the units on one side are destroyed, both sides agree to break off, or the faster planes decide to run. In the last case, the slower planes get as many parting shots as the Dogfight Break-Off Table allows. The players must compare the speeds of the aircraft attacking and the aircraft attempting to escape.

If any aircraft tries to break off after its first turn of combat, use its starting speed, including any dive bonuses. If the aircraft attempting to escape has not maneuvered during any turn of the combat (with the maneuver Rating of 0.0), use its current speed, including any dive bonus. In all other cases, use the aircraft's cruise speed at that altitude and load status as its speed in the dogfight.

A plane attempting to escape a dogfight cannot break off unless its speed is higher than that of the pursuing aircraft. If it is higher, roll on the following table to see how many attacks the pursuer gets to make before the escaping aircraft gets out of range.

DOGFIGHT BREAK-OFF TABLE

D10	Speed Difference (kts)				
Roll	+10	+20	+30	+40	+50
1-3	2A	A	A	A	E
4-6	A	A	A	E	E
7-9	A	A	E	E	E
10	E	E	E	E	E

Results:

E: The evading aircraft escapes.

A: The attacker gets a free attack on the evading aircraft as it escapes.

2A: The attacker gets 2 free attacks on the evading aircraft as it escapes.

If the enemy gets a free attack on an aircraft as it departs, randomly draw two of the enemy's aircraft and assign one to the attack. The enemy player rolls for position and takes a shot if successful. If the enemy gets two attacks, repeat the procedure.

An aircraft's position, altitude, and speed at the end of a dogfight depends on whether or not it elected to maneuver during the fight.

SURPRISE/SUN TABLE

		Number of Aircraft Attacked					
		1	2	3-4	5-8	9+	Sun
Number of Attacking Aircraft	1	30%	25%	15%	10%	5%	3
	2	25%	20%	15%	10%	5%	2
	3-4	15%	15%	10%	5%	2%	1
	5-8	10%	10%	5%	2%	1%	1
	9+	05%	05%	2%	1%	-	0

FORMATION TABLE

# of a/c in formation	# of a/c that can fire	Time to form (min)	Range Reduction
3-6	2	3	0%
7-12	3	9	10%
13-18	4	15	20%
18+	5	30	30%

If an aircraft elected **not to maneuver**, to fly normally, it is placed at the center of the dogfight area, replacing the counter that marked the circle's position. It has the same course and speed as it had during the fight.

If an aircraft **did maneuver**, place it D6 nm from the center of the dogfight on a course of D6-1 x 60°. Subtract D6 x 5 knots from the plane's maximum speed (although the result should not be less than stalling speed).

Roll on the table below to see what altitude the maneuvering aircraft ends up at:

ENDING ALTITUDE TABLE

D10 Roll	Result
1	Up one altitude band
2-3	Same altitude band
4-8	Down one altitude band
9-10	Down two altitude bands

If the resulting altitude band is above the ceiling of the maneuvering aircraft, it is at its ceiling. If lowering the aircraft one or two bands results in it being at ground level, it is at Low altitude.

7.3.5 Initial Position Advantage *(optional rule).* In *FG&DN*, the exact position of an aircraft in the dogfight circle is undefined. Aircraft movement, especially in violent maneuvers, is too complicated to track at this level of play. Instead, the plane is simply somewhere inside the circle.

On the first turn of a dogfight, though, the initial position of the engaged planes is known. An advantageous initial position can finish a dogfight quickly. On the first turn of a declared dogfight, check the relative positions of attacking aircraft. Several different conditions can result.

• **Attacking From the Front Quarter:** Head-on attacks were risky and difficult, but presented the defender with a harder target. If a plane starts its attack facing another aircraft, add 2.0 to the target's Maneuver Rating. If the attacker successfully rolls to gain position, increase its gun attack value by one row. If the attacking aircraft uses its gun, and the aircraft being attacked has offensive guns as well, it automatically is in position and its gun attack value is also increased by one row.

Defensive guns are reduced in effectiveness by one row because of the short time available to line up and fire.

Both aircraft fire simultaneously.

[Head-on attacks are popular against bombers and other large aircraft. They are also possible against fighters, but result in an exchange of gunfire. A bomber's defensive armament is much less dangerous.]

• **Attacking From Abeam or Astern:** If an aircraft started the fight behind the 90° line of an enemy aircraft, and there are no aircraft behind its own 90° line, add 20% to its chance of gaining attack position.

If an aircraft started the fight with an enemy behind its 90° line, subtract 20% from its chance of gaining attack position.

In the example diagram, the British Sopwith Triplane #1 must subtract 20% from its chance of gaining position on the first turn, since there are aircraft behind its 90° line. Triplane #2 can add 20% on the first turn, since it is behind the pair of Albatroses.

The Germans roll normally to gain position, since they have enemies both in front and behind their 90° line.

De Havilland-4 Reconnaissance and Day Bomber Aircraft

(US Dept of War)

• **Surprise.** If one group of aircraft can surprise another, they are allowed one round of dogfight attacks against the other side without the defenders being able to shoot back. This includes not only fighters but aircraft with defensive armament. The attacking aircraft are also allowed to choose their targets, instead of having them randomly chosen. In addition, the Maneuver Rating of the opposing side is reduced by 2.0, since the surprised pilots are not maneuvering to avoid the threat.

[Eighty percent of the aircraft killed in air combat never see their attacker until it is too late. This is easy to understand in the swirling confusion of a dogfight, but it also applies to the initial attack]

To gain surprise, attacking aircraft must approach from behind the enemy's 90° line and be undetected by the enemy group prior to the attack. The attackers then roll on the Surprise//Sun Table.

The number on the Surprise/Sun Table represents the percent chance of a successful surprise attack, rolled on D100. If the aircraft being attacked are not single-seat fighters, use the number from one column to the right. In other words, treat 3-4 multicrew aircraft as 5-8 single-seat aircraft. Extra eyes really help in spotting attackers. If the aircraft are of mixed types, use the majority as the determining type.

If the attackers wish to make their attack from "out of the sun," they must approach the enemy aircraft directly from the east in the morning or the west in the afternoon. The attacking player then declares that he is attempting to approach from out of the sun. He rolls a D10, using the right-hand column of the Surprise/Sun Table. If his D10 roll is less than or equal to that number, he succeeds, add 30% to the chance of surprise, which is rolled separately and under the appropriate column for the number of planes attacked.

Example: A flight of two Fokker DVIIs sees a formation of four DH.4s, escorted by three SE.5a fighters. The British formation has not seen them (see section 5.2 Visual Detection).

Moving carefully, the German positions himself above and behind the British, approaching directly from the east. He declares that he is attempting to attack from out of the sun, then rolls the die. Since there are two attacking aircraft, he must roll a two or less, and he succeeds.

The base chance of the two Fokkers surprising the British is 10%, taken from the Surprise Table. This must be moved one column to the right though, since the majority of the British aircraft are multicrewed. This lowers the chance to 5%, but the successful sun attack raises it to 35%. This is the number the Fokkers' player must roll on D100. Pilot experience modifiers (7.6) could raise or lower this chance.

7.3.6 Formations *(optional rule)* Any group of three or more planes of the same type can declare themselves to be in formation. This allows their defensive armament to be combined against attacks by enemy fighters. This means that they fly at the same altitude, speed and direction. If the group is attacked by aircraft, other planes in formation besides the one actually attacked can fire their defensive guns at the attacker. The number of aircraft who can lend support is shown on the Formation Table. Planes that attack a formation are subject to massed defensive fire whether they successfully gain position or not.

Planes in formation:

• Can make only slow, gentle turns (20° times Maneuver Rating in 3-minute turn).

• Take time to form up. See the Formation Table above. While forming, the group is at range cruise, but circles, remaining stationary on the board.

• Are treated as having a Maneuver Rating of zero.

• Are detected visually at twice normal range.

• Because they are not maneuvering, they may be chosen by attacking aircraft as its target instead of a randomly drawn target.

Breaking Formation. If a formation breaks to maneuver in air combat, it must spend time to reform or continue as a group of unformed planes. A group of aircraft cannot form or re-form if there are hostile planes attacking them.

A formation may break up voluntarily or as a result of losses. Every time a formation loses a quarter of its original aircraft roll D100 to see if the formation breaks. The chance of it breaking is equal to the percentage lost. After a quarter of the aircraft have been lost the chance is 25%. After half are gone the chance is 50%, and so on.

Aircraft that have broken formation may move as a group, but they gain no benefits for massed defensive fire or bombing accuracy.

A formation that has broken, breaks completely. Although a large formation might contain several three-plane vics, these smaller sub-formations were also lost as the aircraft maneuvered and suffered losses.

If a group of aircraft wants to re-form in flight, they may quickly reform in three-plane vics (see the Formation Table). It will take longer for them to completely reform.

Friendly Fighters and Formation Dogfights. Escorting fighters may pursue and attack enemy planes as they attack a formation. They are at risk from the bomber gunners, who, in the confusion, may not be too particular about who they shoot at. They are only in danger if enemy aircraft are attacking the formation, but if they are, every friendly fighter in the dogfight is subject to attack as well, but by half the guns.

Example: A formation of eight DH.4s is attacked by a flight of German Albatros fighters. The escorting Camels also pile into the fight. As the Germans attack the DH.4s, regardless of whether or not they gain position, each German plane will be attacked by three defensive gunners (see the Formation Table). The friendly Camels will also be shot at by one (half, rounded down) gunner.

7.3.7 Air-to-Air Rocket Attacks. Unguided air-to-air rockets were used in the Great War. These weapons can attack aircraft only in a dogfight because they must be launched from close range.

7.3.8 Air-to-Air Attacks Against Airships. All airships, regardless of size, have a Maneuver Rating of 0.5 both full and lightly loaded. Airships are always assumed to be maneuvering defensively.

Once in position, the attacking player must declare whether he is aiming for the envelope (90% chance to hit) or the gondola (standard formula to gain position). If the player rolls and hits, use the Airship Damage rules (section 8.6) find out the effects.

7.4 Aircraft Attacks on Naval Targets. Planes can attack ships (sometimes including submarines) with bombs, torpedoes, rockets and guns. An aircraft involved in a dogfight cannot attack a naval target in the same Tactical Turn.

7.4.1 Bombs. Bombs can only be dropped on naval targets using the level bombing technique. Both glide and dive bombing were only in the very early stages of experimentation and would not become accepted tactics until after the early 1920s. Indeed, level bombing was itself still in its infancy and was very inaccurate as there were no effective bombsights available during the Great War.

7.4.1.1 Level Bombing. This method includes attacks by aircraft both in level flight and in shallow dives. It may be employed from any altitude above 100 m. Below 100 m, there is an 85% chance that a bomb will not detonate as the fuze hasn't had adequate distance to arm it. If the bomb does detonate, there is a 75% chance that the aircraft will be damaged or destroyed by the blast.

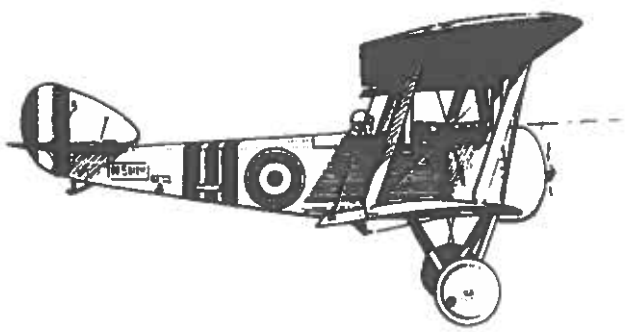
Airplanes making level bombing attacks may do so in either the Planned Fire or Reaction Fire Phase. They must fly straight and level during the turn of attack.

During the attack, part or all of an aircraft's or airship's entire bomb load is released in a single string. The number of hits is based on the number of bombs dropped on the target and the release altitude.

The Level Bombing Table lists the chance of a single bomb hitting the target. Since the vast majority of aircraft carried a small number of bombs, each bomb can be rolled for individually. However if a player so desires, the attack can be resolved with a single die roll by using the Cumulative Probability Table in the back of the Data Annex.

Procedure: To resolve a level bombing attack against a ship, cross reference the ship size with the release altitude. This number is the chance of a single bomb hitting the target. Any attack made by an aircraft from an altitude 200 m is considered to be a "Pressed Home" attack and the aircraft will be subject to a ship's Lt AA fire before it can release its ordnance. Apply the appropriate modifiers, if any, to the listed chance to hit. Roll D100 for each bomb. If the roll is less than or equal to the modified chance to hit, the bomb hits the target.

If the cumulative attack method is used, take the modified chance to hit and the number of bombs dropped (six bombs is the maximum number of weapons in a single attack) to the Cumulative Probability Table. If an aircraft or airship attacks with more than six bombs, then multiple attacks will have be resolved even though all bombs are dropped on a single run. The Cumulative Probability Table will give the chance of a single bomb hitting the target out of the string of bombs dropped.



Sopwith Pup

Since more than one bomb was dropped, there is a chance of multiple hits occurring. The maximum number of hits and the chance of multiple hits are as follows.

# of Bombs	# of Hits	Chance to Hit
1-2	1	CPT
3-4	2	CPT/3
5-6	3	CPT/6

Note: CPT = The chance to hit in the Cumulative Probability Table

Example: A De Haviland-4 bomber carrying six MkIII demolition bombs makes a run on a German *Dresden*-class light cruiser (size C target). The plane releases the six bombs from an altitude of 300 m. The light cruiser is caught by surprise at is anchor when the attack occurs. The attack is resolved using the cumulative method.

Base Chance to hit: 3%
Stationary Target Modifier: x2.0
Modified Chance to hit: 6%
CPT (6% chance, 6 weapons): 31%
1 hit = 31%
2 hits = 10%
3 hits = 03%

The bomber player rolls D100 and gets a 08. Since this result is less 10%, two hits are scored on the light cruiser. [If you think this example says something to you about the accuracy of level bombing against maneuvering naval targets, you're right.]

7.4.2 Air-Launched Torpedoes. The aircraft in the early decades of the 20th century could not carry bombs large enough to do more than scratch the armor of a major ship. Torpedoes, although still somewhat new, were acknowledged ship-killers, and dedicated torpedo-carrying aircraft quickly appeared after WW I started.

The greatest problem in attacking a ship with aerial torpedoes was delivering them. Torpedo aircraft had to approach their target at relatively slow speed (50-60 knots) and fly in a straight line while they released their torpedoes at point-blank range, often under 1,000 yards. Also, the torpedoes used were modified ship-based weapons and the guidance and control systems had considerable difficulty getting the torpedoes under control after the drop.

LEVEL BOMBING TABLE

Target Size	Release Altitude (meters) 200	201-500	501-750	751-1000	1001-1500
A	0.16	0.11	0.07	0.05	0.04
B	0.09	0.06	0.04	0.02	0.02
C	0.04	0.03	0.02	0.01	0.01
D	0.03	0.02	0.01	0.01	x2
E	0.01	0.01	x2	x3	x3

Modifiers:
- Evasive Steering: x0.5
- Target Speed:
  - 25 kts x0.5
  - 10 kts x1.5
  - Stationary x2.0

Note: Attacks from altitudes greater than 1,500 m automatically miss the target.

Annex E2, Aerial Torpedoes lists the performance of the weapons used by each country. It also lists the release conditions for each torpedo. Annex B lists the aerial torpedoes that individual aircraft can carry.

Procedure: To make a torpedo attack, move the attacking aircraft so that it flies directly over the target ship. In that Movement Phase, it must fly within the altitude and speed restrictions listed in Annex E2. If it does not, the torpedo breaks up when it hits the water.

The attacking player must declare whether the torpedoes are set to run shallow or deep. Shallow weapons will strike the belt armor of a larger ship, while deep weapons will strike the anti-torpedo bulges, if any. Deep weapons will not hit a size C (light cruiser) or smaller ship.

Several aircraft may move as a group, and may launch their torpedoes at once. On the turn of launch, aircraft launching torpedoes have a Maneuver Rating of zero (0.0). This is because they are flying straight and level. If they maneuver at all, the torpedo will miss.

The torpedoes are dropped and reach their target in the Planned Fire Phase. Each torpedo attack by an aircraft is resolved individually. This will not be onerous from a game play perspective as there were very few torpedo-armed aircraft during the period covered by *FG&DN.* And a raid of six aircraft was considered to be large in WW I.

Cross-index the release range with the target size on the Aerial Torpedo Attack Table. The result is the chance that the torpedo will hit the target. Apply any modifiers, as listed on the table. The Aerial Torpedo Attack Table assumes that a ship is maneuvering to avoid being hit by a torpedo. If, for whatever reason, a ship chooses not to evade, then the no-evading modifier applies. For ships that are at speeds 10 knots or stationary, the non-evading modifier **is not** applied as it is built into the respective speed modifier.

Roll D100, and if the result is less than or equal to the modified chance to hit, the torpedo has hit the target.

Finally, roll D10 for each hit. On a 1-3, the weapon strikes on the bow or stern quarters, outside the coverage of the armor belt or anti-torpedo bulges. If the roll is a 4 or higher, the weapon strikes broadside, and is subject to armor or protection system effects.

In the turn before and after launch, players may maneuver as their planes allow, but they should make sure that all turn, climb/dive, and acceleration/deceleration limits are met as the aircraft maneuver into launch position.

Example: A Gotha WD11 floatplane makes a torpedo attack on a British battlecruiser. The Gotha player declares he is making a standard attack with the torpedo depth set for deep. The battlecruiser is evading at a speed of 25 knots. A standard attack against an A size target has a 12% chance to hit. Because of the battlecruiser's high speed, the chance to hit is halved. Thus, the final chance to hit for the torpedo attack is 6%.

Pressing Home an Attack: Counting deceleration and dive rates to reach the launch point, then acceleration and climbing away from the target, a torpedo bomber could be exposed to antiaircraft fire for some time.

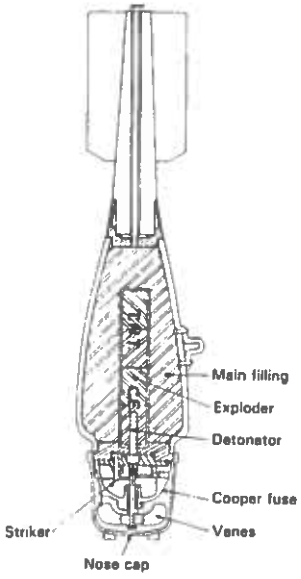
Players controlling torpedo bombers may either launch from outside Light AA range, and are then subject to AA attacks as they pull away, or press home their attacks to close range, and suffer both Area and Light AA losses first.

Aircraft Bombs

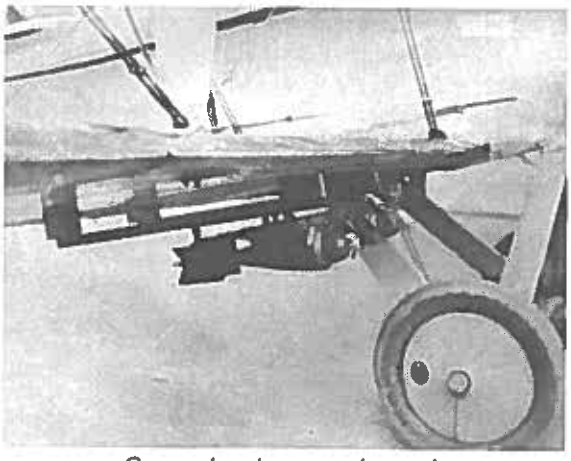
Aircraft bombs in WW I were "high technology," an unproven concept of uncertain effect. Initially, it was believed that raining explosives on the enemy's head would be so devastating that the enemy would surrender immediately. These assessments were fueled by unrealistic expectations about aerial bombs' lethality, their accuracy, and of course their psychological effect.

The limited carrying power of the planes meant that only relatively small bombs could be carried. Typical fighter loads were four 20 -25 lb bombs. Larger patrol aircraft, and later single-engine bombers, could carry up to six 100 - 250 lb bombs. Only the Zeppelins and the largest bombers could carry the larger 500 lb and 1000 lb "monsters."

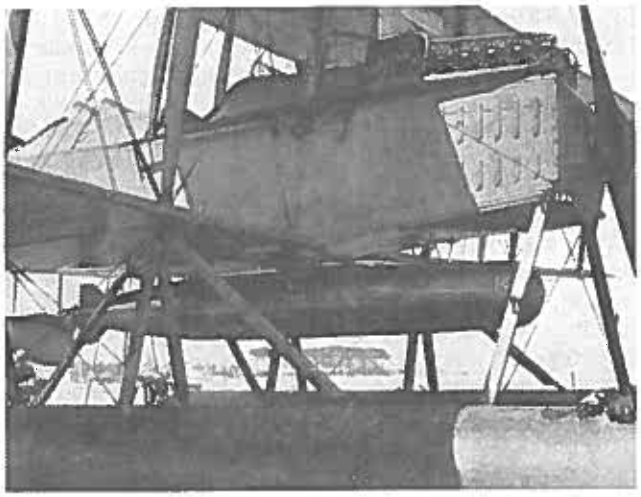
All explosive bombs dropped were general-purpose types, thin-walled containers with only the simplest fuzes. Bombs designed to penetrate armor only appeared after the end of the war. Incendiaries, using magnesium or oil fillers, were used against ground targets.



British 20 lb Cooper Bomb



Cooper bombs on a wing rack
US Dept. of War



PT-1 torpedo plane with a Bliss-Leavitt Mk 7 torpedo. (US Navy)

If the player presses home his attack, he risks fewer aircraft (and their weapons) getting through the defenses, but the torpedoes launched will be more accurate. At long range, more torpedoes will be launched, but on the average, fewer will hit.

In both cases, the launching aircraft will still be subject to Light AA defensive fire.

Early Release *(optional rule)*: Torpedo attacks by aircraft first occurred in August 1915 when the British attacked a number of ships during the Gallipoli campaign. The Germans didn't follow suit until 1916 and the Americans only started toying with the idea in 1918. Therefore, this type of attack was still very new and the tactical techniques associated with it were only just being figured out. Knowing how close you could get to the target before you release the torpedo required a lot of experience.

If players choose to use the Pilot Experience rules (section 7.6), the chance of the early release of torpedoes by pilot experience is listed in the Pilot Experience Modifier Table.

AERIAL TORPEDO ATTACK TABLE

Attack Type	Release Range (yds)	Target Size Class A	B	C	D&E
Pressed Home	<500	0.24	0.16	0.12	0.08
Standard	501-1,500	0.12	0.08	0.06	0.04
Early Release	1,501-2,000	0.07	0.04	0.03	0.02

Modifiers

- Non-Evading Target:	x1.5
- Target Speed:	
25 kts	x0.5
10 kts	x2.0
Stationary	x3.0

7.4.3 Rocket Attacks. Unguided rockets must be fired from either 200 or 500 m altitude. Attacks from higher altitudes will automatically miss a moving naval target. A rocket attack made from an altitude of 200 meters is considered to be a "Pressed Home" attack and the aircraft will be subject to Light AA fire before it can release its ordnance.

Rockets are fired in pairs up to the full load of the aircraft at a single target in the Movement Phase, as a plane flies over a naval target. Each pair of rockets is an individual attack and is resolved using the Unguided Rocket Attack Table.

UNGUIDED ROCKET ATTACK TABLE

Target Size Class	Attack Range (200m)	Attack Range (500m)
A	0.35	0.25
B	0.20	0.14
C	0.10	0.07
D	0.07	0.05
E	0.05	0.03

Modifiers

- Evasive steering:	x0.5
- Target Speed:	
25 kts	x0.5
Stationary	x1.5

Procedure: Find the chance to hit for a pair of rockets by cross-referencing the range of the attack with the target's size class. The number represents the probability that one rocket out of the pair will hit the target. Apply any modifiers to get the final chance to hit. Roll D100. If the die roll results is less than or equal to the modifier chance to hit, then the target has been hit by one of the rockets. Check for armor penetration of the rocket and apply the corresponding damage to the target.

7.4.4 Strafing: Aircraft can use their offensive guns against ships or ground targets. Although these attacks will rarely sink a ship, they can kill topside personnel, knock out light AA weapons, and distract AA from incoming attack aircraft. Any number of planes can strafe a target in a single thirty-second Air Movement Phase.

To strafe, a plane must fly at or below 500 m and during its Movement Phase fly directly over the target.

7.4.4.1 Strafing Ships. Treat the ship as an air target with a damage value of 40 and roll D100 on the Air-to-Air Gun Attack Table. If a hit is scored, apply the plane's gun damage as damage points. Roll normally on the appropriate critical hit damage table for the target type. If the target has any armor at all (rating of 1), the bullets will not penetrate and those critical hits requiring armor penetration are ignored. Finally, check the type of critical against the following table. If the critical rolled is not listed below, ignore the results. For Light AA guns, only a single gun is lost. The chance of a critical being inflicted depends on the type of gun the plane carries.

MG Cal	Criticals allowed
12.7mm	Aircraft, Bridge, Fire Control, Light AA, Searchlight, Wireless antenna, Signal light, Topside cargo
7.62mm	Aircraft, Bridge, Light AA, Searchlight, Signal light, Topside cargo

Optional rule: If the ship being strafed is an aircraft carrier, the attacking player can declare that he is aiming at an aircraft parked on the carrier's flight deck. Roll the attack normally, using the target aircraft's actual damage value. If the D100 roll succeeds, the targeted plane is destroyed (treat as an Aircraft critical hit, section 8.2.1). Only one plane on the deck may be attacked by each strafing aircraft per turn.

7.5 Aircraft Attacks Against Submerged Submarines. Planes can attack a detected sub with depth charges or time delay-fuzed bombs.

In *FG&DN*, airborne depth charge attacks are very similar to ship-delivered depth charge attacks. Depth charges will attack on the turn they are dropped. The same type of combat resolution chart is used and damage is resolved in the same way. In fact, the only real difference is that with airborne depth charge attacks you usually don't have to guess at which depth band you want to attack.

To make an attack, the attacking plane *must have* visual contact on the submarine. If a submarine cannot be seen then there is no chance that an accurate attack can be made. Once the target sub is spotted, the attacking plane must fly directly over the submarine (within speed and altitude limitations) and drop the desired pattern. Depth charge/ASW bomb patterns are defined in Annex D1.

Once the attack is made, the attacking player rolls D100 and compares the result to the appropriate attack table to see what level of damage (lethal, major, or minor) if any, has been inflicted on the submarine.

7.5.1 Speed and Altitude Limitations. Since depth charges and ASW bombs are designed to explode under water they have to survive impact with the surface. For anyone who has gone water-skiing, hitting the water at a good clip hurts. Thus, there are limitations on the aircraft's speed and altitude if the depth charge or ASW bomb is to survive. For all WW I era airborne depth charges or ASW bombs the speed and altitude restrictions are 60 knots and 100 meters. For every knot of speed and every meter of altitude above these limitations, there is a 1% chance that the weapon will break up on impact with the water.

7.6 Pilot Experience *(optional rule).* An aircraft is an extension of the pilot's hands and legs and its performance is a reflection of his skill. Air combat has proven time and again that individual pilot skill is a major consideration in the outcome of any combat. In no other part of *FG&DN* can an individual's skill and experience affect the outcome of combat as much as in the air.

While all parts of an aircraft's operations are affected by the skill of a pilot, it dominates three areas: Air Combat Maneuvering (dogfighting), unguided ordnance attacks, and VLow or Terrain-Following flight. In all of these areas, practice really does make perfect.

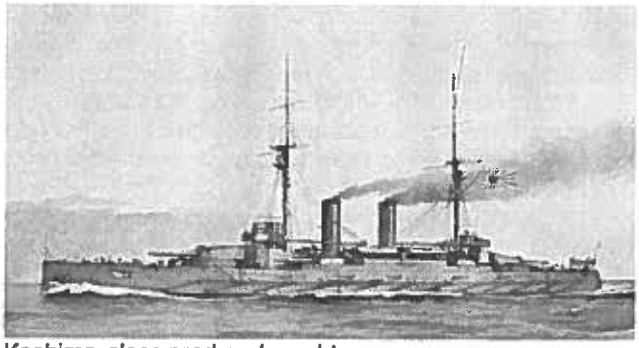
Pilot experience is ranked at four levels:

- **Recruit** - This individual has no place in an aircraft on a combat mission. Probably having soloed for the first time only a few days before, he is barely competent to fly an aircraft from point A to point B. He will suffer severe penalties as the result of his inexperience.
- **Novice** - Described as a "Nugget" in the American naval aviation community, this pilot has had the basics of combat training but is not seasoned. He has never experienced the pressures of combat nor flown in demanding circumstances. He does not know the full capabilities or limitations of his aircraft.
- **Experienced** - This pilot has flown several combat missions, or enough training missions to have built up a base of instinctive reactions to most situations. More importantly, he has learned how to build "situational awareness", the skill of keeping a three-dimensional picture of a fast-moving combat, and its possibilities.
- **Veteran** - This individual has many air-to-air kills and hundreds of combat sorties to his credit. He knows how to push his aircraft to the edge of its performance envelope and beyond (safely), and uses that knowledge with situational awareness to kill the enemy in the most efficient manner possible. This person is a survivor. Barring bad luck or sheer numbers this pilot can't be beat.

The Pilot Experience Modifier Table lists actions which are affected by the experience of the pilot. They apply equally to bomber as well as fighter pilots.

PILOT EXPERIENCE MODIFIER TABLE

	Recruit	Novice	Experienced	Veteran
Gaining Position in a dogfight	-20%	0%	+20%	+40%
Early torpedo release	50%	25%	10%	5%
Air-to-ship attacks	x0.5	x0.75	x1.0	x1.1
Air-to-ground attacks	x0.5	x0.75	x1.0	x1.1
% chance of crashing per turn in VLow/NOE flight:	+3%	+2%	+0%	-2%
Chance of landing accident	+2%	0%	-2%	-5%
Number of air-to-air attacks (ammo)	3	4	5	6



Kashima-*class predreadnought*

Chapter Eight - Ship Damage Results

Weapons hurt a surface ship in several ways. First, the explosive effects damage or destroy a part of the ship's structure, including its shell plating. If this is close enough to the waterline, flooding will occur. If enough of the framing and longitudinal members that make up the ship's structure are broken or damaged the stresses on the remaining ribs could break it in half. This is almost certain if the keel is broken.

An explosion will also send a shock wave through the ship. This may knock heavy machinery off its mountings, or stress previously damaged components to the point where they fail. The explosion's pressure wave will damage exposed items such as aircraft and people.

Finally, shells, bombs and torpedoes create fragments as they detonate. These jagged pieces of shrapnel will fly off on their own, creating more holes in the hull and may strike vital components.

Submarines are damaged in different ways. Depth charges cause damage almost purely by shock waves from the exploding charge to the hull of the submarine. The shock waves damage equipment and may weaken the hull, but will only kill a submarine outright at very close range.

Attacks are modeled in *FG&DN* by measuring damage in two ways: damage points and critical hits. Shells, bombs, and other weapons reduce a ship's damage point level until it reaches zero, thereby sinking it. Those same hits will also knock out weapons and other vital equipment, start fires, or cause flooding. These critical hits to specific parts of a ship may cripple it or sink it indirectly long before the ship's structure is destroyed. Procedures for each type of hit are provided below.

8.1 General Concept. Players resolve attacks as shown on the Combat Resolution Summary Table. Some attacks, such as gun, torpedo and depth charge attacks, are rolled for immediately. Others are resolved at the end of the turn.

COMBAT RESOLUTION SUMMARY

Plotting Phase. No combat resolution occurs.
Movement Phase. Resolve torpedoes, including damage effects, which come within 500 yards of a ship after all movement is completed. Aircraft attacks on ships are also resolved.
Planned Fire Phase. Gunfire and depth charge attacks made in this phase are resolved in this phase, including damage effects.
Detection Phase. No combat resolution occurs.
Second Air Movement Phase. Aircraft attacks on ships and AA attacks are resolved.
Reaction Fire Phase. Gunfire and depth charge attacks made in this phase are resolved in this phase.
Resolution Phase. Die rolls for damage control are made now.

Note: Critical hits are computed and inflicted after every phase, before the next phase begins. Additional damage points received as *a result of critical hits* are accumulated during the turn and inflicted in the Resolution Phase of that Tactical Turn.

CRITICAL HIT TABLE

D10 Roll	Major Surf Combatant (Size A&B)	Minor Surf Combatant (Size C,D,E)	Aviation Ship	Merchant/ Auxiliaries	Torpedo Attacks	Submarine Lethal Dam.	Submarine Major Dam.	Submarine Minor Dam.
1	Main Btry*	Main Btry	Aircraft	Weapon	Weapon	Svr. Flooding	Flooding	Min. Flooding
2	Casemate*	Other Wpn	Flight Deck	Cargo	Weapon	Svr. Flooding	Flooding	Min. Flooding
3	Other Wpn	Other Wpn	Weapon*	Cargo	Fire	Hull Penetr.	Battery	Switch Board
4	Sensors	Sensors	Ammo/Fuel*	Light AA	Flooding	Hull Penetr.	Hull Deform.	Comms
5	Flooding*	Flooding	Flooding*	Flooding	Flooding	Hull Penetr.	Hull Deform.	Comms
6	Comms	Comms	Comms	Cargo	Flooding	Hull Penetr.	Fire	Minor Fire
7	Engineering*	Engineering	Engineering*	Engineering	Engineering	Hull Penetr.	Fire	Minor Fire
8	Bridge*	Bridge	Bridge*	Bridge	Engineering	Hull Penetr.	Sensor	Rudder
9	Fire	Fire	Fire	Fire	Engineering	Hull Penetr.	Weapon	Weapon
10	Rudder*	Rudder	Rudder	Rudder	Rudder	Hull Penetr.	Engineering	Engineering

Notes:
Locations with (*) require armor penetration before the critical hit is inflicted.
Surfaced subs are treated as minor surface combatants. Substitute their torpedo tubes for the Main Battery critical.
Submarine Minor Damage Sensor, Rudder, Weapon, and Engineering criticals are automatically cleared in D6 Tactical Turns. There is no minor fire for the Engineering critical.

8.1.1 Computing Hits. Damage in *FG&DN* is measured in "damage points." These are used to measure the amount of damage a weapon will do, and the amount of damage a ship can absorb before it sinks. The bigger a ship, the more damage it can take, but it is not a linear scale. Larger ships get fewer points for each ton of displacement than smaller ships.

When a weapon inflicts damage on a target, the weapon must first penetrate any armor in the location of the hit before it can do internal damage. Non-penetrating hits will still cause some damage anyway.

The effects of damage, including critical hits, are applied simultaneously to both sides at the end of the phase. *If a critical hit, like a fire or flooding, inflicts more damage points, they are applied in the Resolution Phase of the same Tactical Turn. Secondary effects, like explosions, are applied immediately, in the phase in which the damage is resolved.*

Example: In Turn 1200, a cruiser is hit by a torpedo in the Movement Phase. Resolving the damage at the end of the Movement Phase, the ship suffers several Flooding criticals, which will inflict 35 points of damage on the ship. In the Planned Fire Phase it is hit by enemy gunfire, which results in a Fire Critical. The fire inflicts 10 more points of damage. A total of 45 damage points will be applied to the cruiser in the Resolution Phase of Turn 1200. If one of the shell hits in turn 1200 had hit the main battery magazine, the cruiser would be destroyed by the explosion at the end of the Planned Fire Phase of turn 1200.

Whenever a ship is hit by a weapon, subtract the damage points inflicted by the weapon from the ship's damage point total. When the ship's total reaches zero the ship sinks.

Weapons hitting aircraft destroy the aircraft or damage it so severely that it aborts its mission or is rendered unflyable and is removed from play.

8.1.2 Speed Reduction. As a ship or sub's damage point total is reduced, its speed goes down as well. Loss of structural strength may force a ship to slow down. Drag on the hull will slow it as its smooth lines are broken by holes and other damage, and general damage to the propulsion plant will affect its efficiency.

A ship's speed is reduced by one quarter each time it takes one quarter of its original damage point level, and is reduced to zero at the 90% damage level.

The break points for damage are 0%, 25%, 50%, 75%, 90%, and 100%. The speed percentages are 100%, 75%, 50%, 25%, 0%, and sunk.

Each ship class has a different table which is included with its other characteristics in Annex A. The top line represents the damage point levels where the speed is reduced, while the bottom line shows the new maximum speed at that level of damage.

Example: A British Tiger-class battlecruiser takes 501 points of damage. Its damage and speed breakdown table is shown below:

Damage and Speed Breakdown:

Dam Pts:	0	125	251	376	451	501
Surf Speed:	28	21	14	7	0	Sinks

With no damage (0), *Tiger* is capable of 28 knots. At 124 points of accumulated damage, it can still do 28 knots, assuming no propulsion criticals or other restrictions. At 125 points though, its maximum speed is 21 knots. From 125-250 points of damage, it can make 21 knots. The 251st point reduces its speed to 14 knots, and so on.

Acceleration/Deceleration rules (section 3.1.1) apply here, so the ship slows, coasting to a slower speed at half the deceleration rate, so its speed next turn would be 28 - (8/2) = 24 knots. The following turn it would slow to its new maximum speed, 21 knots.

If a ship has taken propulsion criticals or other damage that also reduces its speed, these are applied to the ship's maximum speed as it changes.

8.1.3 Surface Ship Critical Hits. A ship is a platform which carries the weapons and sensors that allow it to fight. A ship can be destroyed by sinking it, but it can also be rendered useless by destroying the equipment that makes it a warship. Destroying a ship's weapons or sensors while leaving it relatively undamaged is called a "mission kill," meaning that the damage a ship has received prevents it from performing its mission. It is as good as sunk as far as the battle is concerned.

Damage to a vital component of the ship is called a critical hit. These include not only its weapons, but engineering (propulsion), the rudder, and flight decks. In *FG&DN*, whenever a ship is hit, the severity of the hit will be used as a way of determining if there is a chance of one or more critical hits.

DAMAGE RATIO TABLE

Damage	D6 Die Roll					
Ratio	1	2	3	4	5	6
<.10						1
0.10					1	2
0.20				1	2	3
0.30			1	2	3	4
0.40		1	2	3	4	5
0.50	1	2	3	4	5	6
0.60	2	3	4	5	6	7
0.70	3	4	5	6	7	8
0.80	4	5	6	7	8	9
0.90	5	6	7	8	9	10
1.00	6	7	8	9	10	11
1.20	7	8	9	10	11	12
1.40	8	9	10	11	12	13
1.60	9	10	11	12	13	14
1.80	10	11	12	13	14	15
2.00	11	12	13	14	15	16
2.20	12	13	14	15	16	17
2.40	13	14	15	16	17	18
2.60	14	15	16	17	18	19
2.80	15	16	17	18	19	20
3.00	16	17	18	19	20	21
3.30	17	18	19	20	21	22
3.60	18	19	20	21	22	23
3.90	19	20	21	22	23	24

Note: Higher ratios may be extrapolated by adding one to the number of criticals for each 0.3 that the Damage Ratio exceeds 3.90.

In each phase that a ship takes damage, divide the damage points taken by the number of points the ship has remaining after that phase's damage points are applied.

This is the damage ratio *and is used to figure out how many critical hits a ship may have suffered.*

Roll D6 and cross-index the result with the ratio on the Damage Ratio Table. The result is the number of critical hits inflicted on the ship.

Example: A British W-class destroyer has 39 damage points. If it takes 8 points of damage from gunfire in the Planned Fire Phase, the critical hit ratio is 8/(39-8) or 8/30 = .26. The players use the .20 line (always round down).

Once the number of critical hits is determined, find the nature of each on the Critical Hit Table. Each type of ship has its own column. Roll D10 for each critical hit on that column to see what its effect on the ship is. The critical hit types with asterisks are armored (*) if the ship has an armor rating greater than zero. Section 8.1.6 has the rules for armor.

In addition to the critical hits inflicted on a ship by any weapon, certain weapons will automatically inflict certain types of critical hits.

• Each **torpedo** which hits a ship or submarine will automatically inflict a flooding critical hit, in addition to any other critical hits. If the ship hit has a torpedo protection system (see section 8.1.7.2) the torpedo must penetrate it for the flooding critical to occur.

• Each **bomb** of 100 lb or larger which hits a carrier automatically inflicts a flight deck critical hit (penetration allowing) in addition to any other criticals caused by its damage points.

• Each turn of **shellfire** of 120mm or larger which hits a carrier automatically inflicts a flight deck critical hit (penetration allowing) in addition to any other criticals caused by its damage points.

8.1.4 Submarine Critical Hits. While on the surface, submarines are treated as surface ships, and use the Minor surface combatant column for figuring critical hits. When submerged, subs use the Lethal/Major/Minor damage columns, as determined by the severity of the underwater attack that they suffer.

8.1.5 Effects of Massive Damage. Even though most of a ship's weapons may still be intact there is a point where massive damage to the ship overall will prevent the operation of various weapons.

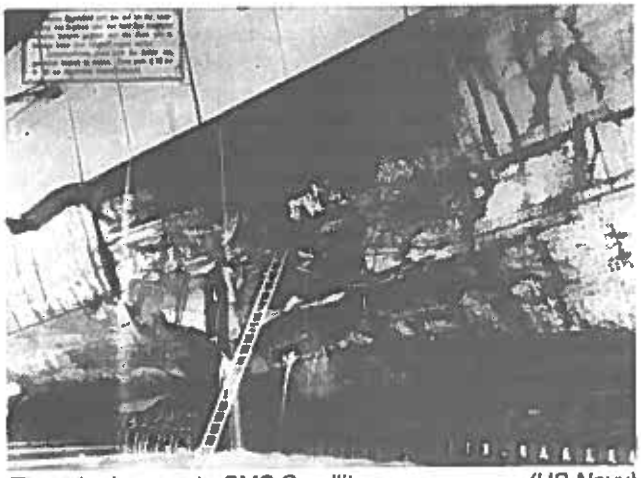
When a ship has only 25% of its original damage points remaining, all primary and secondary batteries, torpedo tubes, and ASW weapons are out of action. Remaining Light AA is unaffected. Submarines must surface. Aircraft carriers cannot launch or land aircraft on the flight deck.

When a ship has only 10% of its original damage points left, all of its weapons, including catapults, are out of action.

8.1.6 Effects of Armor. Armor reduces the amount of damage a ship takes and provides special protection to critical areas of a ship. In World War I, ships larger than a destroyer carried armor covering the magazines and engineering spaces (belt), major weapons (turret top and faces), and the deck. Other critical items, such as the conning station, could also be armored. The armor belt provided protection against close-range shell fire and shallow torpedoes. The deck provided protection from bombs and plunging fire at long ranges.

Larger warships also had special protection against torpedoes. Below the waterline, most ships had a large empty compartment called a void. These were designed to absorb the force of a torpedo's warhead, and prevent the true inner hull from being ruptured. While a torpedo would destroy the void, no real harm would be done to the ship.

Each weapon has a **penetration rating** as part of its statistics. These values are precalculated for each gun at each range bracket, and are listed in Annex C. To find a gun's penetration, measure the range and find the appropriate range band in the Annex for that gun and shell type.



Torpedo damage to SMS Seydlitz *(US Navy)*

The most common shell types are Armor-Piercing (AP), Semi-Armor Piercing (SAP) Common (CP) and High Explosive (HE). Most of the AP, SAP and some CP shells had a special cap added to improve the armor penetrating capability of the shell against face hardened armor. A shell with a cap on it has a "C" after its designator. Thus, a capped armor-piercing round would be APC.

Short and Medium-range gunfire has a relatively flat trajectory, and will strike the side of a ship on the armor belt. Long and Extreme-range fire must arc much higher and is called plunging fire. At Long range, there is a 70-30 chance the shellfire will strike the belt or deck armor, and the firing player must roll to see which armor value must be penetrated. Extreme-range shellfire has a 40-60 chance of striking the belt or deck armor.

Bombs are classed as demolition or general-purpose (GP), fragmentation or incendiary. Armor-Piercing and Semi-Armor Piercing bombs with thicker casings and smaller explosive charges weren't developed until long after WW I. Demolition bombs have relatively thin-walled casings and a large explosive charge. Fragmentation bombs were small antipersonnel weapons, while incendiary bombs were designed to cause large scale fire damage. The latter two types were designed specifically for use against land targets and were largely ineffective against ships. The amount of damage inflicted by GP, fragmentation and incendiary bombs and other weapons is shown in Annex F.

Bombs and rockets always strike the deck armor. In *FG&DN*, bombs will have two penetration ratings which are listed in Annex F. The first penetration rating is for level bombing attacks from altitudes less than 500 m. The second rating is for level bombing attacks 500 to 1,500 m.

Strafing attacks will not penetrate armor.

Shells and Armor

Up until the late 1880s, warships relied largely on mild steel, or a combination of mild steel and wrought iron (Compound or composite armor) for protection against gunfire. Both the mild steel and Compound armor were considerably stronger than wrought iron armor and were able to defeat the chilled cast-iron "Palliser" projectiles by breaking them up on impact. It became quite clear that a harder and stronger material was needed for projectiles, and steel was adopted for this purpose by the mid-1870s. By the end of the 1880s, all shells we made with steel. With the new steel projectiles, the gun once again had the upper hand in the seesaw struggle for supremacy between guns and armor; but not for long.

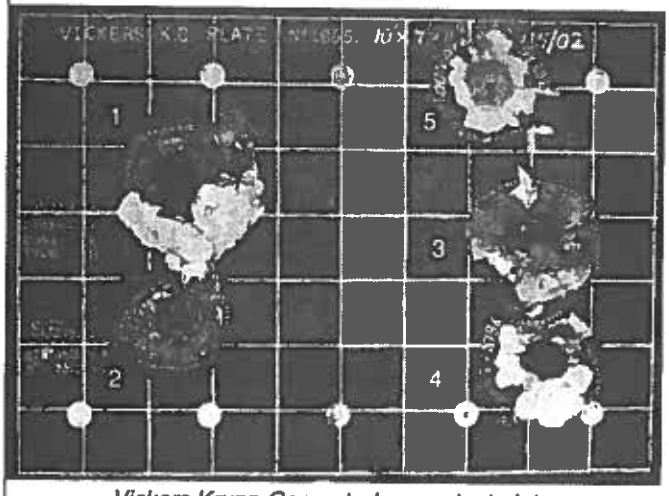
In 1889, the French company Schneider & Co. at Creusot, found that by adding small quantities of nickel to steel alloy, the strength of the armor plate could be increased without any loss in hardness. Hardness was a crucial factor in armor performance, because this was what caused the projectiles to breakup on impact. Although nickel steel was only slightly stronger than Compound armor, it had the advantage of being easier to manufacture and in initial ballistics tests was found to resist the cracking that tended to shatter Compound armor after a few hits. Nickel steel might have become the armor of choice for warships, had it not been for an American by the name of H.A. Harvey.

12-inch AP shell with cap . (Naval Annual 1911)

Mr. Harvey liked the concept of Compound armor, with its very hard face and the tough resistant back, but the transition between the two materials was too sudden and the joint between them was incapable of holding up to the attack of the new steel shells. So Harvey experimented with the idea of "soaking," or diffusing carbon into homogeneous nickel steel by placing a red-hot plate in contact with bone-charcoal for several days. After quenching the plate in water, the face of the plate was "supercarborized" or "cemented" to a depth of a little more than an inch. This process resulted in the first face-hardened armor, with an extremely hard face bound together (i.e. no physical joint) with and supported by, a tough back that provided excellent resistance to cracking. This revolutionary new armor was about 30% better than nickel steel and about 40% better than Compound armor in stopping power. Even many of the new steel shells had considerable difficulty penetrating the superhard face of Harvey armor.

While the Harvey process was a great leap forward in the manufacture of armor, it was soon found that the back of a Harvey plate was still not tough enough to withstand attacks by the newer forged chromium steel alloy shells. On to the world scene now steps Friedrich Krupp of Essen, Germany with a cementing process that becomes the standard for all future face-hardened armor. Krupp's process began with the addition of small amounts of chromium to the steel alloy. The chromium made it easier to harden a plate of armor and the depth of the hardened layer could be much thicker than with the Harvey process. Krupp also kept the steel plates in an oven for three weeks, not days as in the Harvey process, the final result being that the hardened layer was about 30% of the thickness of the plate. The back of the plate, however, had low carbon content and was very tough. The major problem with Krupp cemented armor, hereafter known as KC armor, was its cost - Krupp armor was expensive and many navies didn't view the 10-15% increase in protection over Harvey armor as being cost effective. Thus by the mid-1890s, armor again had once again eclipsed the gun, as even the new forged shells could not penetrate Krupp's armor. But gunmakers would not let this situation last for very long.

Armor-piercing caps had been experimented with as far back as 1878, and even though the results were encouraging, no one adopted the cap right away. However, in 1894 the Russians began putting the cap on their large caliber naval shells. By 1908, every navy had caps on their armor piercing and semi-armor piercing shells. The cap's primary purpose is to prevent the shell from shattering on impact with face-hardened armor by absorbing the shock and protecting the head of the shell from damage (see the photo of the 12-inch shell above). Initially, caps increased the penetration power of shells by 15%; provided the striking velocity and angle of impact were within certain limits. Ultimately, later cap designs would boost the penetration capability by 30%. With armor-piercing caps, the gun could once again penetrate even the thickest KC armor, but usually only from short to medium range.



Vickers Krupp Cemented armor test plate . (Naval Annual 1903)

The picture on the left of a Vickers test armor plate helps to drive home the benefits of armor-piercing caps. Shot numbers 1 and 4 are 6-inch capped armor-piercing shells that completely penetrated the 11.8 inch KC armor plate. Shot numbers 2 and 5 are 6-inch uncapped armor-piercing shells that broke up on impact with the armor plate. Shot number 3 is a 7.5-inch capped armor-piercing shell that penetrated 11.5 inches before being stopped. The larger round had a significantly lower striking velocity than the 6-inch shells.

Deck and belt **armor ratings** are provided for each ship. For example, the *Tiger*-class battlecruisers have a rating of 18/6, meaning a belt thickness equivalent to 18 centimeters, and a deck armor equivalent to 6 cm. The deck is much thinner than the belt, but shells at Long range do not penetrate as much armor and the chance of getting a hit is much less as well. Demolition or GP bombs also lack penetrating power and will not penetrate even this much deck armor.

In the diagram of HMS *Tiger* below, you will note that many of the locations have armor thicknesses greater than the associated belt or deck armor rating. This is due to the fact that all armor is not alike and that a quality modifier has been applied to the weighted average used in determining the ratings. See Annex L for more information.

When the ship is attacked by a weapon, compare the penetration ability of that weapon with the armor rating where it struck (Deck or Belt). If the weapon's penetration is greater than the armor rating, full damage will occur.

If a shell or bomb does not penetrate, divide the damage depending on the type of bomb or shell by:

AP or SAP:	3
CP or HE:	4
All bombs:	4

If the weapon does not penetrate the armor where it struck certain critical hits will not happen either. These are marked with an asterisk (*) on the critical hit table. For example, to knock out a ship's main battery, a bomb must penetrate the ship's deck armor.

A shell must penetrate the belt or deck armor at Long or Extreme range, or just the belt armor at Short or Medium range. If the projectile penetrates, all criticals are inflicted as well as full damage.

8.1.6.1 Faulty shells *(optional rule).* The game's gun system assumes shells are 100% reliable and the damage model reflects this assumption. The one thing that was 100% certain in WW I was that nothing worked perfectly - particularly British shells. As early as 1910, the Royal Navy's armor-piercing shells filled with Lyddite were known to have very poor performance when they struck armor at high angles of obliquity. These shells had a tendency to detonate or break up before they had penetrated the armor, significantly reducing their effectiveness.

If a warship is fitted with British guns, and fires British APC shells, they will have their damage reduced by 40% when firing at targets at Long or Extreme range, provided the target has a belt armor rating greater than, or equal to 1/3 of the shell's diameter. In other words, all gunfire attacks by British APC rounds are resolved normally, with the exception that the final damage is multiplied by 0.60 if the above condition is met. If the shells would normally not penetrate the target's armor, then the damage is calculated normally (according to 8.1.6).

Example: HMS *Tiger* engages SMS *Moltke* at long range with 1,400 lb. 13.5in (343mm) APC shells. The *Tiger* successfully attacks *Moltke* and scores two hits from her eight guns. Normally, the 1,400 lb. APC shell (penetration of 26) would easily defeat *Moltke*'s belt armor (rating of 21) at this range, but since the German battlecruiser's armor is greater than 11 (34.3/3 = 11.4 or 11), the British shell does not perform properly and the damage is reduced from 34 to 20 DPs (34 x 0.6 = 20.4 or 20).

Note: If players intend to use this rule, they should make up a table before the game for each British gun, listing the required armor thickness and the reduced damage.

The Royal Navy wasn't the only one with defective shells. On average, the failure rate of WW I shells of all types for all nations was about 20%. If players desire, all gunfire damage can be multiplied by 0.85 to reflect this historical deficiency

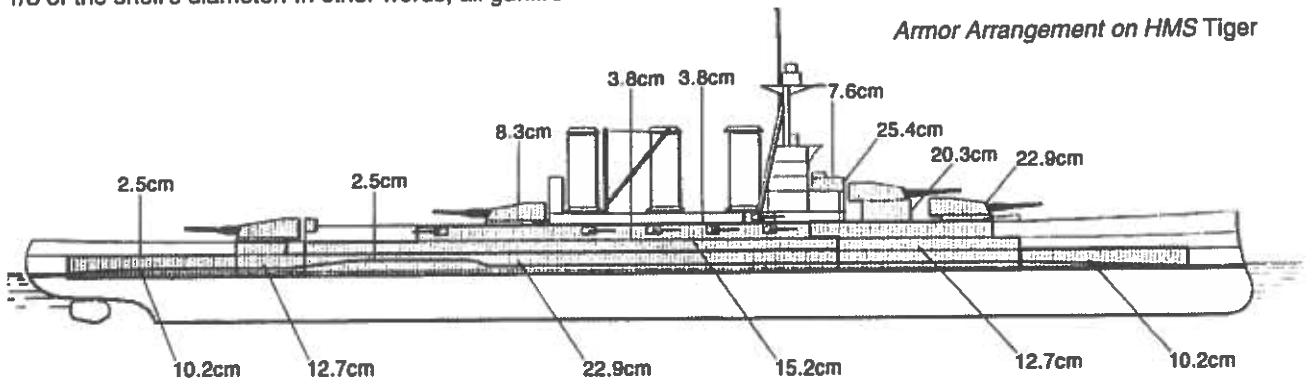
8.1.7 Armor and Torpedoes. Torpedoes can be set to run shallow or deep. Torpedoes must run shallow to hit size C-class (light cruisers) and smaller ships. A shallow torpedo will strike a larger ship's belt armor, however. Deep torpedoes will run under small ships and will strike larger ships below the belt armor, in the area of the anti-torpedo void, if they have any. While many large ships carried torpedo protection systems a number of the older designs did not.

Whatever their depth, torpedoes that strike a ship from the narrow aspect (see the Torpedo Asppect Table on page 6-11) hit outside the armor belt or the torpedo protection system.

8.1.7.1 Shallow-Running Torpedoes. If a shallow-running torpedo strikes the armor belt, its damage is reduced according to the following table.

Target's Belt Armor	Damage Point Reduction
0 - 5	None
5 - 10	10%
11- 15	15%
16 - 20	20%
21 - 25	25%
26 - 30	30%

Armor Arrangement on HMS Tiger



8.1.7.2 Deep-Running Torpedoes. Underwater protection ratings are given for those ships that have them. A German *Kaiser*-class battleship's armor rating, for example, is 26/7/75. The first two numbers are belt and deck ratings, as before. The third number is the underwater protection rating. Unlike the first two numbers, the third number is not an armor thickness but the number of damage points the protection system will absorb on each side of the ship before it fails. However, the system can absorb only one-third the total damage points (25 in this case) from a single torpedo. Any damage points over this inflicted by a single hit are applied to the ship's total.

Example: A *Kaiser*-class battleship is hit by two different torpedoes, one with a 23-damage point warhead and one with 37 damage points. The 23 damage points of the first will be completely absorbed with no damage to the ship. The second torpedo will overwhelm the system, inflicting 12 damage points (37 - 25 = 12) on the interior of the ship.

If a ship takes several torpedo hits on the same side, the protection system will be destroyed. The system itself consists of empty compartments, called voids, just inside the skin of the ship. By lining the ship's side with them, the torpedo will hit one of them and expend its explosive force. The more voids, the better the protection. The compartments will only absorb one torpedo hit in a given area of the ship though. After that, a hit in the same area will reach the ship's vitals. Also, the area around the actual hole is weakened, and is less able to resist a hit.

A ship can absorb torpedo damage on each side equal to the strength of the protection system. Thus, a *Kaiser*-class battleship can absorb 75 points of torpedo damage on the port side and another 75 on the starboard side as well. Damage done to one side will not carry over to the other. Torpedo damage points inflicted on the protection system, even if they do not penetrate, still reduces its total resistance.

For example, A *Kaiser*-class battleship is attacked on the port side by a salvo of four 23-point ship-launched torpedoes. The first three hits do not penetrate, but the port side protection system itself is reduced by 69 points to 6 points (75 - 69 = 6). The fourth 23-point torpedo that hits the port side is only reduced by the protection system's remaining 6 points, allowing 17 to get through. The torpedo protection system on *Kaiser's* port side is now totally eliminated. Any other torpedoes which hit the port side will inflict full damage.

Note: This system is an abstracted model of the reduction of a ship's torpedo defense system. It is a lot easier to keep a running total of damage points inflicted than it is to determine the location of each torpedo hit on the hull, the size of the hole it makes, and whether it is close to any other holes.

8.1.8 Torpedoes & Target Aspect. If a torpedo hits a ship at a narrow aspect (bow or stern), divide the torpedo's damage by two. An extreme bow or stern hit wasted a lot of its energy moving water and not damaging the ship. If the ship is hit in the stern, the first two critical hits, beside the automatic flooding which doesn't count against the critical hit number, are automatically engineering and rudder hits. Roll the remaining critical hits normally.

8.1.9 Sinking. A ship or surfaced sub that has received enough damage to sink it rolls D10 x 10 for the number of minutes it will take to sink. The final disappearance happens in the Movement Phase. Submerged subs and ships that have magazine explosions sink immediately. *Until the hulk sinks, it is a menace to navigation and will still cause damage if another ship collides with it.*

8.2 Effects of Critical Hits. Critical hits take systems out of action, affecting the fighting capability of the target.

8.2.1 Aircraft. An aircraft aboard the ship has been destroyed. There is also a chance that a fire has started. Roll D10-4 on the fire critical table. A result of less than one means there is no fire.

Armed or Fueled Aircraft *(optional rule)* Hits on armed or fueled aircraft ready for launch roll on the fire critical with a -2 modifier instead of -4. If the D10 roll is a ten (0), the ordnance on the plane explodes, inflicting normal damage points on the ship. If the ship is armored, the damage will not penetrate and is reduced by a factor of four in accordance with Section 8.1.6.

Closely Parked Aircraft *(optional rule).* Massed parked aircraft were especially vulnerable to attack. Normally, planes are parked in dispersed locations, or in revetments, with earth walls separating them. Sometimes, though, they are parked close together, such as on the flight deck of an aircraft carrier.

If there are other aircraft parked near a plane that has been hit (within 10 meters) there is also a chance that they were hit as well. A maximum of four other planes are subject to effects of a damaged aircraft.

If the attacked plane explodes because its ordnance detonates, the chance of another aircraft nearby (within 10 meters) being hit is 75%.

If the attacked plane burns, there is a 40% chance of the fire spreading to nearby (within 10 meters) planes.

8.2.2 Ammo/Fuel. Roll D10 with a 1-3 indicating a hit in the aviation ordnance magazine, a 4-10 a hit in the fuel storage.

If the magazine was hit, roll another D10. A roll of 9 or 0 means that the magazine has detonated, destroying the ship.

If the aviation fuel storage tanks have been hit, there is a Fire, adding two to the D10 roll for the severity of the fire. In addition, the chance of reducing the fire is reduced by 2 on a D10.

The player has the option of flooding the magazine areas. Gas purging systems for the aviation fuel storage weren't developed until much later. Flooding the magazine automatically puts out the fire, but the carrier cannot arm any aircraft for the rest of the game.

8.2.3 Battery. Some of the battery cells have been damaged. Essentially, the battery casing has been cracked and the acid is leaking out and into the battery well bilge. This reduces the submarine's submerged endurance because the damaged cells are lost. To figure the percentage of submerged maximum endurance lost, roll D6 x 5% (max loss of 30% per battery critical). Split the loss proportionately between charged and depleted cells.

8.2.4 Bridge. The main conning station has been damaged. Roll D10. 1-6 it maintains current movement orders. 7-8 it circles to starboard at current speed. 9-10 it circles to port. Circles are made in 45° increments.

It takes four Tactical Turns to correct the steering problem. After the problem has been corrected, all changes

to course and speed take two Tactical Turns to execute. Note: If a ship also suffers a Rudder critical hit, the latter takes precedence over a Bridge hit. If the Rudder critical hit is repaired, then the long term effects of the Bridge critical hit are applied. Submarines lose all fire control solutions, and come to periscope depth. Submarines broach (involuntarily surface) for that Tactical Turn on a roll of 1 on D10. Carriers cease flight operations for four Tactical Turns. There is a Minor fire in the bridge/control room.

8.2.5 Cargo. Some of the ship's cargo has been destroyed. If possible, allocate cargo to a hold/tank, then determine which hold or tank was hit. Refer to the cargo damage table to see what the results are.

CARGO DAMAGE TABLE

Contents	Roll	Result
Ammo	1-2	D100% of the ammo is lost
	3-7	D100% ammo lost. Fire, add one to the fire severity and reduction die rolls. There is a 25% risk of explosion each following Intermediate Turn.
	8-10	Explosion. Nearby ships take damage points according to the amount of ammo, in tons, in the hold. 500 yds away tons/5 dp 1000 yds away tons/25 dp 2000 yds away tons/200 dp
		If the ammo in one hold explodes, there is a 70% chance ammo in each other hold will explode. Fires or the chance of explosion can be stopped by flooding the hold, but all the cargo in that hold is lost.
Petroleum Products		Fire. Add one to the severity die roll for crude oil. If it is a refined product, add two. If it is avgas, add three. Add the same number to the reduction die roll.
Troops	1-3	DP casualties
	4-6	2 x DP casualties
	7-9	3 x DP casualties
	10	4 x DP casualties
General Supplies		DP/2 tons destroyed
Vehicles		DP/2 Destroyed
Aircraft		DP/5 Damaged

8.2.6 Casemate. One of the ship's casemate guns has been knocked out (*the armor protection for casemate weapons is 2/3's the belt armor value*). Roll D10. On a 1-2, the fire control (if fitted) for the casemate battery has been knocked out (armor penetration not required). On a 3-0, one of the casemate guns is out of action. Roll D10 again. On a roll of 9 or 0 the ready ammunition detonates, inflicting two times the Short range HE damage to the ship. Roll randomly to see which gun has been disabled.

Some ships lost their entire casemate batteries on one side during WW I because of chain-reaction explosions.

If a casemate gun's ready ammunition detonates there is a chance the explosion will damage adjacent casemate mounts. Roll 2D6 and consult the table below to see how many guns are affected. For each gun that is affected, roll D10 to see if the ready ammo also detonates (9 or 0). If this happens roll 2D6 again. Continue this procedure until there are no more explosions.

2D6 Die Roll	Additional Guns Damaged
2 - 5	None
6 - 8	1 gun
9 - 11	2 guns
12	3 guns

8.2.7. Communications: One of the communications systems has been hit. Roll D10 on the following table:

1-2: Port signal lights destroyed
3-4: Starboard signal lights destroyed
5-6: Port signal halyards destroyed
7-8: Starboard signal halyards destroyed
9: Main Wireless (WT)/radio (RT) (if fitted) destroyed
10: Auxiliary Wireless (WT) (if fitted) destroyed

8.2.8 Engineering. Roll D10. On a 1-9, the ship's engineering plant has been damaged. Reduce speed to the next lower level on the Damage and Speed Breakdown chart. A Minor Fire has started in the engineering spaces. On a roll of 0, there has been a boiler explosion. The ship receives 25% of its original total in damage points, drops one level on the Speed Breakdown chart and has a Severe Fire.

8.2.9 Fire. A fire has been started, the severity of which depends greatly on when the ship was built. Later ship designs were constructed with better fire resistant characteristics. Roll D10 to find out how bad each fire is. The amount of damage for each type of fire is given in the following table.

Year Completed	Fire Damage
Before 1906	4%/8%/12%
1906 - 1916	3%/6%/9%
After 1916	2%/4%/6%

1-5 Minor Fire. The ship loses 4%/3%/2% of its original damage points per Intermediate Turn until the fire is extinguished. Submarines must put the fire out on the first damage control roll or surface to ventilate the boat.

6-8 Major Fire. The ship loses 8%/6%/4% of its original damage points per Intermediate Turn. Ships must cease flight operations, maneuver to put the wind 30 degrees on either bow and slow to 15 knots or less. If they do not maneuver and reduce speed, add +2 to the die roll for reducing the fire. Submarines must surface.

The ship is considered illuminated at night for visual detection and gunfire purposes. It will also illuminate or silhouette other ships similarly to a flare or starshell.

9-10 Severe Fire. The ship loses 12%/9%/6% of its original damage points per Intermediate Turn. Ships must cease flight operations, maneuver to put the wind 30 degrees on either bow and slow to 15 knots or less. If they do not maneuver and slow, add +2 to the die roll for reducing the fire. Submarines must surface.

The ship is considered illuminated at night for visual detection and gunfire purposes. It will also illuminate or silhouette other ships similarly to a flare or illumination round.

Conflagration: A conflagration is defined by the US Navy as a fire which is out of control. If the total percentage of fires present on the ship is 15% or more of the ship's

original damage point rating, the ship is suffering a conflagration. There is a 25% chance per Intermediate Turn (cumulative) that the ship's magazines will explode and sink the ship immediately. This may be avoided by ordering the magazines flooded in the Plotting Phase of an Intermediate or Tactical Turn, but the ship loses all main battery, secondary battery, and aircraft ammunition. Only Light AA ammunition is unaffected.

If the total percentage is not reduced below 15% on the next Intermediate Turn, the fires are out of control and the order is given to abandon ship. If the percentage is reduced below 15%, the danger of conflagration is removed.

Damage Control: Reducing Fires. For each fire, roll D10 in the Resolution Phase of the Tactical Turn the fire started and each following Intermediate Turn: 1-4 means that the fire has been reduced one level, and minor fires have been extinguished; 5-8 means that the fire continues as before; 9-10 means that the fire increases one level of intensity. A severe fire will not increase in severity beyond the 12%/9%/6% associated with a ship's completion date.

Ships which reduce all fires to minor before the Planned Fire Phase are not illuminated. If they have a major or severe fire, they are illuminated.

National Effectiveness *(optional rule).* Different navies were more or less effective in training their crews in how to fight fires. These represent average values, and individual leadership or circumstances could change a crew's performance dramatically. Modify the D10 roll as follows:

US, British, German crews	-1
All other navies	0

A die roll of zero (10) is always treated as a 10, regardless of modifiers.

Fuel Spill *(optional rule).* Aircraft which crash on a ship will always cause fires. Roll D10-2 for severity.

Assistance From Other Ships *(optional rule).* If another ship maneuvers within 100 yards of the damaged ship and parallels its course and speed, it can assist in battling major and severe fires. Up to two ships may assist, one per side. As long as the ships' speed is below 10 knots, there is no risk of collision.

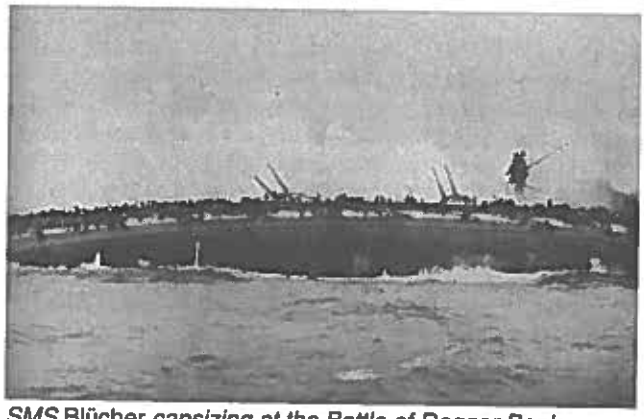
Each ship assisting in firefighting allows the player to subtract one from the fire reduction die roll for one major or severe fire on the damaged vessel.

Ships which themselves have any fires, including minor ones, or which have more than 50% damage, cannot assist in fighting fires on another ship.

8.2.10 Fire Control. The fire control system has been damaged (main, secondaries or backup). Size class A ships lose one of the directors controlling that gun (roll randomly). Ships with only one director for that gun type lose it, and all guns of that type are forced to operate lin local control.

8.2.11 Flight Deck. Hits are either forward, amidships or aft. Hits forward restrict the ability to launch aircraft. Hits aft will prevent aircraft from landing.

If aircraft are stowed in the location which is hit (forward for landing, aft for launch), roll D6 to see how many aircraft are hit as well. Treat each plane hit as an aircraft critical hit (section 8.2.1).



SMS Blücher *capsizing at the Battle of Dogger Bank (US Navy)*

Damage to flight decks can also cause damage in the hangar deck. If the carrier has an armored flight deck, only armor-piercing bombs may penetrate and cause hangar damage. If the bomb can penetrate, Roll D10. On a 1-5 there is no hangar damage, on a 6-10 aircraft in the hangar are hit. Roll D6 to see how many aircraft are hit as well. Treat each plane hit as an aircraft critical hit.

8.2.12 Flooding. If a major breach is made in the hull, the area must be quickly isolated or the ship will sink. Damage to other sections or failure to close off all possible paths for flooding water may make this difficult. The severity of the flooding also depends greatly on when the ship was built. Later ship designs, particularly German capital ships, were constructed with more compartmentation and had greater resistance to flooding. Many ships in WW I were lost due to "progressive flooding", with pre-dreadnoughts having one of the worst records. For each flooding critical, Roll D10 to find out how bad it is. The amount of damage for each type of flooding is given in the following table:

Year Completed	Flooding Damage
Before 1906	4%/8%/12%
1906 - 1916	3%/6%/9%
After 1916	2%/4%/6%

Note: German dreadnoughts completed after 1911 have the same flooding damage characteristics (2%/4%/6%) of capital ships built in other navies after 1916.

1-5 Minor Flooding. The ship loses 4%/3%/2% of its original damage points per Intermediate Turn until the flooding is isolated.

6-8 Major Flooding. The ship loses 8%/6%/4% of its original damage points per Intermediate Turn. Ships must slow to 15 knots or less. Submarines must surface.

9-10 Severe Flooding. The ship loses 12%/9%/6% of its original damage points per Intermediate Turn. Ships must slow to 15 knots or less.

If a submarine suffers a severe flooding critical, it has one chance to reduce the level, or it must surface. For major and minor flooding, the submarine must come to shallow depth.

Capsizing: If the total percentage of all flooding on the ship totals 15% or more of the ship's original damage points there is a risk that the ship will capsize (roll over). It

is not the total amount of water in the ship, but the uncontrolled rate of entry, that creates a risk of capsizing.

The chance of this happening is 25% (cumulative), rolled each Intermediate Turn until the flooding casualties are isolated reducing the percentage below 15%.

Damage Control: Isolating Flooding. For each flooding critical, roll D10 in the Resolution Phase of the Tactical Turn the flooding started and in each following Intermediate Turn: 1-4 means that the flooding has been reduced one level in intensity, and minor flooding is completely isolated; 5-8 means that the flooding continues as before; 9-10 means that the flooding increases one level of severity. Severe flooding will not increase in severity beyond the 12%/9%/6% associated with a ship's completion date.

National Effectiveness *(optional rule).* Different navies were more or less effective in training their crews in how to control flooding. These represent average values, and individual leadership or circumstances could change a crew's performance dramatically. Modify the D10 roll as follows:

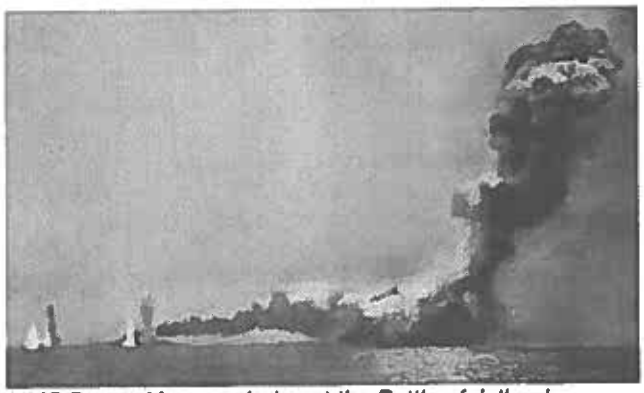
German, Russian crews	-1
All other navies	0

A die roll of zero (10) is always treated as a 10, regardless of modifiers.

8.2.13 Hull Deformation: Shock has deformed or dished in parts of the sub's pressure hull. Because the hull cross-section has lost its circular shape it can no longer support the maximum design depth. The submarine must come Shallow as fast as it can. If a submarine chooses to stay at a depth greater than Shallow it risks the hull failing (40% chance per depth zone below Shallow). A second hull deformation critical hit is treated as a hull penetration critical and requires the submarine to surface immediately.

8.2.14 Hull Penetration. The submarine's hull has been ruptured and it experiences uncontrollable flooding. If the submarine is at Shallow or Intermediate Zone I it has a 50% chance of making it to the surface so the crew can abandon ship. The sub will then take D10 x 5 minutes to sink. If the submarine is at deeper depths, she sinks with the loss of all hands.

8.2.15 Main Battery. Roll D10. On a 1-2, the fire control for the main gun battery has been knocked out (armor penetration not required). See 8.2.10. On a 3-0, one of the gun mounts/turrets in the main battery is out of action. Roll D10 again. On a roll of 9 or 0 the magazine detonates, destroying the ship. Ships within 300 yards of the exploding ship suffer damage equal to the battery's HE damage at Short range.



HMS Queen Mary *explodes at the Battle of Jutland (The Fighting at Jutland)*

If a main battery mount/turret is hit, roll randomly to see which one is destroyed. All mounts/turrets are counted, even if they are already out of action. If the mount has already been destroyed, no further damage is inflicted. If the main battery is also the Area AA battery, see also 8.2.16.

8.2.16 Other Weapon. One of the weapons listed for the ship in Annex A, except a main battery or casemate, has been knocked out. Roll randomly to find out which mounts have been hit. Previously hit mounts can be hit again. If the mount has already been destroyed, no further damage is inflicted. If there are no applicable weapons, ignore the critical.

Area AA and Light AA and Light Batteries have their strength reduced by 1/3. There is no chance for a magazine explosion with these light guns.

If the weapon destroyed is part of the Area AA battery, see also 8.2.15. If it is a torpedo tube or an ASW weapon, see 8.2.20. If the weapon is an aircraft, see 8.2.1.

8.2.17 Rudder. The ship's steering or control surfaces are damaged. Maximum speed is reduced to 1/3 of the ship's undamaged speed. Course changes after moving the required advance are reduced from 45° to 15°. Roll D10 for the rudder's position.

1 - 4: Jammed to Port - ship turns slowly to port
5 - 8: Jammed to Stbd - ship tuns slowly to stbd
9 - 0: Jammed Ahead - ship continues on course

Submarines lose depth control. A submerged submarine has a 5% chance times its speed to involuntarily change depth. Roll before each Plotting Phase. If the submarine does accidentally change depth, roll D10. On a 1-5 it goes up one level, 6-10 it goes down one level. The submarine will not exceed crush depth. A submarine which is at periscope depth and goes up one level will broach, but will automatically dive the following turn, unless another 'up' roll occurs.

8.2.18 Sensors: One of the ship's sensors is destroyed. Roll randomly to determine which one is affected.

1 - 4: One forward searchlight platform
5 - 8: One after searchlight platform
9 - 0: Sonar

Note: Size class C&D ships only have one forward and one aft searchlight platform.

8.2.19 Switchboard: Fuses blow, causing the submarine to lose most of its electrical equipment. The sub cannot launch torpedoes, it loses its ability to maneuver (cannot change depth or course), and it loses propulsion (decelerates to speed zero). It takes D6/2 Tactical Turns (round up) to replace the fuses.

8.2.20 Torpedo or ASW Weapon. A torpedo mount or depth charge rail. Roll D10. On a 9 or 0, the mount's ammunition explodes, doing half the number of weapons warhead's present worth of damage to the ship. If the mount has fired all of its weapons, there is no danger of explosion.

If a torpedo or ASW weapon does detonate, and the mount is above the waterline, treat the warhead damage as a bomb or gunnery attack for critical hit purposes. In other words, do not roll on the DC or torpedo attack table, since these columns assume underwater impacts. Use the

critical hit column that best matches that ship's type.

If a torpedo in the tube detonates, and is below the waterline (either on a sub or a surface ship) it inflicts an automatic flooding critical, and the damage points should be applied as underwater damage. Battleships with submerged torpedo tubes should ignore any torpedo protection system they are fitted with.

8.2.21 Weapon. One of the ship's weapons has been knocked out. Check the total number of mounts carried by the ship and roll randomly to see which one has been hit. If the weapon destroyed is part of the ship's Area AA battery, see 8.2.16. If is the Main Battery, see 8.2.15. If it is a torpedo tube or ASW weapon, see 8.2.20. If the weapon is an aircraft, see 8.2.1.

8.3 Repairs. Damage cannot be repaired during a battle, except to stop fires and flooding. Some damage, especially to sensors and weapons, may be correctable after battle. Damage to the ship's structure is not repairable, except in port. Some connected with flotation damage from flooding can be removed by pumping the water out.

To find the chance of repairing a system take the ship's remaining damage points and divide them by the ship's original damage points. This is the Repair Roll. Roll D100 for each critical. A D100 roll less than or equal to the Repair Roll means the system has been repaired and is operational. Early attempts to repair, at the 6- or 12-hour points, halve the Repair roll.

For example, a ship with 37 damage points remaining out of 100 original points has a 37% Repair Roll. Attempting to repair a system at 6 and 12 hours after the battle, the player has an 18% chance (37%/2) of fixing the problem. At the 24 and 48-hour points, he has a full 37% chance.

8.3.1 Weapon Mount. Make Repair rolls 6 hours, 12 hours, 24 hours, and 48 hours after the battle is over. If a system is hit or damaged again before the roll is successful, compute the new roll and start over. Failure to successfully roll the 48 hour Repair roll means that the system cannot be repaired at sea.

8.3.2 Communications. Make Repair rolls 6 hours, 12 hours, 24 hours, and 48 hours after the battle is over. If a system is hit or damaged again before the roll is successful, compute the new roll and start over. Failure to successfully roll the 48 hour Repair roll means that the system cannot be repaired at sea.

8.3.3 Flooding. Remove one half of the flooding damage points automatically (they pump the water out), but there is a chance of the patch popping. Subs must stay at Periscope depth or the patch pops automatically. The chance for surface ships equals the (sea state x 5%) - (30 - maximum speed that day in knots)%.

A failing patch inflicts a flooding Critical hit.

Example: A ship with a flooding patch spends one Intermediate Turn at 20 knots in sea state 3. The chance of the patch popping is (3 x 5%) - (30 - 20)%= 15% - 10% = 5%, a low chance. If the sea state were 6, though, the chance would be (6 x 5%) - (30 - 20)% = 30% - 10%, or 20%. It pays to reduce speed in rough weather when you have holes in your ship.

8.3.4 Fire. A fire may restart at the 6- (10%), 12- (5%), 24- (2%), and 48-hour (1%) marks. Find out the size of the fire by rolling D10-2 applied to 8.2.9. Use this procedure for all fires (except planes). Aircraft fires cannot restart.

8.3.5 Engineering. Make repair rolls 6 hours, 12 hours, 24 hours, and 48 hours after the battle is over. If a system is hit or damaged again before the roll is successful, compute the new roll and start over. Failure to successfully roll the 48 hour repair roll means that the system cannot be repaired at sea.

8.3.6 Bridge. Repair rolls are made at the 12 hour, 24 hour, and 48 hour marks. A fire on the bridge is resolved according to 8.3.4. Degraded operations are allowed automatically 1 hour after the critical hit was taken. Two Tactical Turns are needed to change course and the aircraft land/launch rate is halved. Normal operations are allowed after the repair roll is successfully made.

8.3.7 Rudder. Make repair rolls 6 hour, 12 hours, 24 hours, and 48 hours after the battle is over. If a system is hit or damaged again before the roll is successful, compute the new roll and start over. Failure to successfully roll the 48 hour repair roll means that the system cannot be repaired at sea.

8.3.8 Flight Deck. Make a repair roll at the 12-hour, 24-hour and 48-hour marks after the battle for each flight deck critical hit. If a system is hit or damaged again before the roll is successful, compute the new roll and start over. Failure to successfully roll the 48-hour repair roll means that the system cannot be repaired at sea.

8.3.9 Aircraft. Destroyed planes have a 50% chance of being only damaged and repairable under the rules in 8.4 (unlss the plane's fuel or ordnance exploded according to optional rule 8.2.1).

8.3.10 Cargo. Cargo cannot be repaired.

8.4 Equipment Serviceability *(optional rule).* Just before beginning the game (or daily in a campaign game) roll D100 for the engineering plant, each sensor, and each weapons system on the ship. First rank navies experience failures at 5%. Second rank navies have failures at 10%.

The failed item cannot be repaired during the tactical game. During non-battle periods it can be repaired as a critical hit of that type using the Breakdown Repair Table. Systems not repaired within 48 hours cannot be repaired at sea.

At a forward base, systems could be repaired alongside a tender (+20% to the roll). At a more established port, or shipyard, add 30% to the Repair Roll.

Damaged aircraft also use the Breakdown Repair Table. If the plane cannot be repaired in 48 hours it cannot be repaired at sea. Land-based aircraft have 10% added to the repair roll, and are not subject to the 48-hour limitation.

BREAKDOWN REPAIR TABLE

Time Since Breakdown (hours)	6	12	24	48
First rank navies:	25%	30%	35%	40%
Second rank navies:	15%	20%	25%	30%

First rank navies: US, Great Britain, Germany, Japan, Russia
Second rank navies: Austria-Hungary, Turkey, France, Italy and all others

8.5 Search and Rescue *(optional rule).* Players who want to realistically play the role of a naval commander should feel compelled to find and recover survivors from

sunken ships and aircraft that have been shot down. The effect this can have on a longer game is dramatic.

These rules create a group of survivors which must be rescued. The exact number is not carefully modeled. More important is that fact that they exist and must be found and saved. This takes resources and time.

If an aircraft is destroyed, place a group of survivors near the spot where it goes down. Single or twin-engine aircraft will have crews of one to three, while airships can have up to ten or twelve men inside. Round numbers of survivors above ten to the nearest tens, e.g., twelve becomes ten, twenty-five becomes thirty.

If a ship is sunk, D6 x 10% of its crew survive. Magazine explosions or other spectacular destructions reduce the number to a D6/2 x 10% roll. If another ship is alongside or within 250 yards of the sinking vessel, and is stationary, increase the number of survivors by 20%.

Place a counter marking the location of the survivors on the spot where the ship is sunk or the plane goes down. In a short game, the counter is stationary, but if the survivors are in the water more than six hours, roll D6 for the speed of the current in knots, and randomly for its direction, consistent with the local geography.

Unless the ship or aircraft is in sight when it is lost (and the survivor marker is placed), the survivors must be searched for. At night or in poor visibility, this will be difficult and even with their general location known it will mean a lot of effort.

Groups of less than ten men are treated as a periscope for sighting purposes. Ten to thirty men are treated as a size class E. Thirty to one hundred men are treated as size class D, and one hundred or more are size class C. Apply the sighting modifier for no wakes (half range).

Survivors in the water may be wounded, suffer from exposure, and may even be subject to shark attack. Even so, unless the environment is extreme (the North Atlantic in the Winter) survivors can last for many days, or weeks if they have a little food or water. In a tactical game, survivor endurance does not need to be modeled.

Once found, a flying boat can land in the water, taxi over, and pick up ten or less survivors in D6 three-minute Tactical Turns. A ship can pick up many more survivors, D6/2 groups of 10 each Tactical Turn. It must be stationary and upwind of the survivors. This creates a lee for the recovery, and also ensures that the ship won't drift downwind from the recovery site.

Recovery is slowed by high waves. Reduce the die roll by one for every sea state level over two. For example, in sea state 4, the die roll would be (D6-2)/2.

A ship can hold as many survivors as its own crew or passenger complement. Practically, this will have a long-term effect on the ship's performance and endurance, but in a tactical game these can be ignored.

If survivor rules are used, rescuing survivors should count as part of the players' victory conditions. Resolving actions and results can be very subjective, but search and rescue is an important factor in real naval battles.

8.6 Airship Damage. Because they do not depend on airfoils to remain airborne, and because of their size, a successful hit on an airship does not automatically mean it is shot down, even if it has hydrogen in its cells. Like warships, airships are subject to critical hits.

As described in 7.3.8, the attacker must declare whether he is aiming for the gondola or the envelpe. If an aircraft gun or AA gun rolls a "hit" against an airship, it is considered to have inflicted a critical hit (it would normally be enough to bring down a conventional aircraft). Each hit by a plane or AA gun inflicts a critical hit.

Roll for each critical hit on the Airship Critical Hit Table. This table tells exactly what has been hit, and the descriptions below provide their effects:

AIRSHIP CRITICAL HIT TABLE

Die Roll	Gondola	Envelope
1-2	Engine	Gas Cell*
3	Engine*	Gas Cell*
4	Fuel	Gas Cell*
5	Fuel*	Gas Cell*
6-7	Control	Gas Cell*
8	Control	Gas Cell
9	Comm.	Gas Cell
10	Weapons	Gas Cell

Starred (*) items start a fire, in addition to the listed critical. If the envelope is filled with helium, ignore the fire.

Control: Roll D6. On a 1-2 the airship loses elevator control, on a 3-4 it loses rudder control, on a 5 it loses valving control, on a 6 it loses ballast control. Airships without elevator control cannot control their height. Each Tactical Turn the ship must roll to see if it randomly climbs or dives an amount equal to half the maximum rate, or remains level. Airships without rudder control can steer using the engines by halving their speed (to 50% of maximum). Airships without valving control cannot release gas to descend. (The airship commander can always order any number of cells to be "ripped," which involved the crew ripping out special panels to vent all the gas in a cell at once.) Airships without ballast control cannot release ballast to lighten ship, although they can always jettison fuel, ordnance, or mission equipment.

Communications: The airship's wireless or associated equipment is destroyed. It can still communicate by signal lights or message streamer.

Engine: One of the airship's engines is destroyed. Reduce its maximum speed at all altitudes proportionately. If the airship has no rudder control and no other engines on the same side as the damaged one, it will circle in that direction. If it has rudder control, but no other engines on that side, it must throttle back to half remaining speed on that side to maintain control.

Fire: A fire in a hydrogen-filled envelope means the ship is lost immediately. Helium envelopes will not burn.

If the fire is in the gondola, roll D10 in the Plotting Phase of each Tactical Turn. If the airship uses hydrogen, there is a 30% chance the fire spreads to the envelope and the ship is lost (8,9, or 10 on the die). There is a 50% chance it is extinguished (1-5 on the die). If it is not extinguished, roll once on the Airship Critical Hit Table in the Resolution Phase for one additional Critical Hit.

Fuel: One-quarter the airship's maximum fuel is lost. If the airship has used up one-quarter or more of its fuel, see which tanks have been hit by rolling dice. If all fuel is lost, the airship drifts with the wind, losing all elevator and rudder control. It can still valve gas and drop ballast.

Gas Cell: One of the airship's gas cells has been ruptured. Annex B1, Airships will tell how many cells each airship has. Roll randomly to see which cell has been hit, since one cell might sustain several simultaneous hits. The effect of the loss depends on how many cells have been lost:

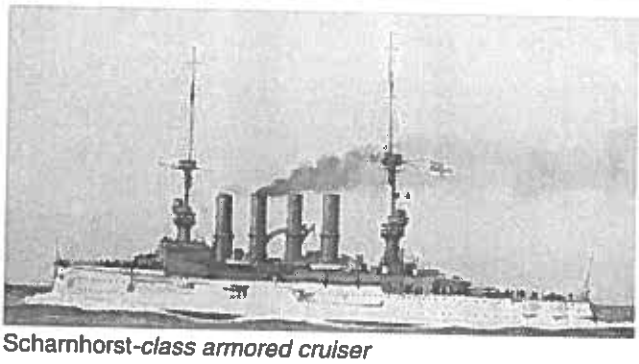
24% or less: No effect

25 - 49%: The airship may not climb.

50%+: The airship must descend at maximum rate of descent.

75%+: The airship is in an uncontrollable dive at three times the maximum rate of descent.

Players may compensate for the loss of one cell by dumping all ballast, all payload and throttling to maximum speed to generate lift over the envelope.



Scharnhorst-*class armored cruiser*

Chapter Nine - Attacks Against Land Targets

Unlike ships, buildings, tanks, and gun batteries cannot be sunk. They must be destroyed in total, or rendered useless to the enemy by destroying vital equipment (critical hits). The attack of land targets by naval units, while not new, was still a crude military art and usually executed with little or no coordination with ground forces. The results of such unsupported attacks usually had little effect on the bigger picture and could be viewed merely as landscaping with explosives.

9.1 Land Targets. Land-based targets have damage points and armor ratings just like ships. The damage points are based on the size and the construction of the target. A large building may have 175 damage points, while a single artillery piece may only have 5 damage points. If a land target takes enough damage points it is destroyed.

Like ships, land targets also have size ratings. The size of the target will determine how easy it is to hit. If the target moves, there may be a modifier as well. The target may be armored, and if it is not penetrated, the weapon won't inflict any permanent damage to the structure but it could still cause critical hits. A land target that is destroyed means that the installation and any units contained in it are eliminated, and cannot be repaired. They must be rebuilt or replaced.

9.1.1 Land Structure Damage Points and Size Class. There are two types of land targets in *FG&DN*, regular structures and armored structures. Regular structures are divided further into light, medium and heavy construction types. Armored structures are divided into earthworks or heavily reinforced construction types. The construction type affects the number of damage points a land structure will have, but size is the primary attribute.

Unlike ships, where flotation damage is of equal (or perhaps greater) concern, the critical issue for land-based structures is whether or not they continue to function. Since the damage points are based on the effective horizontal area of a structure, this is the number of damage points required to reduce it to rubble. *The structure, however, will cease to be functional when it has sustained 50% damage.* Since most players don't have access to blueprints with the dimensions of coastal defense structures, Annex J, Land Targets provides a list of typical military structures and civilian targets used during WW I with their associated damage point ratings and their size classes.

Because land targets usually do not have vertical and horizontal areas that are even close to being similar, land targets have two size classes. One is for direct fire (Short and Medium range) gunnery attacks and another for indirect fire (Long and Extreme range) attacks or attacks by aircraft. In Annex J, Land Targets, the size classes are given with vertical first followed by the horizontal size class. For example, a medium observation tower has a size class of F/E, meaning it has a larger horizontal area than a vertical one.

The following table gives land target size classes and their associated areas in square feet.

Area (sq ft)	Size Class	Area (sq ft)	Size Class
40,001+	A	1,001 to 5,000	E
20,001 to 40,000	B	501 to 1,000	F
10,001 to 20,000	C	11 to 500	G
5,001 to 10,000	D	10	H

When land targets are grouped together, such as a coastal defense gun in a turret mount on an armored concrete base, the combined target uses the overall size class of the largest structures. For example, Battery Pommern in Belgium combines a large (15 inch) shielded gun with a large concrete support base. The large gun shield has size classes G (vertical) and G (horizontal). The concrete support base has a vertical size class of H and a horizontal size class of E - this is a good-sized gun mount. The entire gun complex would have a combined size class of G/E.

Some targets in Annex J don't have a vertical or horizontal size class because their construction lacks a surface to shoot at. For example, a mortar pit has no vertical surface, since it is basically a large hole in the ground. Only plunging, indirect gunfire or attacks by aircraft have a chance of hitting. A target that cannot be hit by a particular attack will have a "-" in place of a letter for the vertical or horizontal size class. A medium mortar pit has a size class rating of "-/F" in Annex J.

In Annex J, turrets, mortars, and open gun emplacements are described as small, medium, and large. These designations also describe the size of gun that could be accommodated by the emplacement. Large guns have a bore size greater than 10 inches (254 mm). Medium guns are greater than 5 inches (127 mm) but less than 10 inches (254 mm). Small guns are 5 inches or less in bore size.

A typical mortar emplacement. *(U.S. Army)*

9.1.2 Armor Ratings. Steel armor plate was rarely used in coastal defense or land structures. Instead, high-strength reinforced concrete was more commonly used. In more remote areas, such as on Gallipoli peninsula, most structures were protected with rock, logs and dirt. This type of armor is collectively known as "earthworks." Since there are few weight restrictions for land structures, it was common for the armor to be the same on all sides and on top of the structure. Land structures use the same vertical and horizontal armor rating system used for warships, but in many cases the vertical and horizontal armor ratings will be the same and this will be represented by a single number in Annex J.

Even though a land structure's armor rating is given in equivalent thicknesses of steel armor, non-metallic armor materials behave very differently when struck by naval shells. These modifiers must be multiplied by the shell's penetration listed in Annex C to find out how much non-metallic armor a shell will penetrate. Remember, for penetration to occur, the round's armor penetration rating must be greater than the structure's armor.

NON-METALLIC ARMOR PENETRATION MODIFIERS

Shell Type	Short Range	Medium Range	Long & Extreme Range
AP, APC, SAP, SAPC, CP, CPC	1/2	1	2
HE/HC	1	2	3

9.1.3 Attacks on Coastal Defense Positions. In *FG&DN*, coastal defense positions are typically shore batteries, which are often an integrated system of gun emplacements, observation and fire control positions and supporting facilities. When attacked by warships or aircraft, the various structures of a battery are usually attacked as individual targets. To destroy armored structures requires direct fire from short or medium range. Although less likely to destroy an emplacement, a general bombardment is all a warship can do without knowing the exact location of each structure. This can be especially difficult if the battery has used extensive camouflage to conceal its emplacements. Detecting land targets and the effects of camouflage are covered in Sections 5.2.6 and 5.2.7. Until an individual emplacement is visually detected, only its general location can be bombarded.

9.1.4 Shore Battery Format. Each battery in a scenario will be described using the following standard shore battery format. The example below is for the German Kaiser Wilhelm II Battery located near Zeebrugge, Belgium. Originally called Ostbatterie (East Battery), it was renamed in honor of the Kaiser. The battery's four shielded 30.5cm/50 SKL 50 guns made the Kaiser Wilhelm II Battery one of the most powerful German coastal defense installations on the Belgian coast.

Batterie Kaiser Wilhelm II (formerly Ostbatterie)
Type: Fixed **Camouflage:** Prepared
Power Handling? Yes **GCS:** [(4*23)+(3*2*3)]+7+1
Sensors: Two 18 ft stereoscopic range finders
Fire Control: Single instrument (similar to a ship)

Structures	**Size**	**DP**	**AC**
Base Command Post (100 ft)	F/D	101	14/14
(24-03) (1)4 30.5cm SKL 50	G/E	77	12/6
Large munitions bunkers	F/D	101	14/14
- Four magazines for 30.5 cm guns			
Medium Obs Posts (100 ft)	F/E	86	9/9
- Range finders are unarmored			
(360) 4x150 cm Searchlights	G/G	15	0/0
(360) 2x90 cm Searchlights	G/G	15	0/0
Area AA: (1)8 8.8cm Flak L45			**(10.4)**
Lt AA: 12 7.92mm MG			**(1.7)**

Remarks: Three line infantry companies provide local security (3 x 2 GCS).

This example illustrates a fixed battery with prepared camouflage, except the Base Command Post (BCP) which has a concealed camouflage level. It has four single shielded 30.5 cm (12 inch) guns controlled by a single command post. The BCP receives fire control data from the two large stereoscopic range finders.

For weapons emplacements, each line is formatted:

(Firing arc in tens of degrees) (# of barrels) number of mounts and the type of gun

In this example, the four 30.5cm/50 guns are each in separate shielded emplacements with a G vertical size class and an E horizontal size class. The turrets have a vertical armor of 12 and a horizontal armor of 6. All four guns cover the same firing arc of 24-03. This arc is equivalent to 240° to 030° True. Some gun arcs, for simplicity, are listed as "sea." This means they can fire on any naval unit they can visually observe. Each turret has a large bunker which houses the gun's magazine, crew's quarters and administrative spaces. Each bunker is made of reinforced concrete and has a F vertical size class and a D horizontal size class. The bunker's armored walls and roof is made of reinforced concrete. This gives the bunker a vertical and horizontal armor rating of 14.

The command post and observation posts all have an elevation or height of eye in feet given in parentheses. For example, the Batterie Kaiser Wilhelm II command post is 100 feet above sea level. This elevation is used with the Land Sighting Table in section 5.2.6 to find out how far away a ship can be visually detected.

The range finders, searchlights and other supporting facilities are listed as separate structures since they are not physically part of the gun emplacements, munitions bunkers, or the command post.

Finally, the battery is defended by three companies of regular infantry with a ground combat strength of two each and it has an Area AA Strength of 10.4 and a Lt AA strength of 1.7. This is a heavily armed and defended coastal battery and is about as mean as the Germans got on the Belgian coast.

If Batterie Kaiser Wilhelm II should take part in defending against an amphibious assault, it can add the Ground Combat Strength of its guns in fortified emplace-

ments (6 x 4 for the guns x 4 for the fortifications = 96), the strength of its three infantry companies in heavy entrenchments (3x2x3=18), and the GCS of its Area AA guns (6.4) and its Light AA guns (0.6), for a total GCS of 121. Alternatively, the big guns could attack ships off the beach, the AA guns attack aircraft overhead, and the infantry take part in the land battle with a GCS of 18. The GCS of coastal defense guns and land units and the entrenchment multipliers are found on page 10-7.

9.2 Naval Bombardment. Bombarding warships (size classes A-D) use their gun batteries to destroy or neutralize enemy ground units and installations. Ships can perform two different types of naval bombardment: Direct Fire or General Bombardment.

9.2.1 Direct Fire. This mission is used to actually destroy known point land targets, such as gun emplacements or other structures. It requires accurate flat-trajectory gunfire, so a ship must be in the Short or Medium range band and less than 6 kyds from the target. The degree of accuracy required also restricts the fire to one ship for each target. Several ships firing on the same target would make it virtually impossible to correct the fall of shot. Should more than one ship attack the same target in the same Tactical Turn with direct fire, the final modified chance of hitting for each ship is halved.

Direct fire is not used against troops, only against land structures that can be seen from the firing ship. Because of the lack of reliable communications during this period, it cannot be used to support friendly troops on the move.

9.2.1.1 Direct Fire Procedure. To find the chance of a hit, count the number of gun barrels on the ship that are firing and multiply it by the Direct Fire ROF modifier for the gun's bore size on the Naval Bombardment Attack Table (page 9-4). This is the number of rounds that will be fired at the target in one Tactical Turn. Cross-index the number of rounds fired with the appropriate range band to find the base probability of hit. Add up all applicable to hit modifiers listed on the table and divide the total by two. This number is then added to the base probability to obtain the final probability of hit. Roll D100. If the number is less than or equal to the final to hit number, the target has been hit.

Example: HMS *Queen Elizabeth* is firing at the Turkish fort of Sedd-El-Bahr on the southern tip of the Gallipoli Peninsula. The fort is an old stone fortress with 10 guns situated on the shoreline. *Queen Elizabeth* engages the fortress with Direct Fire from 5,500 yards - Medium Range band. The *Queen Elizabeth* has eight 15in/45 guns. The target has a vertical size class of C. *Queen Elizabeth* is on a steady (non-evasive) course at a speed of 4 knots in Sea State 2 conditions. Visibility is 50%.

Base Probability to Hit:
# of Rounds Fired = 8 barrels x 0.5 (>8in) guns = 4 rounds

4 Rounds at Medium range = 22% chance to hit

To Hit Modifiers:
Ship Spotting (Medium): +5%
Speed 5 knots: +0%
Ship Course - Steady: +0%
Sea State 2: +0%
C size target: +0%
Visibility of 50%: +0%

Some Definitions

The Oozlefinch provides a short message for the Coast Defense-Impaired:

Emplacement? Battery? What does all this stuff mean?

Many gamers purchasing this product will be well-versed in the lore and vocabulary of naval warfare. Few will be familiar with coastal fortresses, what their individual parts do and are called and how they work together. Here are some short notes to help our waterlogged friends get up to speed.

First, who am I? I am the fabled Oozlefinch, the all-seeing mascot of the United States Coast Artillery Corps. I allowed myself to be found by an officer at Fort Monroe and have been guiding budding coastal gunners ever since. Here are some definitions and examples that should make the arcana of coastal artillery more clear. For more in-depth treatment of this fascinating subject try locating some of the books listed in the bibliography.

A *fortification* is a group of batteries under a single command designed to attack enemy ships with gunfire, torpedoes, or mines. It is normally, but not necessarily, a permanent installation. The fortification may be one structure, as in Fort Drum, or many structures grouped in batteries with other separate supporting structures.

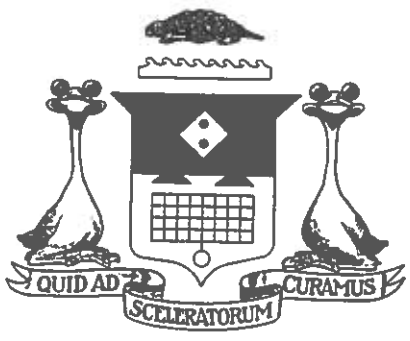
A *battery* is a system of structures designed to attack enemy ships. It is normally, but not necessarily, a permanent installation. It is the smallest independent tactical grouping among coastal defense forces. It contains the fire control, weapons, and all supporting structures needed to support its weapons.

It is normally, but not always, equipped with only one type of weapon.

A *structure* is a man-made construction that performs some specific function. It may hold a gun, serve as a command post, house troops, or serve any one of a hundred other functions.

An *emplacement* is a structure that holds one or more weapons and the equipment needed to work them. It may be a sophisticated concrete structure, an earth revetment, or simply the spot where an artillery piece has unlimbered and set up.

A *bunker* is a hardened or protected structure. If it contains an artillery piece, it may also be referred to as a *casemate*.



The Crest of the Gridiron Club

Naval Bombardment Attack Tables

# of Barrels	Direct Fire Short	Direct Fire Medium	General Bombardment Medium	General Bombardment Long	General Bombardment Extreme
1	0.18	0.06	0.03	0.02	0.01
2	0.33	0.12	0.06	0.03	0.01
3	0.45	0.17	0.09	0.04	0.01
4	0.55	0.22	0.11	0.06	0.02
5	0.63	0.27	0.14	0.07	0.02
6	0.70	0.31	0.17	0.09	0.03
7	0.75	0.35	0.19	0.10	0.03
8	0.80	0.39	0.22	0.11	0.04
9	0.83	0.43	0.24	0.13	0.04
10	0.86	0.46	0.26	0.14	0.05
11	0.89	0.49	0.28	0.15	0.05
12	0.90	0.52	0.31	0.17	0.06
13	-	0.55	0.33	0.18	0.06
14	-	0.58	0.35	0.19	0.07
15	-	0.60	0.37	0.20	0.07
16	-	0.63	0.39	0.21	0.08
17	-	0.65	0.40	0.23	0.08
18	-	0.67	0.42	0.24	0.09
19	-	0.69	0.44	0.25	0.09
20	-	0.71	0.46	0.26	0.10
21	-	0.73	0.47	0.27	0.10
22	-	0.74	0.49	0.28	0.10
23	-	0.76	0.50	0.29	0.11
24	-	0.77	0.52	0.30	0.11
25	-	0.79	0.53	0.31	0.12

Target Size Class	Short & Medium	Long & Extreme
A	+20%	+10%
B	+10%	+5%
C	0%	0%
D	0%	0%
E	-10%	-5%
F	-15%	-10%
G	-20%	-15%
H	-30%	-20%

Note 1: Monitors have a Direct Fire ROF modifier of 1.0.
Note 2: To obtain the aerial spotting modifier, the aircraft must be within 3 nm of the target and at Low or Medium altitude. The aircraft and the ship conducting the attack must also be fitted with RT.
Note 2 1/8: Remember to divide the net modifiers by two before applying it to the chance to hit.

Gun Bore (in)	Rate of Fire Modifiers Direct Fire	Rate of Fire Modifiers Gen Bomb Fire
8	1.0	2.0
>8[1]	0.5	1.0

Fire Control Modifiers	Short & Medium	Long & Extreme
Ship Spotting	+5%	0%
Kite Balloon	+5%	+5%
Aircraft[2]	+10%	+5%
First Turn of Fire	-10%	-5%
Third Turn or Later	+5%	+5%
Ship Not Engaged	+5%	+5%
Local Control	-15%	-10%
Ship Speed		
Anchored	+10%	+5%
5 knots	0%	0%
6 - 10 knots	-5%	-5%
11 -15 knots	-10%	-10%
16+ knots	-20%	-20%
Ship Course		
Steady	0%	0%
10° - 45°	-10%	-5%
46° - 90°	-15%	-10%
90°+	-20%	-15%
Evasive Steering		
A - B	-15%	-10%
C - E	-20%	-15%
Sea State		
SS <4 for All	0%	0%
SS 4 for A - B	0%	0%
SS 4 for C - D	-10%	-5%
SS 5 for A - B	-10%	-5%
SS 5 for C - D	-20%	-10%
SS 6 for A - B	-20%	-10%
SS 6 for C - D	-30%	-15%
SS 7 for All	No Fire Poss	No Fire Poss
Visibility		
40%	+10%	
<40%	-10%	
<25%	-20%	
Target Speed		
25 mph	-10%	

Total Modifiers = +5%
Halve modifier total = 2.5% rounded up to 3%

Final To Hit chance = 22% + 3% = 25%

If the target is hit, check to see if the round penetrates the structure, taking into account the penetration modifier in the Non-Metallic Armor Modifier Table if need be.

If the structure was penetrated, apply the round's damage points to the target and resolve any critical hits. If the structure was not penetrated, reduce the shell's damage accordingly (*FG&DN* section 8.1.6). The damage by a non-penetrating hit is not applied to the structure's total, but will be used to see how many non-penetrating critical hits it has suffered.

Queen Elizabeth is firing 15-inch CPC rounds that have a penetration of 30 at Medium range, including the modification for non-metallic armor, will easily penetrate the old stone walls of the Turkish fort. The shell does 35 damage points at Medium range, and while this is just a small amount of the fort's damage points it could still suffer critical hits which could make it nonfunctional.

9.2.2 General Bombardment. Pre-landing shore bombardment is critical to a successful amphibious assault. Without it, the approaching troops in their exposed landing craft would be easily mauled by an enemy's defenses. In contrast to the sniper-like approach of direct fire, the general bombardment of an enemy's coastal defenses, is more like a shotgun being fired in the general direction of the target.

This type of fire usually does not cause many enemy casualties, but will force them to keep their heads down and interfere with their ability to move or shoot. However, the effect is only temporary, and the enemy can recover soon after the gunfire stops.

General bombardment against enemy positions is conducted before the amphibious assault. Once friendly landing forces enter the last "Boat Lane" box, as illustrated on page 10-3, all bombardment directed against land targets on the beach is converted to a GCS and added to the invading troops' GCS used in resolving the amphibious combat.

General bombardment can be conducted from the Medium, Long and Extreme range bands, although warships rarely fired from Extreme range. At Extreme range, the effects weren't worth the barrel wear. Since accurate gunfire is not required, several ships can attack the same target box without penalty.

When general bombardment is done from the Long and Extreme range bands, it is basically "map fire," where a ship is attacking a target it cannot see. In essence, the ship is firing on the coordinates of a fixed target provided by ground forces or aerial reconnaissance. Land targets that haven't been visually detected, regardless of range, can only be engaged with general bombardment.

Since pre-landing shore bombardments are carefully planned, the attacking player must declare, before any shots are fired, how many Tactical Turns of fire will be on a specific part of the beachhead and by which ship.

General bombardment can be planned against point targets (structures, usually defensive positions) or against area targets (usually entrenched troops). While point targets are shown on a map, troop positions are not tracked within the beach area. Instead, the player just declares that he is firing against troops on the Beach. This procedure is described in more detail in 9.2.2.2 below.

Once the attacks have been declared, they are carried out and can only be stopped (check fire) and not restarted. Thus, a player must be well aware of when his forces will reach the beach and how long he thinks the general bombardment effects will last.

9.2.2.1 General Bombardment Against Structures. To find the chance of a hitting a land-based structure, count the number of gun barrels on the ship that are firing and multiply it by the General Bombardment ROF modifier for the gun's bore size on the Naval Bombardment Attack Table. This is the number of rounds that will be fired at the target in one Tactical Turn. Cross-index the number of rounds fired with the appropriate range band to find the base probability of hit. Add up all applicable to hit modifiers listed on the table and divide the total by two. This number is then added to the base probability to obtain the final probability of hit. Roll D100. If the number is less than or equal to the final to hit number, the target has been hit.

Example: HMS Queen Elizabeth has been provided the rough location of a Turkish Army 21cm mobile coastal defense gun from ground troop reporting. Using "map fire" from Long Range with HE shells, *Queen Elizabeth* hopes to neutralize the gun and strip away its camouflage (critical hit) so that she can find the gun, close the range, and finish it off with direct fire. The target has a horizontal size class of F and a horizontal armor rating of 0. *Queen Elizabeth's* course and speed are the same as in the previous example.

Base Chance to Hit:
# of Rounds Fired = 8 barrels x 1.0 (>8in) guns = 8 rounds

8 Rounds at Long range = 11% chance to hit

To Hit Modifiers:
Ship Spotting (Long): +0%
Speed 5 knots: +0%
Ship Course - Steady: +0%
Sea State 2: +0%
F size target: -10%
Visibility of 50%: +0%

Total Modifiers = -10%
Halve modifier total = -5%
Final To Hit chance = 11% -5% = 6%

Unless the bombardment is conducted by a battleship or battle cruiser, most armored land targets won't be penetrated. In this example, a 15-inch HE round has an armor penetration of 5 and inflicts 54 damage points. Since the target in this example doesn't have any armor, the matter is moot. However, if a round doesn't penetrate a target's armor, the damage by the shell is reduced per section 8.1.6. Again, the damage points from non-penetrating hits are not applied to the structure's total.

9.2.2.2 General Bombardment Against Ground Troops. Since troops are dispersed over a wide area, ships conducting shore bombardment were usually assigned a box 200 yards wide by 200 yards deep. This is roughly the area taken up by an infantry company in

prepared defensive positions. In *FG&DN*, this box is used as the target's size for resolving general bombardment attacks against troops. Ships conducting general bombardment against troops from Medium range will only attack one target box, however, attacks from Long and Extreme will attack two target boxes due to the dispersion of the gunfire. Thus attacks from Long and Extreme range bands will apply half of the attack to each target.

All troops in the area should be listed so that they can be identified as company-sized formations. A roster is useful for tracking damage points inflicted, which will be used to figure the unit's neutralization level. Space should also be allowed for the recovery time, described below.

Since *FG&DN* uses an amphibious combat model that doesn't require a unit's exact location, either roll randomly to see which units are attacked by the general bombardment, or let the referee decide which unit is attacked.

Because the target area is much larger than an A-size target, the chance of a hitting the target area is fairly high and only visibility, speed, ship course, and sea state to hit modifiers are used. The chance of hitting the target area is 70% for Medium range, 50% for Long range and 30% for Extreme range. Since there will be many rounds of fire, players should use the final probability of hit as an expected value in resolving the large number of attacks quickly, or if they choose, each Tactical Turn of fire can be rolled individually. A number of ships can coordinate their fire into a single large attack.

If the target area is hit, apply the gun's equivalent GCS to the enemy troop unit(s), include any entrenchment modifier from the General Bombardment Entrenchment Table below. For Long and Extreme range attacks, one half of the GCS is applied to the two target boxes.

GENERAL BOMBARDMENT ENTRENCHMENT TABLE

Type of Entrenchment	Entrenchment Factor
None	1.00
Light	0.75
Heavy	0.50
Fortifications	0.25

In the Resolution Phase of each Tactical Turn in which the General Bombardment has hit enemy troops, divide the modified bombardment GCS by the twice the defender's GCS, rounding in favor of the defender. Using these odds, roll D10 and consult the Bombardment Combat Result Table.

BOMBARDMENT COMBAT RESULTS TABLE

D10	Odds										
Roll	≤1:2	1:2	1:1	2:1	3:1	4:1	5:1	6:1	7:1	8:1	≥8:1
1	-	-	-	-	-	-	-	-	-	N1	N1
2	-	-	-	-	-	-	-	-	N1	N1	N2
3	-	-	-	-	-	-	-	N1	N1	N2	N3
4	-	-	-	-	-	-	N1	N1	N2	N3	D1
5	-	-	-	-	-	N1	N1	N2	N3	D1	D1
6	-	-	-	-	N1	N2	N2	N3	D1	D1	D2
7	-	-	-	N1	N1	N2	N3	D1	D1	D2	D2
8	-	-	N1	N1	N2	N3	D1	D1	D2	D2	D3
9	-	N1	N1	N2	N3	D1	D1	D2	D2	D3	D3
10	N1	N1	N2	N3	D1	D1	D2	D2	D3	D3	D4

Table Results:

- = No effect
N# = # of Tactical Turns the unit is neutralized
D# = % of the unit GCS lost due to casualties

When a unit is neutralized, its GCS is temporarily halved. The amount of time that a unit remains neutralized depends on how many Tactical Turns of neutralization it has accumulated. The number of turns is determined by adding up all the N# results and adding one Tactical Turn for any D# result.

Example: HMS *Queen Elizabeth* has been provided the location of a German Army unit in heavy entrenchments by aerial reconnaissance. Firing from Long Range with HE shells, *Queen Elizabeth* hopes to soften up the position for a planned assault later in the day. *Queen Elizabeth* is on a steady course at 10 knots while conducting the bombardment. The visibility is 50% and the sea state is 3.

Base Probability to Hit at Long Range: 50%

To Hit Modifiers:
Speed 10 knots: -5%
Ship Course - Steady: +0%
Sea State 3: +0%
Visibility of 50%: +0%

Total Modifiers = -5%
Halve modifier total = -2.5% = -3%

Final To Hit chance = 50% -3% = 47%

Since *Queen Elizabeth* is firing from long range, two infantry units are attacked. *Queen Elizabeth's* GCS for eight 15in/42 guns is 68 (8 x 8.5). This is divided equally between the two infantry companies which have a GCS of 2.0. The final GCS ratio is then:

Odds = (68 x 1/2)/(2 x 2)
Odds = 4.3 or 4:1

Rolling twice on a D10, results in an 8 and a 3. Looking down the 4:1 column, a 3 results in a "No effect" on one company while the 8 results in a N3 on the other one. This company is neutralized for 3 Tactical Turns and has its GCS halved should it be attacked by ground troops.

If *Queen Elizabeth* fired for an hour, this would require 20 separate die rolls. Or the players could use the final to hit chance as an expected value, which would result in 9 hits on the infantry companies (20 x 0.47). Each company would have nine D10 rolled for the effects. For one of the companies, the nine D10 die rolls result in 2, 6, 5, 6, 9, 1, 8, 4, 0 or 10 which gives the following results:

1, 2, 4 = No effect
5 = N1
6, 6 = N2
8 = N3
9, 10 = D1

Thus the company suffers a permanent loss of 2% of its GCS due to casualties (new GCS = 1.96) and the

survivors are neutralized for 10 Tactical Turns (N1+N2+ N2+N3+2). Therefore, for the next 10 Tactical Turns the modified GCS of this company is 1.98 if it were to be attacked by ground troops.

9.3 Air Support. Aircraft were often used to soften up the enemy's defenses. Given an aircraft's mobility, they are more flexible than ships in attacking ground targets. Their limited payload meant they had to be employed in large numbers to be really effective. Large strikes, however, were particularly difficult in WW I because of the significant reliability problems with early aircraft. For most of WW I, a mission with 15 bombers was considered to be quite large.

9.3.1 Air Attacks Against Structures. Aircraft can attack land structures with bombs, rockets and by strafing. All attacks on a land target will be on the target's horizontal surface and all combat resolution tables refer to the horizontal size class. Any attack made by an aircraft from an altitude of 200 m or less is considered to be a "Pressed Home" attack and the aircraft will be subject to Light AA fire before it can release its ordnance. Level bombing attacks from 2,000 m or greater cannot be engaged with Light AA fire. An aircraft involved in a dogfight cannot attack a ground target in the same Tactical Turn.

To make an attack against a land target, the attacking player must decide what type of attack is to be made and at what altitude the weapon(s) will be released. Next, find the target's horizontal size class on the left-hand column in the Bomb Attack Table below and move to the right to the appropriate attack/altitude column. The number is the chance of a hit for each bomb dropped or each pair of rockets fired, of which only one will hit the target. If there is an "x" followed by a number in the column, this is the number of bombs or rockets that have to be expended in order to have a 1% chance of a single bomb/rocket hitting the target. If a hit is made, check for armor penetration and resolve the damage as described in 9.2.1 Direct Fire.

BOMB ATTACK TABLE

Target Size Class	Level Bomb (200m)	Level Bomb (500m)	Level Bomb (1000m)	Level Bomb (2000m)	Level Bomb (5000m)
A	0.26	0.22	0.13	0.07	0.02
B	0.14	0.12	0.05	0.02	0.01
C	0.07	0.06	0.02	0.01	x3
D	0.04	0.03	0.01	0.01	x6
E	0.02	0.01	0.01	x3	NA
F	0.01	0.01	x3	x6	NA
G	0.01	x3	x6	NA	NA
H	x3	x6	NA	NA	NA

- A mobile target at a speed of 10 mph or more, x1/2
- A mobile target at a speed of 25 mph or more: x1/4

A strafing attack can only be made by aircraft with offensive gun armament. Cross-reference the target size with the altitude of the attack in the Rocket and Strafing Attack Table below to find the probability of hit. If the strafing run is successful, the damage suffered by the target is equal to twice the offensive gun rating rounded to the nearest whole number. If the target has an armor rating of 1 or more, no damage will be inflicted, since the bullets bounce off the armor. Rocket and strafing attacks from an altitude of 200 m are considered to be a "Pressed Home" attack.

ROCKET AND STRAFING ATTACK TABLE

Target Size Class	Rocket Attack (200m)	Rocket Attack (500m)	Strafing Attack (200m)	Strafing Attack (500m)
A	0.55	0.45	0.65	0.55
B	0.35	0.30	0.45	0.35
C	0.20	0.15	0.35	0.25
D	0.12	0.09	0.25	0.20
E	0.05	0.03	0.20	0.15
F	0.02	0.01	0.15	0.10
G	0.01	x4	0.10	0.05
H	0.01	x8	0.05	0.01

If the strafing player scores a critical, roll on the appropriate critical hit table for the target type. Finally, check the type of critical against the following table. The chance of a critical being inflicted depends on the type of gun the plane carries.

MG Cal	Criticals allowed
12.7mm	Aircraft, Fire Control, Light AA, Communications, Searchlights
7.62mm	Aircraft, Light AA, Searchlights

Optional rule: If the target being strafed is an airfield, the attacking player can declare that the plane is aiming for a parked aircraft. Roll the attack normally, using the aircraft's actual damage value. If the D100 roll succeeds, the targeted plane is destroyed.

Example: Two American DH-4 biplanes make a bombing run on a small German reinforced concrete observation post (OP). The horizontal size class of the OP nest (from Annex J, Land Targets) is F and the armor rating is 4. Each DH-4 has six Mk III 150 lb demolition (HE) bombs that will be dropped during a single pass from an altitude of 1,000 m. Cross-referencing a F-size target with a bombing altitude of 1,000 m yields a probability of hit of 1% for a three bomb attack. The attacking player could roll for each bomb group or he could roll once for each aircraft. Using the cumulative probability table, two attacks with

Mk I 100 lb demolition bomb. *(US Dept of War)*

Mk I 300 lb demolition bomb. *(US Dept of War)*

INDIVIDUAL STRUCTURE CRITICAL HIT TABLE

Die Roll	General Hit	Command Post	Gun/Mortar Emplacement	Torpedo Emplacement	Mine Casemate	Not Penetrated
1	Comms	Fire Control	Gun/Mortar	Torp. Tube	Mine Group	Camoufl-1
2	Comms	Fire Control	Gun/Mortar	Torp. Tube	Mine Group	Camoufl-1
3	Area AA	Comms	Gun/Mortar	Ammo Handling	Mine Group	Camoufl-1
4	Area AA	Comms	Ammo Handling	Comms	Mine Group	All Camo
5	Lt AA	Sensor	Comms	Sensor	Comms	All Camo
6	Lt AA	Sensor	Electric Power	Electric Power	Electric Power	Neutralized
7	Sensor	Fire	Fire	Fire	Fire	Neutralized
8	Sensor	Crew	Crew	Crew	Crew	Neutralized
9	Admin Bldg	Generator	Generator	Generator	Sensor	Comms
10	Electric Power	Electric Power	Magazine	Magazine	Generator	Electric Power

three bombs each at a 1% to hit gives a cumulative chance of 2% of one bomb hitting.

Since the DH-4s are attacking from 1,000 m, they will not be attacked by Lt AA attacks before they drop their bombs.

9.3.2 Air Attacks Against Ground Troops. Aircraft, particularly the larger ones, were sometimes used in a general bombardment role. Since ground units can rarely be seen by bombers, the practice of dumping bombs in the general area was the standard method of attack. Rarely did bombers make low-level bomb runs to increase their accuracy as it significantly increased their chances of being shot down. As with air attacks on land structures, an attack from an altitude of 200 m is considered to be a "Pressed Home" attack and the aircraft will be subject to Light AA fire before it can release its ordnance. The probability of hit for each bomber's attack is based on its altitude at the time of drop. The higher the altitude the attack is made from, the lower the probability of hit but the greater number of target boxes that are attacked due to bomb dispersion. Roll D100 and compare the results to the probability of hit for the applicable altitude band.

If the number rolled is less than or equal to the chance of a hit, then all the bombs fell within the target area. The damage from the bombs is treated the same way as general bombardment, with the GCS of each bomb totaled up and divided by the number of units attacked. Resolve the damage from the attack in the same manner as a general bombardment from ships (Section 9.2.2.2).

AIRCRAFT BOMBARDMENT ATTACK TABLE

Attack Altitude	Chance of Hit	# of Companies Attacked
200 m	50%	1
500 m	40%	1
1000 m	25%	2
2000 m	12%	3

9.3.3 Errant Ordnance. More often than not, ordnance missed their intended target because of factors which were just beginning to be understood by scientists and military personnel. If gunfire, bombs, or rockets miss their intended targets roll D6 twice. First roll on the Miss Diagram to see in which direction the weapons are off-target and then on the Magnitude Table for the amount of deviation. In the case of rockets, use the deviation diagram to find out where the rest of the rockets that missed the target are scattered (all will scatter to the same location). If the whole ripple misses, divide the number fired in half and roll one deviation location.

MISS MAGNITUDE TABLE

D6 Roll	Amount of Miss
1-4	Miss Distance *1
5-6	Miss Distance *2

Miss Distance	Distance in yards
Short Range Gunfire	50
Medium Range Gunfire	100
Long Range Gunfire	150
Extreme Range Gunfire	200
Dive Bombing	50
Level Bombing (Low/Med alt)	200
Level Bombing (High Alt)	500
Unguided Rockets	75

9.4 Damage to Land Structures. Individual land structures can lose their ability to function either through critical hits or by having suffered more than 50% of their damage points. If a structure has had 100% of its damage points inflicted on it, the structure is a pile of rubble and cannot be repaired.

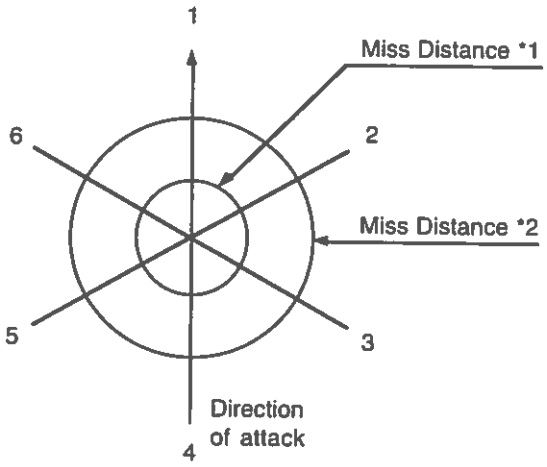
Any hit on a part of a shore battery or fortification, whether caused by direct fire, general bombardment, or aerial attack that inflicts damage points may generate a critical hit. To find out the number of critical hits, calculate the critical hit ratio and roll for the number of critical hits using *FG&DN* section 8.1.3.

9.4.1 Shore Battery Critical Hits. Many of the "hits" on a shore battery are actually near misses. While these will do damage, they will not necessarily destroy a structure, especially if it is armored.

For each critical hit, roll first on the Battery Critical Hit Table. Some critical hits, such as Camouflage, will not need a second roll, but others, such as a Structure hit, will require a second roll on the Individual Structure critical hit table. If the target's armor was not penetrated, use the Not Penetrated critical hit column.

BATTERY CRITICAL HIT TABLE

LAND TARGET MISS DIAGRAM



Die Roll	Critical Hit Table
1- 4	General Hit
5-8	Emplacement
9-10	Command Post

9.4.2 Shore Battery Critical Hit Results.

Admin Building: A support building associated with the battery, but not vital to its function, has been destroyed. If enough paperwork is destroyed, the battery's efficiency may actually improve.

Ammo Handling: The ammunition hoists and other handling gear are damaged. For torpedo tubes, the mounts cannot be reloaded. For power-loaded guns, the rate of fire is reduced. Damage is halved for guns 5.5 inch and below, and quartered for larger weapons. If the guns are not power-loaded, treat as a Neutralization critical hit.

Area AA: Roll D10. On a 1-2, the fire-control for the Area AA battery has been knocked out. On a 3-0, one AA gun is out of action. Roll D10 again. On a roll of 9 or 0, the ready magazine explodes. See the Magazine critical hit for the damage radius and damage points to applied to nearby structures or emplacements.

Camouflage: Either the camouflage is removed completely, or is reduced by one level for the structure that was hit, depending on the listed result. This means Concealed camouflage is treated as Prepared, Prepared as Hasty, and Hasty as None. If the emplacement is not camouflaged, ignore the critical hit.

Communications: The battery's communications have been damaged.

1-3: Communications to command post are broken. The battery is no longer able to receive firing data from fortress command post. All guns must fire in local control, and must pick targets individually (closest, largest target).

4-10 Communications between the emplacement/structure and the command post are broken. If it is a gun/mortar emplacement, it must now fire under local control. If it is a torpedo/mine emplacement, it must now use secondary sensors.

For a General hit, roll D10. If it is the result of a critical hit on the Command post, treat it as an automatic roll of 1-3. For a critical hit on an emplacement, treat it as a 4-10 result.

Reestablishing contact: Every five Tactical Turns the battery can attempt to reestablish contact to one structure. The chance is 25% if the battery is under attack during any of the five Tactical Turns, and 75% if it is not being attacked.

Crew Hit: The first crew hit has no effect. The second causes the rate of fire to drop to half for five Tactical Turns. The third hit drops the rate of fire to half for remainder of game. Command posts treat crew hits as a Neutralization hit with a +3 to the die roll.

Electrical Power: For a General hit, the battery's main power grid has been damaged and all battery emplacements must use their emergency generators. For individual structure hits, that structure's connection to the grid has been broken and it must use its emergency generator.

Fire: Roll D10

1-5 Minor Fire: The emplacement has its ROF (and damage it inflicts) halved until the fire is extinguished.

6-8 Major Fire: Emplacement must cease firing until the fire is reduced in severity.

9-10 Severe Fire: If the fire is not reduced in severity on the first attempt, the emplacement is abandoned.

Damage Control: Reducing Fires. For each fire, roll D10 before the Plotting Phase of the following Tactical Turn and each following Intermediate Turn: 1-4 means that the fire has been reduced one level, and minor fires have been extinguished; 5-8 means that the fire continues as before; 9-10 means that the fire increases one level of intensity. A severe fire will not increase in severity.

Structures which reduce all fires to minor before the Planned Fire Phase are not illuminated. If they have a major or severe fire, they are illuminated.

Fire Control: The battery's fire control system has been knocked out. All weapons that receive fire control data from the command post must shift to local control. The command post is still in communication with the emplacements and can assign their fire to a single target, but it cannot provide firing data.

Generator: The emergency generator for the structure has been destroyed. This also disconnects the structure from the battery's electrical grid. All power-assisted functions cease if a gun is power-loaded. Treat it as an Ammo Handling critical. All powered sensors such as magnetic loops, passive hydrophone arrays and searchlights are inoperable. All controlled mines can no longer be detonated. If a Command Post emergency generator is hit, all weapon emplacements must operate under local control.

Gun/Mortar: One of the emplacement's guns or mortars has been damaged and may not be fired for the rest of the game. The emplacement also suffers one Crew and one

Neutralization Critical hit.

Lt AA: The Battery's Light AA strength is reduced by one-quarter for each hit.

Magazine: Roll D10

1-8: The magazine serving that emplacement is destroyed. Guns have D6 Tactical Turns of ready service ammunition in the emplacement, after which the emplacement must cease fire. Torpedoes have whatever weapons are loaded in the tubes.

9-10: The magazine explodes, destroying the structure. Nearby structures take damage depending on their distance from the magazine and the caliber of gun it served:

Gun	Distance from Magazine in yds			
Caliber	100	500	1000	2000
20 - 76mm	1	-	-	-
78 - 149mm	8	4	1	-
150 - 203mm	12	6	1	-
204 - 305mm	28	14	3	-
305mm+	50	25	5	-

Mine Group: A mine Casemate loses the cable connections to 25% of its mine groups. If two mine casemates share control of the mine groups, the other casemate retains control.

Neutralized: The structure/emplacement is silenced for D6 Tactical Turns. For every two additional neutralized critical hits, add one to the D6 roll.

Sensor: For a General and Command/Observation Post hit, one of the battery's sensors, such as an optical range finder, a horizontal base station, vertical base station, radar, searchlight, etc., has been knocked out. Roll randomly to see which one.

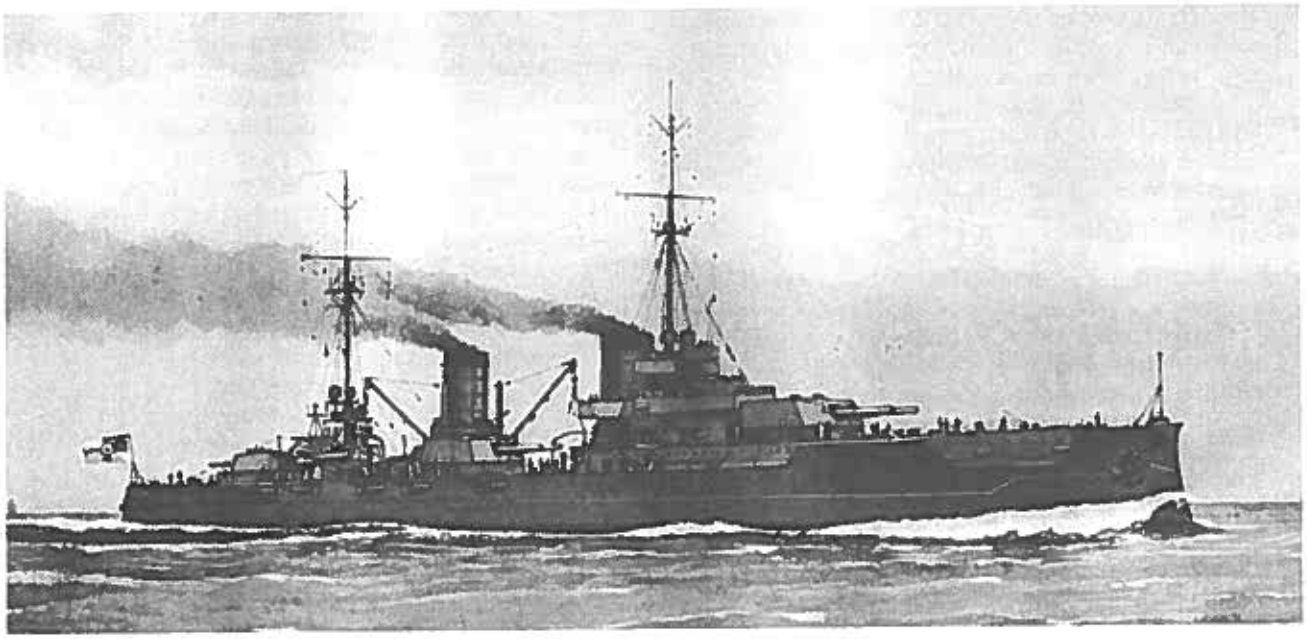
For a torpedo or mine emplacement, the secondary sensor has been hit. Sensors already destroyed can be hit more than once, with no additional effect.

Torpedo Tube: One of the Torpedo mounts in the emplacement is damaged, rendering all tubes on that mount unable to fire. If the tubes are loaded, roll D10. On a 9 or 0, one torpedo warhead detonates inflicting one warhead's worth of damage on the emplacement.

9.4.3 Critical Hits on Other Land Targets. For land targets other than coastal defense batteries, such as bridges, buildings, hangars, etc., the critical hit system is simplified considerably and concerns itself with the ability of the target to perform its function.

Total the damage points that hit each land target in a single Tactical Turn. Divide the total by the original damage points for the structure. This is the percentge chance, rolled on D100, of inflicting a critical hit.

A critical hit means that the target cannot perform its function until it is repaired. If the target is used as shelter, then the contents are also considered to be nonfunctional as well. Thus, bridges become impassable, buildings cannot be used for housing or storage, and hangars cannot store or repair aircraft or airships.



German Battle Cruiser von der Tann *(Naval Annual 1912)*

Lion-*class dreadnought battlecruiser*

Chapter Ten - Amphibious Warfare

10.1 Introduction. An amphibious landing is the riskiest, most complicated form of warfare known to man. Its goal is simple: place ground forces on a hostile shore, occupying enemy territory and moving inland as quickly as possible. Amphibious operations have been carried out as long as there have been naval forces, but WW I was not a good time for them. Mechanized forces were just appearing on the battlefield, but ways of getting them safely from ship to shore had not been developed.

There are many problems associated with amphibious operations. First, a naval force must give up its mobility to close on a hostile coast and remain there, often in restricted waters, for long periods of time. That close to a hostile shore they may quickly be spotted, and attacked by coastal defenses, naval forces and aircraft.

Troops and heavy equipment must move, in what is essentially a big cargo-handling operation, from the ships to the beach at the right time, in the right order, and at the right place. Even in training it's hard to get three out of three. In battle, with the enemy entrenched and waiting, the chance of success is even less likely.

To make an amphibious landing possible, naval forces usually try to gain and hold control of both the surrounding sea and air space so that only the enemy forces actually in the beachhead will be able to fight. Friendly ships and aircraft can also attack the land forces, supporting their troops as they make their assault.

Surprise is vital. Naval forces can use their mobility to land at an unexpected place so that the enemy is not present in strength, or does not have enough time to prepare defenses. Meeting a prepared defender is a recipe for disaster.

If the attackers do not have naval and sea control, situations like the Falklands (1982) or Guadalcanal (1942) can develop, where air and sea attacks on the transports and the troops on the beach threaten the success of the entire operation. While they are loaded on landing craft ground troops are extremely vulnerable.

Fear God and Dread Nought models tactical *naval* warfare in WW I, but many naval actions took place because of an amphibious operation. If an amphibious convoy is attacked and one or more of the transports hit, are the remaining forces sufficient to accomplish their mission? Should a player go all-out attacking an amphibious force as it approaches his coastline or should he conserve his forces, waiting until the actual landing starts, and then attack?

These rules do not model the land combat part of an amphibious assault. The best amphibious landing involves no combat at all, but is instead a quick move ashore against a weak and surprised opposition. Also, the organization and proper execution of even the smallest landing can quickly transform a wargame into a bookkeeping exercise.

Instead, these rules focus on the naval part of the mission: landing forces ashore, defeating the enemy there, and quickly moving off the beach. This is the goal of any amphibious operation, but these rules do not look at it too closely. Instead, the battle is "abstracted," which means a loss of detail but not necessarily accuracy.

At a higher level (operational as opposed to tactical), an amphibious landing is a struggle between the defenders on the beach and the attackers at sea. The attackers try to build up their forces on the beach as quickly as possible while they use aircraft and naval gunfire to reduce the defenders' strength. Other forces isolate the beachhead so that the defenders cannot receive reinforcements.

The defenders use their weapons to destroy the attackers either on the beach, or preferably, while they are still vulnerable on the water. They may have to rely on the beach defenses alone or they may be able to call on aircraft and naval forces of their own, especially if the attackers do not have enough firepower to successfully isolate the beachhead.

Aircraft attacks and gunfire from both sides can be added to the battle (General Support) but the attacks are not resolved on a unit-by-unit basis. Instead, the strength of the attacking force and its supporting weapons are totaled into a single value, the Ground Combat Strength. The defenders and their supporting units are likewise totaled into a single Ground Combat Strength. Depending on the odds and the die roll, losses will be inflicted on each side, or the attackers may be stalled, or achieve their breakthrough, a victory.

10.2 Amphibious Turn Sequence. An Amphibious Turn is 30 minutes long, designed to match an Intermediate Turn in *FG&DN*.

During each 30-minute Amphibious Turn, the attacking force moves its troops from area to area on the Amphibious Operating Area (AOA) Movement Chart. This is process is described below. It is called the **Amphibious Movement Phase**. As the attacking ground forces move over the water to the beach, they can be attacked using *FG&DN* rules, either by the defenders on the beach, or aircraft and ships the defenders control. Attackers that reach the beach become part of the landing force.

Defending units may also appear during this phase, either by random die roll or according to a prearranged schedule, as the scenario allows.

At the end of the Amphibious Movement Phase, the progress of the ground battle between the landing force and the defenders is resolved with a single die roll. This is the **Amphibious Ground Combat Phase**.

Naval combat using standard three-minute Tactical Turns may be going on in parallel with the landing, either outside the AOA, or inside, as described below.

By marking the time of each Tactical, Intermediate, and Amphibious Turn players can make sure that all events happen in the proper order.

The primary purpose of the AOA chart, the Amphibious Combat Turn, and the ground combat strengths is to simplify the complex movement of troops to the beach and the even more complex battle on the beach itself.

10.3 The Amphibious Operating Area. All action in an amphibious battle takes place in the Amphibious Operating Area (AOA). By definition, all attacking and defending forces involved in the action are present in the area. It may actually contain several "beaches," but they are all supported from one ocean area.

Like a dogfight circle, a unit's exact position within the AOA is undefined, but any unit present in the area can take part in the combat.

New ground units can be added to the fight by either side. The attackers do this by moving units from the transports to the beach. That's the whole idea of the battle.

The defenders can also do it, if the scenario setup allows it. These would be reinforcements moving from somewhere else in enemy territory and successfully making it to the beach area. The exact numbers and time of arrival will vary from scenario to scenario. They may appear on a fixed timetable (historical) or the defender may have to roll each turn to see what arrives.

10.3.1 The AOA Movement Chart divides the AOA into distinct areas each with its own function. A ship's exact position within an area is undefined. It takes a fixed amount of time to move from one area to the next, and arrows show into which areas units can move. These help the players organize and move units from the transports to the beach.

10.3.2 Screen/Fire Support Area. Units in this area are guarding the beach from seaward attack. Naval vessels attempting to attack ships in the AOA must enter the screen area first.

It takes 9 minutes (three Tactical Turns) to move from the Screen Area to the Transport Area, or to the open sea.

10.3.3 Transport Area. This is the normal operating area for transports. Small craft are loaded, launched, recovered, and unloaded in this area. Ships must remain stationary (dead in the water) except when entering or leaving the area.

It takes 9 minutes to move from the transport area to the screen area, or for small craft or beaching ships to move from the transport area to the approach lanes.

10.3.4 Fire Support Area. Any ship that wants to attack targets on the beach or provide General Fire Support must be placed in this area. It physically occupies the same space as the Screen Area, however, the mission objective is directed towards the beach and not the sea.

Ships must be in the area for the entire 30-minute Amphibious Combat Turn if they wish to provide general fire support. If they are going to attack specific targets they may not also provide General Fire Support. They may attack as many specific targets (per the rules in Chapter 9) as their guns and time allow.

Ships within the Fire Support Area (FSA) may use their antiaircraft guns normally if they are attacked by aircraft, but they may not initially fire at other ships at sea from within the FSA. They must wait until the next Tactical Turn when they can plot fire against the enemy ships. Ships that are engaged with other naval vessels cannot provide General Fire Support or attack specific land targets at the same time.

Defending ships, aircraft and coastal defenses may attack ships in the Fire Support Area using standard *FG&DN* rules in Chapters 6 and 7.

If ships are firing at the beach, they are considered to be moving at 5 knots and may not steer evasively. If they wish to maneuver to avoid attack, they may steer evasively, but maximum speed is 15 knots.

Ships firing at the beach must declare their distance from the beach which will normally be just inside the Short or Medium range band for their main battery. They must remain at this range for the entire 30-minute Amphibious Combat Turn.

10.3.5 Boat Lanes. There are two areas through which the assault craft must travel on their way to the beach. Only small craft may enter these areas. It takes three Tactical Turns, or nine minutes, for an amphibious craft to move from the Transport Area to the first Boat Lane, or from one Boat Lane to the next, or from the inner Boat Lane to the Beach.

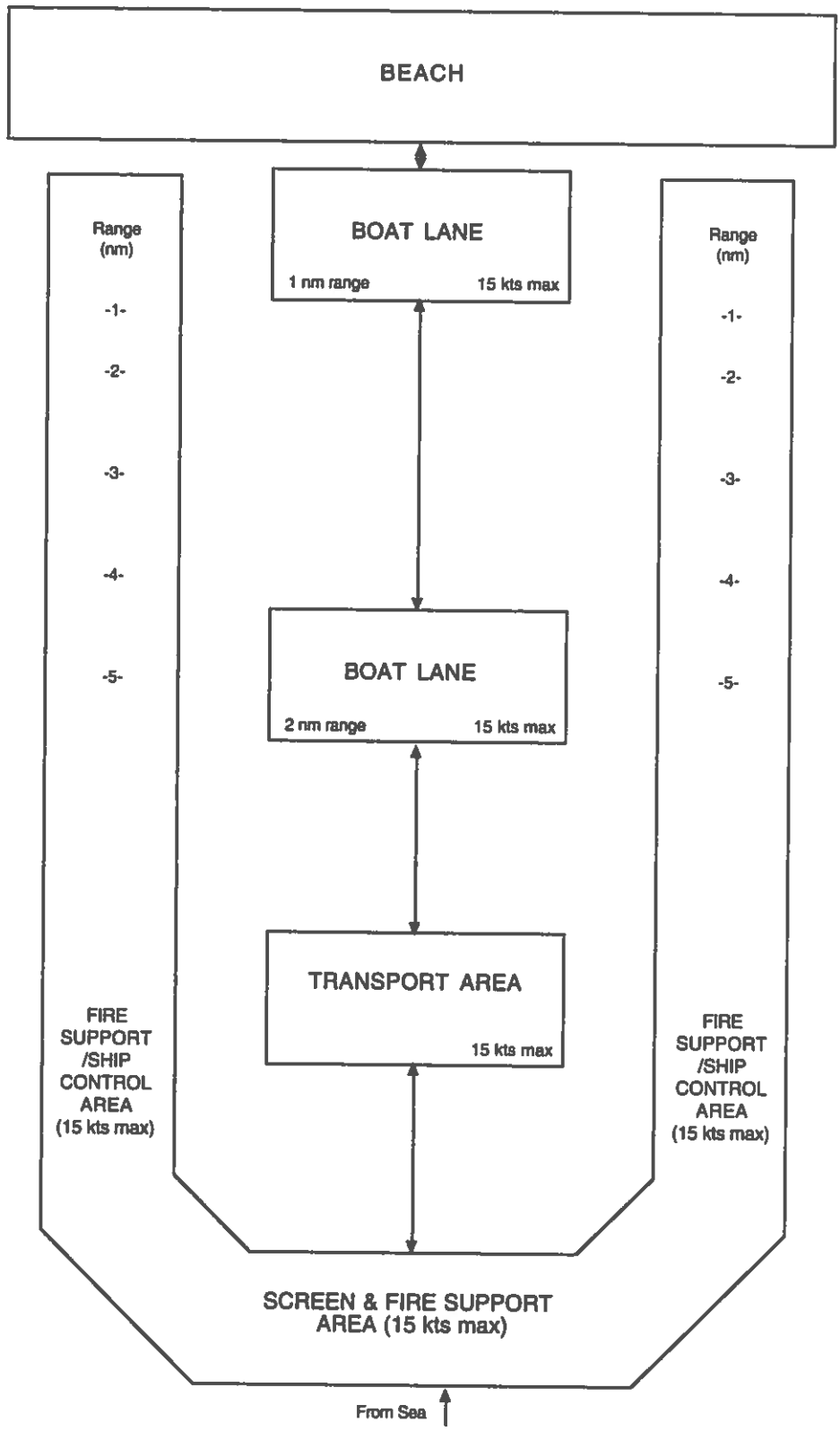
Special conditions may be present in one lane or another depending on the scenario. For example, a sand bar may be impassable to some craft, or slow their movement rates. Similarly, the area may be mined or have obstacles that slow movement.

While the number of boat lanes is usually two, the number may be reduced or increased for a specific scenario.

10.3.6 The Beach. Once a ground unit arrives on the beach, it adds its strength to the amphibious battle in the following Amphibious Combat Phase. Each unit has a ground combat strength. For example, a company of regular infantry, the smallest-size unit in the game, has a Ground Combat Strength of one.

10.4 Amphibious Loading and Unloading. Ships must lower landing craft or other small boats into the water, then fill them with men or lower equipment into them. The troops must climb down netting on the side of the ship, and the equipment must be lowered by crane. The process is slow. Night or bad weather can make it difficult or outright impossible.

15 minutes to lower boats over the side
D6/2+1 Tactical Turns for the troops or cargo to board once the boats are in the water.
Modifiers to the boarding process:
+1 Tac Turn for each sea state over two.
+3 Tac Turn for Night.
+2 Tac Turn for bad weather (precipitation, visibility less than 40%).
D6/2+2 Tac Turns to recover boats.
Modifiers to the recovery process:
+1 Tac Turn for each sea state over 2.
+3 Tac Turn for Night.
+2 Tac Turn for bad weather (precipitation, visibility less than 40%).



AMPHIBIOUS OPERATING AREA MOVEMENT CHART

The Remarks section of a ship's listing in Annex A will show how many troops or vehicles it can carry.

10.5 Amphibious Combat Phase

10.5.1 Ground Combat. Landing troops is the purpose of any amphibious battle. The strongest gun emplacements can be quickly neutralized by infantry, and no amount of bombardment will completely eliminate the infantry defenders from a beach.

On a tactical level, all amphibious assaults are in essence frontal attacks. These are the worst types of battle to engage in. Maneuver has less to offer than sheer raw firepower. At the operational level, however, maneuver can play a significant role in that the attacker can pick his landing spot, and may outflank the defender, but when his troops come ashore, they have to deal directly with whatever enemy forces are present.

To win, the attacker must break out of the beach and move inland. This does not mean that he has eliminated all resistance, just that the defensive network is broken up, and that he can now leave the beach area. At this point, the battle is over and the attackers have won.

10.5.2 Land-Based and Naval Gunfire. These include individual artillery pieces of 57mm and over, or batteries of smaller stuff and mortars for the defenders.

Ships can use their main and secondary batteries against targets on the beach or in General Support.

Attacking guns may also be land-based. For example, they might be based on a small island nearby.

If the defenders have guns they will be listed as a separate target or targets and will have their own armor rating for whatever bunker or other protection they have. The light guns and mortars that are a normal part of the defending unit's organization are already factored into the defender's ground combat strength value.

Defending guns may attack ships or boats on the water using standard *FG&DN* rules. They may also add their ground combat strength to the battle itself, but if they do both during the same 30-minute Amphibious Combat Turn, their ground combat strength is halved.

Example: A concrete bunker contains two 75mm guns. It may fire at troops on the beach (ground combat strength 1.0 for two 66-85mm guns), or it can try to sink landing craft in the water, using the rules section 10.5.5. If it fires at the landing craft, sinking it, then fires at the troops in the same 30-minute Amphibious Combat Turn, its ground combat strength is halved to .5.

Example: A British destroyer with five 4-inch guns moves into the Fire Support Area. It may choose to fire at defending troops on the beach (general fire support, combat strength 7.5), or it may shoot at the bunker with the 75mm guns and attempt to knock it out.

10.5.3 Aircraft Attacks. Defending planes can either attack ships and landing craft on the water or troops landing on the beach (General Support). Attacking planes can either attack specific targets on the beach or defending troops (General Support).

If planes make a bombing attack, add their Combat Strength to both sides (bombing accuracy was poor).

As planes attack, they are subject to normal AA fire from the beach or from ships at sea as appropriate.

Planes can also try to intercept other aircraft. Either side at the beginning of an *FG&DN* turn can move planes in the area on a patrol mission. Planes on attack missions are automatically intercepted by any patrolling aircraft. If both sides put pursuit aircraft over the AOA on patrol, then they automatically engage in a dogfight and other planes enter it.

To continue on their attack mission, the planes must either destroy the enemy patrols or break off (see section 7.3.4). Attacking planes are then allowed to make only one strafing attack, which is actually a series of passes. After the strafing attack they are out of ammunition.

Planes that strafe a beach cannot perform patrol and planes that engage in air combat cannot strafe a beach.

Example: On the first three-minute Tactical Turn of an Amphibious Combat Phase, three British DH.4s and three Sopwith Camels on patrol arrive over a German-held beach. Two German Albatros D.Vs also enter the area on a patrol mission. A dogfight automatically ensues, and in two Tactical Turns (two 1 1/2 min air combat rounds each), both Albatros fighters are shot down at the cost of one Camel and one DH.4. The remaining two DH.4s bomb German gun positions, then leave, taking the two Camels with them.

On the third three-minute Tactical Turn, four more Camels arrive. They make a general support attack but do not strafe the beach, only attacking with Cooper bombs. In the next three-minute Tactical Turn, the British player assigns them to the CAP mission and they remain over the AOA for the next five turns.

Now running low on fuel, and not having encountered any other enemy aircraft, on the ninth turn they attack the beach again, strafing in General Support. They then fly home.

10.5.4 Amphibious Combat CRT. At the end of each 30-minute Amphibious Combat Turn divide the attacker's Ground Combat Strength by the defender's, rounded in favor of the defender. Using these odds, roll D10.

The result in the table will be either two numbers separated by a slash, or a number and a dash, or a number and a letter.

The number to the left is the percentage strength of the attacker's Ground Combat Strength he loses. The number on the right is the percentage lost by the defender. A dash "-" to the left or right means that side did not suffer any loss that turn.

If the defender's result is a "B", then the attacker has broken through the beach defenses, and the amphibious battle is over. If the attacker's result is an "S", stalled, then the forces on the beach lose 10% of their point strength and will not attack again until the odds have been changed at least one column to the right.

AMPHIBIOUS COMBAT RESULTS TABLE

D10	Odds										
Roll	1:6	1:5	1:4	1:3	1:2	1:1	2:1	3:1	4:1	5:1	6:1
1	S/-	S/-	S/-	S/-	S/-	5/-	5/-	4/-	3/-	3/1	2/2
2	S/-	S/-	S/-	S/-	5/-	5/-	4/-	4/-	3/1	3/2	1/3
3	S/-	S/-	S/-	5/-	5/-	4/-	4/-	3/1	3/2	2/3	-/3
4	S/-	S/-	5/-	5/-	4/-	4/-	3/1	3/2	2/3	1/3	-/4
5	S/-	5/-	5/-	4/-	4/-	3/1	3/2	2/3	1/3	-/4	-/5
6	5/-	5/-	4/-	4/-	3/1	3/2	2/3	1/3	-/4	-/5	-/B
7	5/-	4/-	4/-	3/1	3/2	2/3	1/3	-/4	-/5	-/B	-/B
8	4/-	4/-	3/1	3/2	2/3	1/3	-/4	-/5	-/B	-/B	-/B
9	4/-	3/1	3/2	2/3	1/3	-/4	-/5	-/B	-/B	-/B	-/B
10	3/1	3/2	2/3	1/3	-/4	-/5	-/B	-/B	-/B	-/B	-/B

(attacker/defender)

10.5.5 Firing at Groups of Assault Craft. Shore batteries of 57mm size and larger can be used to fire at groups of assault craft instead of individual boats. The light construction of most landing craft makes the necessity of a direct hit irrelevant. The fragments and splashes from near misses are often enough to swamp, disable or sink fragile landing craft.

This type of fire may only be used at landing craft in the Transport Area or a Boat Lane. These areas were occupied by dozens of small craft either circling near the transports as they unloaded or formed up in waves as they approached the beach.

The landing craft may have no more than 4 DP each. If they are larger, they must be fired at as individual ships. If a group of craft consists of boats both above and below the 4 DP limit, the casualties inflicted should be reduced proportionately.

Small craft operating singly, such as fire support craft, must also be fired at individually.

Procedure: First the firing player should declare which Area he is shooting into: the Transport Area or one of the Boat Lanes. He then finds out what the range band is for the firing gun and how many damage points it inflicts if it hits. He multiplies the damage points by the appropriate ROF modifier, listed below. This compensates for the relatively few shells fired by the larger guns, or the larger number of shells fired by the smaller weapons. There are also modifiers for guns that can only fire AP shells or those that fire mechanical time fuzed shells capable of airburst.

Take the modified damage point value and roll on the Landing Craft Attack Table. The result is the number of landing craft, out of a maximum of 4, that are sunk.

ROF MODIFIER TABLE

Gun Size	Modifier
75 - 130mm	2.0
131 - 155mm	1.5
156 - 239mm	1.0
240 - 356mm	0.5
357+ mm	0.25
AP shell	0.5

LANDING CRAFT ATTACK TABLE

Modified	Die Roll					
Dam Pt	1	2	3	4	5	6
1-10	-	-	-	-	-	1
11-20	-	-	-	-	1	1
21-30	-	-	-	1	1	2
31-40	-	-	1	1	1	2
41-50	-	1	1	2	2	3
51-60	1	1	2	2	3	3
61-70	1	1	2	2	3	4
71-80	1	2	2	3	3	4
81+	1	2	3	3	4	4

To find out which craft are lost, the firing player picks the first, then the owning player picks one, then the firing player and so on until all the boats are gone or the required number of boats are sunk.

The blood bath resulting from a rain of high explosive shells will quickly illustrate why very few landings were ever conducted anywhere near operational coastal defense batteries, and on those occasions where there was no choice, every effort was made to smother the coastal guns with high volumes of naval gunfire.

10.5.6 Reinforcement Areas. In addition to ground units actually present and fighting in the Beach Area, other troops present nearby may be able to move to the Beach and reinforce the defenders.

These ground units may be in two places, the Near Reinforcement Area or the Distant Reinforcement Area. Ground units in the Near Reinforcement Area can move to the Beach, or the Distant Area if the controlling player wishes. Units in the Distant Reinforcement Area can move to the Near Reinforcement Area.

At the start of a scenario, these two Areas may contain ground troops that can reinforce the defending units. Although the times to move between the areas can be defined in the Scenario Setup, normal times are one hour for a motorized unit to move from one area to another. Double this time if moving at night. Double this time for animal-drawn or mounted units. Quadruple it for foot units. Thus, it would take a foot infantry unit 8 hours (16 Amphibious Combat Turns) to change areas at night.

As opposed to the Beach, where defending troops are assumed to be deployed and always in some form of defilade, troops in the two Reinforcement Areas can be deployed or in transit. Only transiting troops can move from one area to the next, either from Distant to Near or Near to the Beach. This movement ability comes at a price. They are more vulnerable to gunfire and air attack and the roll on the Amphibious CRT is shifted two columns to the right, after the odds are computed. Transiting troops can deploy, removing the two-column modifier, in two Tactical Turns, or reform for transit in three Tactical Turns, but if they are suppressed it takes ten Tactical Turns for them to reform.

10.6 Planning an Amphibious Landing. An amphibious operation is carefully choreographed, with many different units acting to put troops ashore at a single time. Shore bombardment is coordinated so that it ends just as the men hit the water's edge. The movement of hundreds of ships, most without radios, is all timed so that they move together and arrive at the beach at the right times.

Once a player puts boats into the water, or in any way starts unloading ships, he must commit to a specific time

for the first wave to land. This may be "as soon as possible," limited only by unloading and movement rates, or he may say "in two hours, at 0800" which allows some margin for delays. The only order he can give after that is to issue a general recall.

The coxswains and others were committed to a prearranged timetable, worked out weeks in advance for a large landing. Last-minute changes were rare.

Players should try to keep the time the troops spend in the boats to a minimum. Not only are they vulnerable to air attack but the men quickly become fatigued, and if they are in the landing craft for very long, will become seasick, hungry, and so on.

If amphibious troops stay in their landing craft more than three hours, they fight at one-half efficiency for the Amphibious Turn they land on the beach. The following turn, they recover their full GCS, less any casualties suffered.

10.7 Night Amphibious Landings. While loading was slower and riskier in the darkness, surprise often outweighed the risks. Night offered a concealed approach, and even if the force was discovered by the defenders, the lower visibility offered some protection.

If the attacker starts the landing process during the hours of darkness, roll for visibility each Amphibious Combat Turn. This will tell how far away the defenders can see (and shoot at) the approaching ships and amphibious craft. Comparing the visibility to the Amphibious Operating Area Movement Chart will show at which areas the defenders may shoot.

Starshell, searchlights, and other night visibility aids work normally.

10.8 Beach Defenses. The defenders often used entrenchments and mines to augment their strength.

10.8.1 Entrenchments. Troops and guns can be given four levels of protection:

- No entrenchments, hasty positions; troops use whatever cover is at hand - normal strength
- Entrenchments (at least 24 hours to prepare); slit trenches, gun pits, earth and sandbag construction - double strength
- Heavy entrenchments; log bunkers, reinforced dugouts - triple strength
- Fortifications; concrete and steel - quadruple strength

A single value/description affects all defending ground troops on the beach. Individual guns may have different values. For example, there may be a pair of heavily entrenched 5-inch coast defense guns, and a battery of 3-inch AA guns that are only entrenched.

The entrenchments are transformed into armor class values if the units are attacked using standard *FG&DN* rules (see Chapter 9). If they are attacked as part of the ground forces, use the modifiers to increase their Ground Combat Strength before adding it to the total and calculating the odds.

Note: Although it might seem that entrenchments should only affect the defensive strength of the troops or guns, at this level of abstraction they affect the forces' overall combat strength. Because of their protection, the troops using them can fight more effectively.

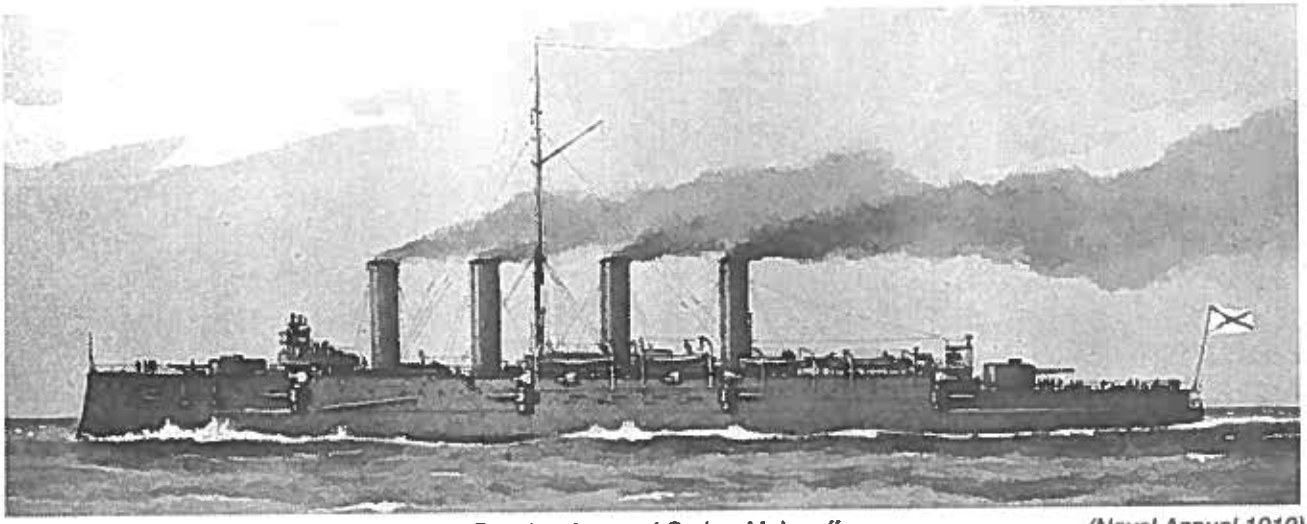
Example: A unit of regular infantry has a Ground Combat Strength of 1.5. In entrenchments it would have a Ground Combat Strength of 3.0. A 5-inch coast defense gun in the open has a Ground Combat Strength of 1.5. Inside a heavy emplacement its Ground Combat Strength is 4.5.

10.9 Movement Between Beaches. Once a beach is taken (breakthrough achieved), players may want to transfer units to other beaches in the same AOA. *Movement of friendly forces off a beach after breakthrough is not possible.*

First, although a breakthrough has been achieved, there are still enemy troops present. Friendly units have to finish securing the beach.

Second, units which have broken through are needed to exploit the victory. Pulling them off the beach would stall the advance they've fought to win.

Once friendly units have landed on a beach they cannot be removed during the amphibious battle. Boats and landing craft may be recovered, but the ground forces are there to stay.



Russian Armored Cruiser Makaroff *(Naval Annual 1910)*

GROUND COMBAT STRENGTHS

Infantry Units	
Elite Company	2.0
Combat Engineering Company	2.0
Line Infantry Company	1.5
Garrison, Militia Company	0.5
Armored Units (6 vehicles)	
Light Tank Company (37-50mm main gun)	3.0
Aircraft	
Strafing (2 MGs)	0.3
Air Rockets	
1-4 Rockets	0.2
Bombs (Demolition)	
20 lb	0.1
50 lb	0.2
100 lb	0.4
300 lb	1.1
500 lb	1.5
1,000 lb	3.0

- Incendiaries x1.5
- Fragmentation x2.0

Artillery GCS Values (Naval and land-Based)

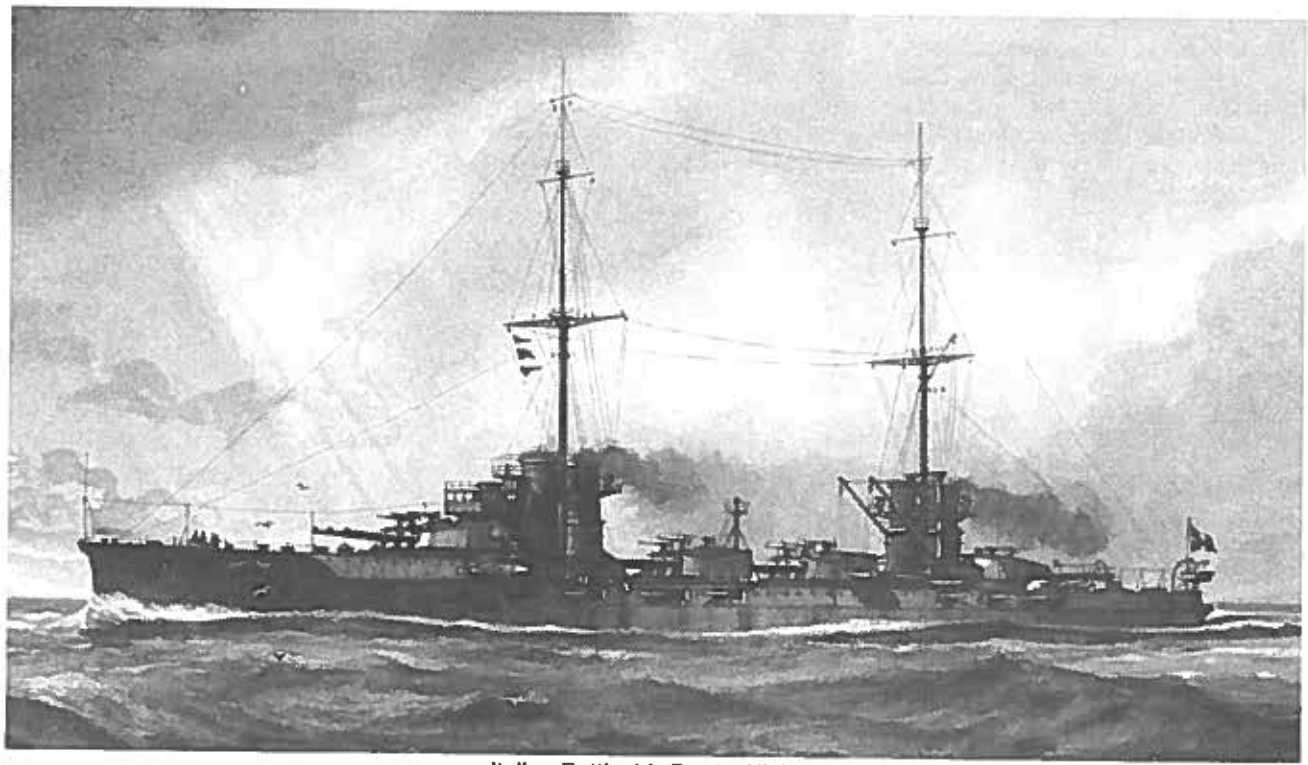
Bore Size	w/Power Loading	w/o Power Loading
Lt. MG	-	.05
Heavy MG	-	.1
20-45mm	-	.2
46-65mm	-	.3
66-85mm	-	.5
86-100mm	-	.8
101-120mm	-	1.0
121-160mm	-	1.5
161-200mm	2.5	2.0
201-240mm	3.5	2.5
241-280mm	4.5	3.5
281-320mm	6.0	4.5
321-360mm	7.5	6.0
361-400mm	8.5	6.5
401+mm	9.5	7.5

Entrenchments GCS Multipliers

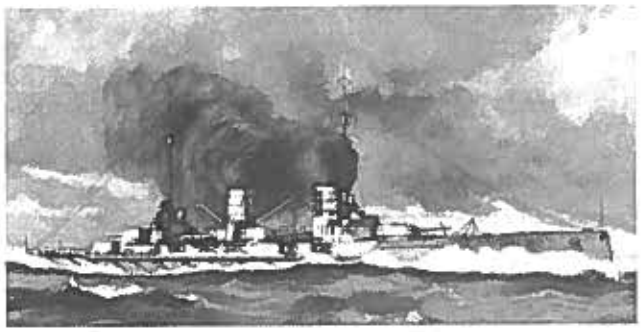
None	x 1
Entrenchments	x 2
Heavy Entrenchments	x 3
Fortifications	x 4

Gun Size Classifications

Small Gun: Less than 127mm
Medium Gun: 127mm - 253 mm
Large Gun: 254mm+



Italian Battleship Dante Aligheri *(Naval Annual 1913)*



Moltke-*class dreadnought battlecruiser*

Chapter Eleven - Mine Warfare

Mine warfare has always been the unwanted stepchild in the arena of naval warfare. Unglamorous, unchivalrous, and cheap, mines were a source of constant frustration for naval commanders. In WW I, mines were used heavily in all theaters (over 300,000 laid) and in some instances had strategically significant results. The minefields in the Dardanelles, along with the coastal defenses, prevented the Allied navies from sailing up to Constantinople. This failure by the naval forces then led to the equally disastrous land campaign on the Gallipoli peninsula.

While laying mines was rather simple, the same could not be said of mine sweeping. Risky business at best in uncontested waters, attempting to clear a minefield with small wooden ships while under gunfire was virtually suicidal. And in the end, one could never be sure that all of the mines had been removed.

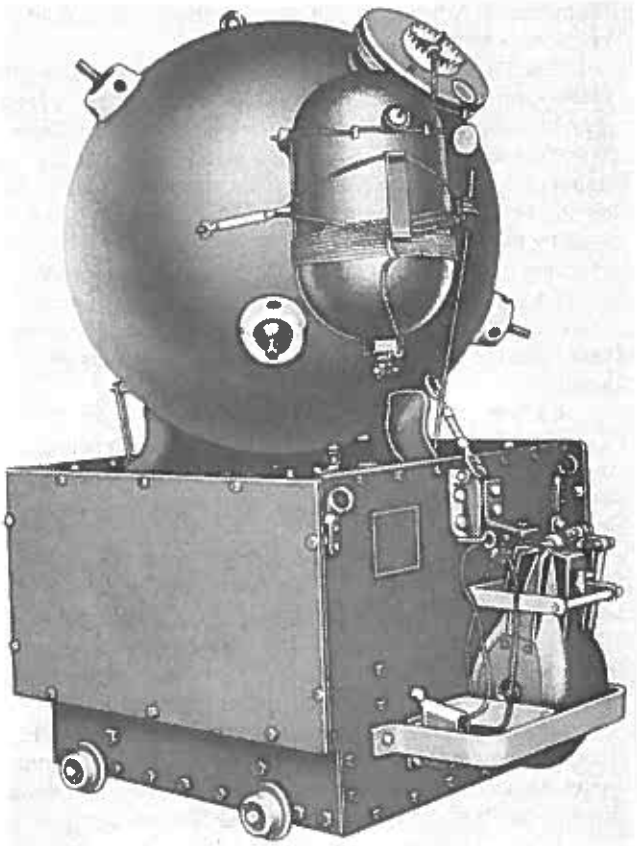
This chapter addresses the laying of mines, attacks against ships and submarines, and mine sweeping.

11.1 Mine Types. Mines are classified by their means of control, position in the water column and the mode of actuation. The control aspect deals with whether the mine is autonomous (i.e., independent) after being laid, or if it is under direct human control via a cable. Independent mines, once laid, will cause harm to friend and foe alike. The position describes where in the water the mine body or case is located. Is the mine moored, or anchored, with a buoyant capsule at a shallower depth, or does the mine lie on the sea floor? Finally, the actuation describes what causes the mine to detonate. A contact mine explodes when you hit it, and an influence mine explodes when a particular signature of a ship (magnetic, acoustic, or pressure) reaches a preset level.

All mines in *FG&DN* will be defined by their type in Annex G. For example, the US Navy Mk6 mine shown here is an independent, moored contact, antenna mine. The contact fuze was activated by hitting one of the horns on the mine body, or by hitting the floating antenna.

11.2 Mine Employment. Mines are always used in groups because an individual mine has a very limited danger area. A grouping of mines is called a minefield and the attack potential depends on the number of mines in the field and the spacing between them, or its "density."

11.2.1 Minefields. Minefields are usually not laid as part of a tactical level game. However, given that many of the naval operations in coastal waters during this period were mine warfare-related, *FG&DN* covers the deploying of



Mk6 Mod 1 Antenna Mine *(US Navy)*

minefields. Of greater significance for tactical game play are the pre-laid minefields which are part of a player's coastal defenses. Minefields played an important role in the Great War at sea and present the attacking player with a difficult tactical problem.

Large minefields were usually laid by purpose-built auxiliaries or surface combatants, and were usually defensive. Smaller fields, especially those laid by submarines, tended to be offensive and had low probabilities of sinking or damaging a ship unless the mines were laid in narrow channels or other choke points. The minefield model presented in *FG&DN* provides a referee with the means to add large, defensive fields to a tactical scenario.

Since an on-scene commander rarely had the luxury of planning where a minefield would be laid, the scenario writeup or a referee will usually provide a player with the location of the mined areas. The field's exact composition was almost as much of a mystery to him as to the enemy - but at least the friendly player knows there is a minefield. On those rare occasions where the players are required to do the planning and laying of a minefield, the number and types of mines available will be provided in the appropriate forces section of a scenario.

Designing a Minefield. The first step in designing a minefield is to take a look at what you intend to defend or restrict. Is there a narrow passage that can exploited? What's the water depth? What types of mines are available? These questions and more form the basis of minefield planning. Remember that unless they are controlled (command-detonated from a shore station) mines owe allegiance to no one. Any ship that enters a minefield, regardless of the flag its flying, will be attacked.

So be careful where you put these things as they could come back to bite you.

Once a suitable location is found, measure the length of the area to be mined. Next, select the desired chance of a hit for a single row of mines from the Mine Attack Table. The distance between mines for a given hit chance can be found at the top of the column. Note that mines cannot be closer than 50 yards apart. Now divide the length of the area by the mine spacing and add one. This is the number of mines needed to lay one line, or row, of the minefield.

To find the depth of the minefield, take the number of lines, add one and multiply by the desired spacing between lines. The minimum spacing between mine lines is 250 yards.

Each line is made up of only one type of mine. A minefield can be made up of several lines, each with a different type of mine. This restriction is necessary because the mine attack model assumes that each line contains the same mine throughout.

Water depth is also very important in planning a minefield. In Annex G, there are two depth bands listed for each mine type. The first is the maximum anchor depth. This is the deepest water that the mine can be laid in and still function properly. The second depth band is the case depth, and this is the maximum water depth that the warhead of the mine can be at without being crushed. For moored contact mines, there can be a very big difference between anchor depth and case depth. For bottom mines, anchor depth and case depth are one and the same.

To attack surface ships, contact mines must be at periscope depth. Bottom influence mines must be in the Shallow Depth band. The only exception to this rule is when a moored contact mine is equipped with a buoyant antenna. These mines are called, not surprisingly, antenna mines (see figure below) and they can be at Shallow Depth and still be able to attack a surface ship. If the case depth of a mine is deeper than those described above, a surface ship will pass safely overhead.

In the case of a submarine, the mine case depth must be in the same depth band as the submarine. If a submarine attempts to penetrate a moored contact minefield at depths deeper than the mine case depth, reduce the hit probability for the mine line by half. A sub can still snag an anchor cable and drag a mine down and into contact with the hull.

Example: A Russian player has 274 M-08 moored contact mines to place in a minefield in the approaches to the Gulf of Riga before a scenario is to begin. The area to be mined is 5,000 yards long and 2,000 yards deep. He wants to have as many lines as possible with a probability of hit of 40% against a dreadnought battleship, which gives a 75 yard spacing between mines. The Russian player also chooses to space the mine lines 300 yards apart.

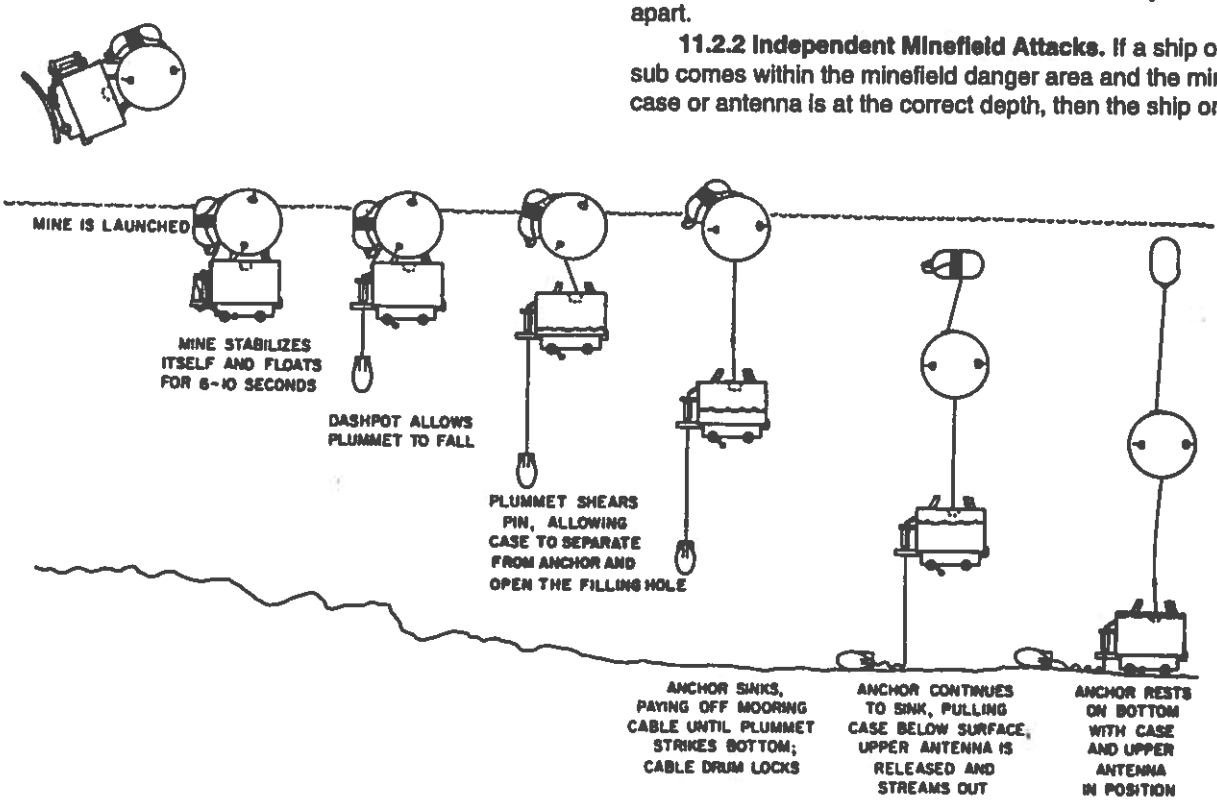
# of mines/line = (5,000/75) + 1 = 66.67 + 1 = 68 mines

# of lines = 274/68 = 4.03 = 4 lines (272 mines total)

Minefield depth = (4 lines+1) x 300 yards = 1,500 yards

Thus, the Russian minefield would be recorded as having a danger area 5,000 yards long by 1,500 yards deep, containing four lines of mines with each mine 75 yards apart.

11.2.2 Independent Minefield Attacks. If a ship or sub comes within the minefield danger area and the mine case or antenna is at the correct depth, then the ship or



Deployment of a Mk6 Moored Antenna Mine

US Navy

submarine is subject to attack. As most minefields will be made up of multiple lines, a ship will be attacked more than once as it traverses the minefield. Since keeping track of each mine line on the playing surface is very tedious, an abstracted method, based on the distance traveled by a ship or submarine is used to find out when an attack takes place. The distance between attacks is equal to the depth of the minefield divided by the number of lines in the field, rounded to the nearest 50 yards.

Example: The Russian minefield in the previous example would have a distance between attacks equal to:

Distance = 1,500 yards /4 lines = 375 yards
Rounding to nearest 50 yards = 400 yards

Thus, every time a ship or submarines travels 400 yards in the minefield it is subject to an attack by a mine. **Note:** if the entire depth of the minefield is crossed, then the ship or submarine will be attacked at least as many times as there are lines in the field.

Once the ship or submarine is in the minefield and has traveled the required distance, the minefield player rolls for the success of the attack. Cross-reference the ship size class with the mine spacing, for either a contact or influence fuzed mine, to find the chance that the target will hit a mine. Roll D100 and compare the results to the Mine Attack Table. If the number rolled is less than or equal to the value in the table, then the target has hit a mine. The attack is made secretly by the minefield player, or a referee, as the victim cannot tell initially where the attack came from and may not even be aware he is in a minefield. Many times a detonating mine was mistakenly thought to have been a submarine-launched torpedo attack and vice versa.

11.2.3 Controlled Minefield Attacks. A controlled minefield is designed in the same way as any other minefield. Mines will be of one type per row. Each group of mines, no more then three per group, is fired from a designated mine casemate, and a casemate can control any number of mines or mine groups. Each group of mines can be controlled by two mine casemates, although single casemate control was more common.

When a ship enters a controlled minefield, and the defending player decides to attack it, roll to see if it would normally have hit the mine. If the ship does hit a mine, the mine does full damage to the ship. If it does not set off a mine normally, the defending player may still attack the ship with mines.

If the mining casemate has a range finder, magnetic loop or passive hydrophone array, the defending player will know if a ship is near or within a mine group, as the mine group's location is known with great accuracy. The defending player may then command-detonate the mine group, hopefully catching the ship in the explosion. The chance of a hit is the normal chance of a single mine in the Mine Attack Table plus 5% for each additional mine that is detonated. Up to two mine groups, a total of six mines, maybe detonated at once. If the attack is successful, the ship takes one-half damage from one of the mines.

Example: A minefield is made up of three lines of 21 (7 groups) US Mk4 controlled, moored contact mines. Individual mines are 50 yards apart. There is a single mining casemate with an optical range finder that controls the minefield. An enemy destroyer (Size class D) attempts to run the minefield. The normal probability of hit for a destroyer with a mine spacing of 50 yards is 0.16. After successfully navigating the first two lines, the minefield player decides to command detonate two groups of mines (6 mines total) in the last line should the destroyer pass through without hitting a mine. The probability of a hit with the six command-detonated mines is:

Chance to hit = 0.16 + (6-1) x 0.05 = 0.41

11.2.4 Mine Nets. In an attempt to defend critical areas from submarines, many navies used antisubmarine nets with small contact mines woven into them. These mine nets operated on the assumption that as a submarine tried to penetrate the net, the mines would be drawn into contact with the submarine's hull and detonate. If a submarine comes in contact with a mine net, a mine attack is also conducted against the submarine in addition to the other benefits of a net barrier. Mine nets are to be treated as a contact minefield with a probability of hit of 40% against a submerged submarine. The discussion on the effectiveness of the nets themselves can be found in section 3.5.2.

11.2.5 Damage from Mines. Treat mine damage against ships exactly the same as if it were a torpedo hit. If the mine is a contact mine, the torpedo protection system of the ship will have to be penetrated first before damage can be applied to the ship. For an antenna mine or a bottom mine, the torpedo protection system is of no help to a ship because the mine detonated under the ship, not beside it. If a submarine hits a contact mine, the result is automatically a pressure hull penetration critical hit and the submarine has a 15% chance of getting to the surface if it is at Shallow depth. This includes the small contact mines used in mine nets. If the submarine is deeper, it automatically sinks.

Mine Attack Table

Contact Mines

	Distance between Contact Mines (yds)						
Ship Size	50	75	100	125	150	175	200
A	0.60	0.40	0.30	0.24	0.20	0.17	0.15
B	0.48	0.32	0.24	0.19	0.16	0.14	0.12
C	0.28	0.19	0.14	0.11	0.09	0.08	0.07
D	0.16	0.11	0.08	0.06	0.05	0.05	0.04
E	0.10	0.07	0.05	0.04	0.03	0.03	0.03

Probability of hit is for one row of contact mines.

Influence Mines

	Distance between Influence Mines (yds)					
Ship Size	75	100	125	150	175	200
A	0.75	0.56	0.45	0.37	0.32	0.28
B	0.60	0.45	0.36	0.30	0.26	0.22
C	0.35	0.26	0.21	0.17	0.15	0.13
D	0.20	0.15	0.12	0.10	0.09	0.07
E	0.12	0.09	0.07	0.06	0.05	0.05

Probability of hit is for one row of influence mines.

Bottom mine attacks against submarines are resolved as a lethal depth charge attack, with the mine damage halved if the submarine is submerged. For surfaced submarines and ships, bottom mine attacks inflict full damage.

For antenna mines, if the submarine or ship hits the antenna, the attack is treated the same as a contact mine attack only with the mine damage halved. If the submarine is at the same depth as the mine case itself, the contact attack inflicts full damage and is resolved as described above. For antenna mines with a case depth in the Intermediate I depth band, the antenna does not reach submarines at periscope depth or surface ships.

Example: A minefield is made up of US Mk6 antenna mines with the case depth in the Shallow depth band. Any submarine at periscope depth could hit the antenna with the normal chance to hit, but with only half damage if the attack was successful. The same would be true for surface ships as well. If the submarine was in the Shallow depth band, the chance to hit and damage would both be unmodified. Should the submarine be at Intermediate I, the chance to hit is halved, but the damage is unmodified.

11.2.6 Minelaying. In those situations where the major thrust of one side's operations is minelaying, the following section provides some simplified rules to lay mines from submarines and surface ships.

Any ship can be modified to carry mines, although this was usually done only to light cruisers, destroyers, submarines, coastal craft and merchants. In addition, there were a few ships whose sole purpose was to carry and lay a large number of mines - often several hundred at one time. The mine capacity of a particular ship will be listed in Annex A. Mines carried on board surface combatants are treated as "Other Weapons" for critical hit purposes.

Mines can be laid from ships up to 20 knots, however, it was more commonly done at 15 knots or less. At speeds higher than 20 knots, the mines would likely be damaged. This would prevent them from working properly and could even cause premature detonation. Submarines, because of their significantly lower maximum submerged speed, can lay mines at any speed.

Minelaying operations can only be done in Sea States of 4 or less. Submarines are less affected by sea state and can lay mines up to Sea State 5. In higher sea states, the wave heights will damage the mines as they bob on the surface.

For visual detection purposes, minelaying operations are treated in the same manner as a torpedo launch (see section 5.2.2.4). Deployed mines that are floating on the surface, or have an antenna that is on the surface, are to be treated as a normal periscope per section 5.2.3.

The rate at which mines can be laid depends on the ship's construction. Specially built minelayers can lay mines at a rate of nine mines per Tactical Turn. Submarines, modified merchants and surface combatants with specialized mine rails can lay mines at a rate of six mines per Tactical Turn. Submarines and ships without specialized mine rails can lay mines at a rate of four mines per Tactical Turn.

Mines that have case depths in the Shallow depth band (this includes Periscope depth) are considered armed at the beginning of the second Tactical Turn after they are laid. This includes bottom mines as well. Mines with case

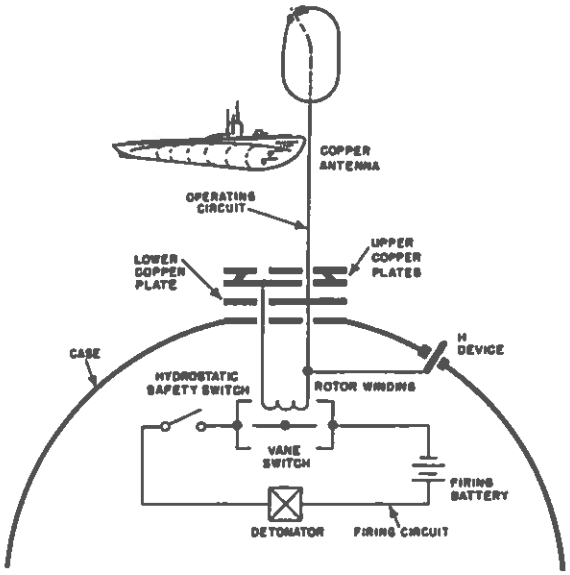
Antenna Mines

During the early part of WW I, it became clear to the Royal Navy that mines could play a significant role against the U-boat threat. Unfortunately, the state of the Royal Navy's mine inventory was deplorable with few mines available, and those they had didn't work particularly well.

To obtain usable defensive mines for their major harbors, the RN had to purchase older Russian moored contact mines. By early 1917, British naval mines, reliable ones at that, were being produced in sufficient number to consider the laying of barrage minefields across the Channel between England and France. The biggest problem encountered by the minefield planners was at what depth to put the mine case? The debate between shallow and deep mining would rage on for months and the adopted compromise involved simply laying more lines of mines at staggered depths. It was a solution, but far from a good one.

When the United States entered the war, the Bureau of Ordnance had been working on a new firing device for moored contact mines since early 1917. This new fuze, called the K-device, used a copper wire to extend the vertical coverage of the mine, thereby allowing the case to be set at deeper depths without compromising the ability to cover shallower depths as well. The K-device finally provided the means to lay an effective mine barrage against the German U-boat.

In the case of the Mk6 Mod 0 antenna mine, the copper wire antenna is about 100 ft long and is attached to a float. The copper wire is insulated from the steel float and the steel mine case and is connected to a series of copper plates. Since seawater is a salt solution, it can act as the electrolyte of a standard galvanic battery. However, since the copper wire antenna is only connected to copper plates, no current is produced. Once a ship's steel hull comes in contact with the copper wire antenna, the battery circuit is completed and a small current flows through a relay which closes the vane switch and completes the firing circuit containing the battery and the detonator. The mine's warhead then explodes.



Antenna mine fuze mechanism or K-device *(US Navy)*

depths in the Intermediate I depth band arm after three Tactical Turns.

Example: A modified destroyer has 24 moored contact antenna mines on two mine rails. The case depth of the mines is set for Intermediate I. It will take the destroyer four Tactical Turns to lay all the mines. Those mines deployed in Turn 1 will be armed at the beginning of Turn 4 (three turns later).

11.2.7 Tactical Minelaying. Several navies had considered laying mines in the wake of their battle fleet as it attempted to disengage from an enemy fleet. Though this type of minelaying was rarely done, it could have a major impact on the course of a battle, and was a major concern of pursuing fleet commanders.

While moored mines could be used in tactical minelaying, drifting mines were usually the weapon of choice as they could be activated rapidly and because the minelaying teams usually didn't know the exact depth of the water the ships were operating in. During a naval battle errors in navigation often became quite large, so charted water depths were useless and it wasn't possible to take soundings to establish water depth. Drifting mines are activated on the Tactical Turn following their entry into the water.

Tactical minelaying has the same speed and sea state limitations as regular minelaying and the rates of mining are still determined by the ships conducting the operation. Each ship may lay a single line of mines at any spacing up to 200 yards between mines. Resolve attacks by each line of a tactical minefield in the same way as a regular minefield.

If moored contact mines are used in a tactical minefield, and if the water depth in the area is deeper than Intermediate II depth band, there is a 60% chance that the mines have incorrect depth settings. An antenna mine line has a 30% chance of having the incorrect depth. If the mines are laid at an incorrect depth, there is a 50% chance that they are too deep and the minefield will have no effect on surface ships. For the other 50% of the time, the mines will float on the surface and while still dangerous, they can at least be seen.

Drifting mines suffer from two distinct disadvantages if they are used in a tactical minefield. First, the spacing between mines will change over time as the current moves the mines around. This will reduce the mine line's effectiveness (probability of hit) as time goes on. Secondly, drifting mines are a threat to any ship and since the field moves with the current, it was considered to be extremely dangerous to lay this type of field if battle was to be continued in the area.

Once a drifting tactical mine line is laid, it will hold its original mine spacing for five Tactical Turns. After the five Tactical Turns, and every five thereafter, the spacing will increase by 25 yards. Once the spacing exceeds 200 yards, the drifting mine line will have a set probability of hit of: 5% for A size ships, 4% for B, 3% for C, 2% for D, and 1% for E size vessels.

Single mine lines essentially have a danger space equal to their length. If multiple mine lines are laid, and the lines are within 500 yards of each other they can be considered as one large tactical field with the danger space equal to the minefield's length and depth. For tactical minefields, the danger area increases proportionately to the increased spacing every five Tactical Turns. While a drifting minefield would also move in the direction of the current, unless the current is fast (5+ knots) the minefield can be considered to be stationary for purposes of game play.

Example: A modified destroyer lays 12 drifting mines in a single line at 75 yard intervals. The danger space of this minefield is a line 900 yards long (12 x 75 yds). Against an A size target, the probability of hit is 40% for the first five Tactical Turns after the field is laid. For Turns 6-10, the mine spacing increases to 100 yards (with a 30% probability of hit) and the danger area becomes a line 1,200 yards long. By Turns 11-15, the mine spacing grows to 125 yards (with a 24% probability of hit) and the danger area becomes a line 1,500 yards long.

11.3 Minesweeping. Once mines have been reported in a particular area, usually by a ship hitting one, the mines must be removed in order to allow ships to pass safely. Minesweeping is the tedious and dangerous operation taken to clear an area, or a channel, of mines. In the case of moored mines, this was usually done by streaming a heavy gauge steel wire cable between two ships and running them through a minefield. The wire sweep would catch the mooring wire or rope of a mine and cut it, thereby allowing the mine case to rise to the surface where it was destroyed by gunfire. The only way to sweep influence mines during this time frame was to run a specially modified ship through the field as a "guinea pig" with the intent of setting off the mines.

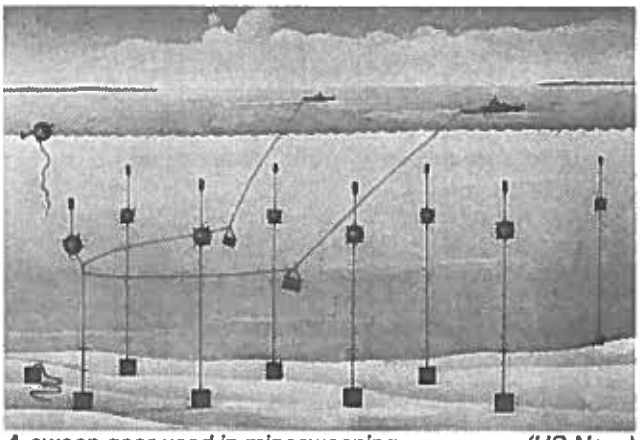
Minesweeping was a particularly hazardous occupation where the odds of losing a ship was high - intentionally running around in a minefield tends to be hard on small vessels. To dramatically illustrate the dangers of minesweeping, one only has to point out that by the latter part of WW I, the Royal Navy minesweeping force had worked up to the point where they would lose only one minesweeper for every 80 mines swept. Earlier in the war, the trade-off was almost one for one.

11.3.1 Types of Minesweepers. There were essentially three types of minesweepers, many of which were converted merchants and fishing trawlers. The first type is the small fishing trawler, these slow ships were very lightly armed and had A-sweep gear fitted for coastal minesweeping. They could sweep in Sea State 3 or less and up to speeds of 5 knots.

The second type of minesweeper includes converted or purpose built sloops and paddlewheel steamers. These ships were fitted with A-sweep gear, or single Oropesa gear, and could sweep in Sea State 4 or less and up to speeds of 10 knots.

The third group were destroyers that were outfitted with modified mine paravanes and served as fast minesweepers for fleet operations. These ships could sweep in Sea State 4 or less and up to speeds of 25 knots.

Types of Sweep Gear. During the early part of the 20th century, mine countermeasures consisted of finding a minefield and then using explosive charges to try and set off as many mines as possible. It was a slow process and not a very efficient means of ridding an area of mines. The Russian Navy is credited with the idea of sweeping minefields by towing a weighted metal wire to cut the mine mooring line. Initially, this concept wasn't very popular as ordinary steel wire tended to catch the mines and drag



A-sweep gear used in minesweeping. *(US Navy)*

them about rather than cutting the mooring rope of cable. This led to higher casualties among the minesweepers than the explosive method, but sweeping was considerably faster. By the beginning of WW I, the primary sweep gear was only a slightly modified version of the original Russian idea. The A-sweep was a thick serrated steel wire, about 2.5 inches in diameter that was towed between two ships and weighted down so it would come in contact with mooring rope or cable of a mine. The serrated wire would then saw the mooring line and the mine case would float to the surface where it would be destroyed by rifle fire. The A-sweep takes seven Tactical Turns to stream between the two minesweepers and requires the two ships to be a slow speed (5 knots) and within 250 yards of each other. At slow speed, as is the case with towing, there is little chance for a collision. Once streamed, A-sweep gear can be towed up to speeds of 12 knots and has a sweep width of 300 to 500 yards.

One of the major disadvantages with the A-sweep was that the two minesweepers were severely restricted in their ability to maneuver. With the A-sweep gear streamed, a minesweeper pair can only turn in 15° increments instead of the normal 45°.

By 1919, a new type of minesweeping gear was introduced into the Royal Navy and soon thereafter, in every other navy. Called the Oropesa sweep gear, named after the trawler on which it was first used, it allowed for minesweeping operations by a single ship. It consists of a steel wire with cutters fixed along its length that was attached to a torpedo-shaped float. Oropesa gear can be deployed from one side of the minesweeper, called a single sweep, or from both sides, called a double sweep.

The Oropesa sweep gear takes seven Tactical Turns to stream a single sweep and ten Tactical Turns to stream a double sweep. The minesweeper must be at slow speed (5 knots) to deploy the sweep gear. Once streamed, Oropesa sweep gear can be towed up to speeds of 15 knots and has a sweep width of 250 yards for a single sweep and 500 yards for a double sweep. With Oropesa sweep gear streamed, a minesweeper can turn at the normal 45° interval, but it must spend one Tactical Turn before making a turn reeling in the sweep gear to prevent fouling. After the turn is complete, it takes another Tactical Turn to re-stream the sweep.

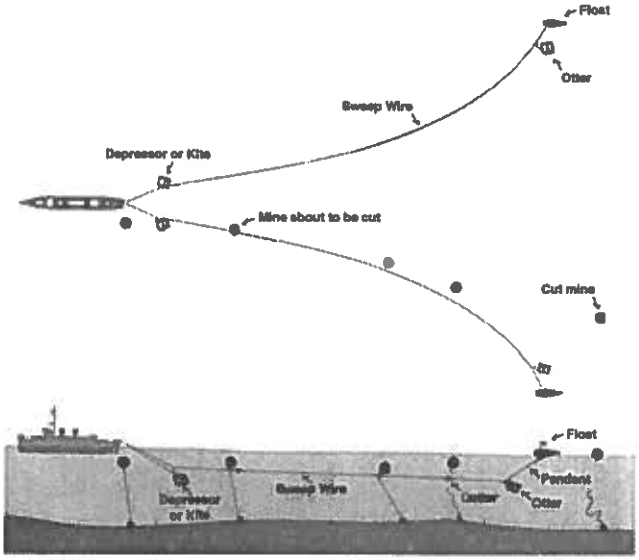
During WW I, it was often necessary to sweep ahead of the battle fleet as it left port and out into deeper waters. Unfortunately, the speed of the early minesweepers was far too slow and they could not keep up with the rest of the fleet. In early 1917, fast sweep gear, based on the mine paravane, was developed for destroyers to act as fleet minesweepers.

The paravane sweep gear takes five Tactical Turns to stream and the minesweeping destroyer must be at slow speed (5 knots) to deploy the sweep gear. Once streamed, the paravane sweep gear can be towed up to speeds of 25 knots and has a sweep width of 150 yards. For speeds 15 knots, the paravane sweep will not cut the mooring cables of mines and will therefore, have no effect on a minefield. With the paravane sweep gear streamed, a destroyer can turn at the normal 45° interval, however, the sweep width is halved during the turn as the paravane on the side in which the turn is made is not being dragged through the water. After the turn is complete, it takes one Tactical Turn to reestablish the sweep at its full width.

Note: All minesweepers are considered to be size class C vessels when they are engaged in minesweeping. The minesweeping gear could snag a mine's mooring cable and would either foul the sweep gear, or drag the mine under the minesweeper. The sweep gear could also just detonate a mine, and an explosion close aboard was all that was necessary to sink a minesweeper.

11.3.2 Effectiveness of Minesweeping. Minesweeping doesn't eliminate the threat from mines, but it will reduce the minefield's effectiveness or its probability of hit. Within the width of a minesweeper's gear, the number of mines will be gradually reduced with every pass over the area. Immediately after WW I, three passes over an area was considered sufficient to reduce the mine threat to an acceptable level, although early sweep gear would require more passes to get the same results. To do this to an entire minefield would require a considerable amount of time. That is why it was standard practice during the war to sweep out safe channels rather than an entire area in which mines were thought or known to exist.

A "pass" is defined as the passage of a sweep gear



Oropesa double sweep gear. *(US Navy)*

through a mined area. Three passes could be achieved by one ship making three separate runs or three ships making a single pass each. Each time that a pass is made, the minefield's probability of hit decreases. The reduction depends on the effectiveness of the sweep gear. The Minesweeping Reduction Table lists the remaining effectiveness of a minefield as a percentage of its original capability. The maximum reduction of a minefield's probability of hit is 75%.

MINESWEEPING REDUCTION TABLE

	Date of Minesweeping Gear		
Pass #	1900 - 1910	1911 - 1918	1919 - 1924
1	0.80	0.70	0.60
2	0.65	0.50	0.40
3	0.50	0.35	0.25
4	0.40	0.25	NE
5	0.35	NE	NE
6	0.25	NE	NE

NE = No additional effect.
Remaining probability of hit for one row of contact mines.

Example: A moored contact minefield has three lines of 20 mines with 75 yards between mines. A minesweeper squadron with 1917 sweep gear sweeps out a channel to allow a squadron on dreadnought battleships to pass. The minesweepers make a total of three passes and marks the 300-yard wide channel with buoys. The probability of a hit from a mine within the swept channel is:

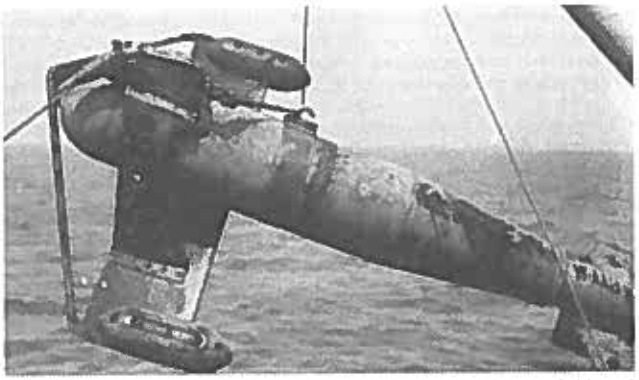
Original Ph for an A-size ship = 0.40
Remaining effectiveness after sweeping = 0.35

New Ph for an A-size ship = 0.35 x 0.40 = 0.14

Thus, each dreadnought has a 14% chance of hitting a mine inside the swept channel. Outside of the channel the minefield probability of hit is still 40%. Remember to consult section 3.5.3 Steaming in Marked Channels to see if a dreadnought strays outside the swept channel.

11.3.3 Mine Paravanes. While it was desirable to have minesweepers with the fleet at all times, there was rarely enough fast sweepers to provide protection. Since the use of slow minesweepers was a tactical impossibility, navies began developing the mine paravane to help protect their ships when traveling through minefields. By 1916, the vast majority of navies had a mine paravane system for warships, and by 1917 for merchants and trawlers.

The mine paravane is a towed float with control surfaces to make it submerge to a preset depth. For game play purposes this is Periscope Depth. Two paravanes are attached to the bow of a ship with a steel wire. When the ship picks up speed, the paravanes go to the determined depth and stream away from the ship, thereby stretching the wire taut. The bow wave of a ship usually pushes a moored mine out of the way. The mine would then normally swing back around into the side of the ship but with a pair of paravanes streamed, the mine's mooring cable is caught by the wire and the mine is dragged towards the paravane which has a cable cutter attached to it. While the paravane



Mine paravane used on US battleships. *(US Navy)*

wasn't a dedicated minesweeping system, it often would cut a mine's mooring cable.

Mine paravanes take five Tactical Turns to stream and the ship must be at slow speed (5 knots) to deploy the paravanes. Once streamed, the paravane gear can be towed up to speeds of 28 knots and provides protection out to 50 yards on either side of a ship. For speeds 15 knots, the mine paravane will not cut the mooring cable of mine, but it will still protect the ship. Mine paravanes reduce the effectiveness of a minefield by 50%. Warship mine paravane gear is not effective below speeds of 8 knots. Trawler mine paravanes provide protection at speeds greater than 4 knots, and can be towed up to speeds of 15 knots. With mine paravanes streamed, a ship can turn at the normal 45° interval, however, there is no protection provided on the side in the direction the turn is being made and the reduction in the minefield's effectiveness is only 25%.

Example: The same moored contact minefield (three lines of 20 mines with 75 yards between mines) is being crossed by a dreadnought at 16 knots, with a pair of mine paravanes deployed. The probability of a hit from a mine against a paravane equipped size A ship is:

Original Ph for an A-size ship = 0.40
Remaining effectiveness with paravanes = 0.50

New Ph for an A-size ship = 0.50 x 0.40 = 0.20

While mine paravanes provide protection from mines, they are not considered to be sweep gear even though they often cut mine mooring lines. However, warship mine paravanes can provide protection, i.e., the same minefield effectiveness reduction, for up to four ships in a single column if the mine paravane equipped ship is at speeds >15 knots. If the ship is at 15 knots or less, then only the ship with the paravanes has any protection.

Mine paravanes can be used in conjunction with minesweeping gear, to provide enhanced protection to the minesweeper, but paravanes do not count towards the total number of passes.

Rules Bibliography

Books

Baudry, A., *The Naval Battle; Studies of the Tactical Factors*, Hugh Rees, 1914
Brassey, T.A. ed, *The Naval Annual 1900 through 1921*, William Clowes and Sons Limited, London, 19 Volumes
Bray, Jeffery K., *Mine Warfare in the Russo-Soviet Navy*, Aegean Park Press, 1995
Broome, Jack, *Make a Signal*, Putnam, 1955
Brown, David K. (ed), *The Eclipse of the Big Gun - The Warship 1906-45*, Conway Maritime Press
Brown, David K., *Warrior to Dreadnought: Warship Development 1860-1905*, Naval Institute Press, 1997
Brown, David K., *The Grand Fleet: Warship Design and Development 1906-1922*, Naval Institute Press, 1999
Castex, Admiral Raoul, *Strategic Theories*, Naval Institute Press, 1994
RADM Chalmers, W. S., *The Life and Letters of Davis Beatty - Admiral of the Fleet*, Hodder and Stoughton, 1951
Campbell, John, *Jutland: An Analysis of the Fighting*, Conway Maritime Press, 1986
Coletta, Paolo E., *Sea Power in the Atlantic and Mediterranean in World War I*, University Press of America, 1989
Corbett, Julian S., *Some Principles of Maritime Strategy* , Longmans, Green and Co., 1918
Crowie, CAPT J. S., RN, *Mines, Minelayers and Minelaying*, Oxford University Press, 1949
Darrieus, Gabriel, *War on the Sea*, Naval Institute Press, 1908
Fioravanzo, Giuseppe, *A History of Naval Tactical Thought*, Naval Institute Press, 1979
Freeman, Lewis, *Sea-Hounds*, Dodd, Mead and Company, 1919
Fitzsimons, Bernard (ed), *Warships & Sea Battles of World War I*, Beekman House, 1973
Gill, C. C., *Naval Power in the War 1914-1918*, George H. Doran, 1918
Golding, Brad, *Grand Fleet Battle Orders Volume III: Jutland*, AAD Services, 1997
Goldrick, James, *The King's Ships Were at Sea*, Naval Institute Press, 1984
Gordon, Andrew, *The Rules of the Game; Jutland and British Naval Command*, Naval Institute Press, 1996
Gray, Edwyn A., *The Killing Time; German U-Boats 1914-1918*, Charles Scribner's Sons, 1972
Greger, Rene, *The Russian Fleet 1914-1917*, Ian Allen, 1972
Grove, Eric, *Big Fleet Actions: Tsushima, Jutland, Philippine Sea*, Arms and Armour Press, 1995
Hackman, Willem, *Seek & Strike: Sonar, Anti-submarine Warfare and the Royal Navy 1914-54*, Her Majesty's Stationary Office, 1984
Harris, Brayton, *The Age of the Battleship 1890-1922*, Franklin Watts, 1965
Hartmann, Gregory K. and Truver, Scott C., *Weapons that Wait: Mine Warfare in the US Navy Updated Edition*, Naval Institute Press, 1991
Hezlet, VADM Sir Arthur, *Electronics and Sea Power*, Stein and Day, 1975
Hogg, Ian V., *Allied Artillery of World War One*, The Crowood Press, 1998
Hough, Richard, *Dreadnought; A History of the Modern Battleship*, Macmillan Publishing, 1964
Hovgaard, William, *Modern History of Warships; Comprising a Discussion of Present Standpoint and Recent War Experiences*, Naval Institute Press, 1970), (orig. published London: Conway Maritime Press, 1920
Hovgaard, William, *General Design of Warships*, Spon & Chamberland, New York, 1920
Hovgaard, William, *Structural Design of Warships*, US Naval Institute, 1940
Hurd, Archibald, *Italian Sea-Power and the Great War*, Constable and Company, 1918
Hughes Jr., Wayne P., *Fleet Tactics; Theory and Practice*, Naval Institute Press, 1986
Kemp, Paul, *Convoy Protection; The Defence of Seaborne Trade*, Arms and Armour Press, 1993
Layman, R. D., *Naval Aviation in the First World War: Its Impact and Influence*, Chatham Publishing, 1996
Legg, Stuart (ed), *Jutland; An Eye-Witness Account of a Great Battle*, John Day, 1966
Levert, Lee J., *Fundamentals of Naval Warfare*, The Macmillan Company, 1947
Makarov, VADM S. O., *Discussion of Question in Naval Tactics* , Naval Institute Press, 1990, (orig. published by United States Office of Naval Intelligence, 1898
Manchester, William, *The Arms of Krupp 1587-1968*, Little, Brown and Company, 1968
McFarland, Stephan L., *America's Pursuit of Precision Bombing 1910-1945*, Smithsonian Institution Press, 1995
McKee, Alexander, *Against the Odds; Battles at Sea 1591-1949*,
Mitchell, Donald, *A History of Russian and Soviet Sea Power*, Macmillan Publishing, 1974
Mowthorpe, Ces, *Battlebags; British Airships of the First World War*, Sutton Publishing, 1995
Moss, Michael and Russell, Iain, *Range and Vision: The First Hundred Years of Barr & Stroud*, Mainstream Publishing Co, 1988
Padfield, Peter, *Aim Straight; A Biography of Sir Percy Scott-the Father of Modern Naval Gunnery*, Hodder and Stoughton, 1966
Padfield, Peter, *Guns at Sea*, St Martin's Press, 1974
Paine, Ralph D., *The Fighting Fleets; Five Months of Active Service with the American Destroyers and Their Allies in the War Zone*, Houghton Mifflin, 1918
Pemsel, Helmut, *Atlas of Naval Warfare*, Arms and Armour, 1977
Pollen, Arthur Hungerford, *The Navy in Battle*, Ghatto & Windus, 1919
Roberts, John, *ShipShape: Battlecruisers*, Naval Institute Press, 1997
Roberts, John, *Anatomy of the Ship: The Battleship DREADNOUGHT*, Naval Institute Press, 1992
Roberts, John, *The Design and Construction of the Battlecruiser TIGER*, WARSHIP Volume II, Conway/Naval Institute Press, 1978
Robison, RADM S. S., *A History of Naval Tactics from 1530 to 1930; the Evolution of Tactics Maxims*, Naval Institute Press, 1942
Rose, H. Wickliffe, *Brittany Patrol; The Story of the Suicide Fleet*, W. W. Norton & Company, 1937
Roskill, Stephen, *Admiral of the Fleet Earl Beatty*, Atheneum, 1980
Scheer, Admiral , *Germany's High Seas Fleet in the World War*, Peter Smith, 1934
Sims, RADM William Sowden, *The Victory at Sea*, Naval Institute Press, 1984) (originally published by Doubleday, Page & Company, 1920)

Sokol, Anthony, *The Imperial and Royal Austro-Hungarian Navy*, Naval Institute Press, 1968
Sumida, Jon Tetsuro, *In Defence of Naval Supremacy: Finance, Technology, and British Naval Policy 1889-1914*, Routledge, 1993
Tarrant, V. E., *The U-Boat Offensive 1914-1945*, Naval Institute Press, 1989
Terraine, John, *The U-Boat Wars 1916-1945*, Henry Holt and Company, 1989
Thomas, Lowell, *Raiders of the Deep*, Naval Institute Press, 1928
Tucker, Spencer C., *Handbook of 19th Century Naval Warfare*, Naval Institute Press, 2000
Walter, John, *The Kaiser's Pirates; German Surface Raiders in World War One*, Naval Institute Press, 1994
VADM Wegener, Wolfgang, *The Naval Strategy of the World War*, Naval Institute Press, 1989, (originallly published Berlin: E.S. Mittler & Son, 1929)
Weir, Gary, *Building the Kaiser's Navy*, Naval Institute Press, 1992
Wilson, H. W., *Battleships in Action*, (2 Vols), Naval Institute Press, 1995
Woodward, David, *The Russians at Sea; A History of the Russian Navy*, Frederick A. Praeger, 1965
Woodward, E. L., *Great Britain and the German Navy*, Clarendon Press, 1935
Yates, Keith, *Graf Spee's Raiders; Challenge to the Royal Navy 1914-1915*, Naval Institute Press, 1995
Young, Filson, *With the Battle Cruisers*, Naval Institute Press, 1986), (orig. published by Cassell and Company, 1921

Articles

Cleary, CDR F. J, USN, *Range Finders and Range Finding*, Journal of the American Society of Naval Engineers, Vol XXXII, February 1920, p. 1.
Jurens, William J., *Exterior Ballistics with Microcomputers*, Warship International No. 1 1984, p. 49
Jurens, William J., *The Evolution of Battleship Gunnery in the U.S. Navy, 1920-1945*, Warship International No. 3 1991, p. 240
Okun, Nathan, *Armor and its Applications to Warships Part 1*, Warship International No. 2 1976, p. 115
Okun, Nathan, *Armor and its Applications to Warships Part 2*, Warship International No. 2 1977, p. 98
Okun, Nathan, *Armor and its Applications to Warships Conclusion*, Warship International No. 4 1978, p. 284
Okun, Nathan, *Face Hardened Armor*, Warship International No. 3 1989, p. 262
Schleihauf, William, *A Concerted Effort: Royal Navy Gunnery Exercises at the End of the Great War*, Warship International No. 2 1998, p. 117

Official Documents

Air Defense: An Historical Analysis Vol I, US Army Air Defense School, Fort Bliss, 1965
America's Munitions 1917-1918, Washington Government Printing Office, 1919
Barr and Stroud Naval Rangefinders and Mountings, Admiralty Gunnery Branch, 1912
Corbett, Sir Julian S., *History of the Great War; Naval Operations, (Vols 1-3)*, The Imperial War Museum, 1938) 2nd ed.
Development of the Paravane, CB1515/51, Admiralty, July 1921
Duncan, Robert C., *America's Use of Sea Mines*, US Naval Ordnance Laboratory, White Oak, US Government Printing Office, 1962
Final Report of the President, Projectile Committee, 1917, CB01303, Admiralty Gunnery Branch, June 1917
Fire Control in H.M. Ships, CB1515/23, Admiralty Gunnery Branch, December 1919
Fire Control Notes 1940 for U.S. Naval Reserve, US Government Printing Office, 1941
Government Printing Office, *Conference on the Limitation of Armament* (Nov 12, 1921-Feb 6, 1922) 1922 copy in French and English
Howeth, CAPT L.S. USN (Ret), *The History of Communications Electronics in the United States Navy*, US Government Printing Office, 1963
Italy, Marina. Stato maggiore. Ufficio Storico, *The Italian Navy in the World War 1915-1918*, (Roma: Provveditorato Generale Dello Stato, 1927
Melia, Tamara M., *"Damn the Torpedoes": A Short History of U.S. Naval Mine Countermeasures, 1777-1991*, Naval Historical Center, US Government Printing Office, 1991
Manual of Gunnery Volumes I & II For His Majesty's Fleet, Admiralty Gunnery Branch, 1915
Naval Ordnance 1915, US Naval Academy, 1917
Naval Ordnance Activities: World War 1917-1918, Washington Government Printing Office, 1920
Naval Ordnance and Gunnery, NAVPERS 16116-B, US Government Printing Office, 1950
Newbolt, Henry, *History of the Great War; Naval Operations, (Vols 1-3)*, The Imperial War Museum, 1938) 2nd ed.
The Blue Jackets Manual 1917, United States Navy, Military Publishing Co, 1917

Websites

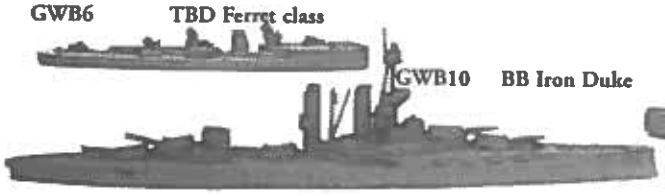
Okun, Nathan, *Miscellaneous Naval Armor Related Formulae*, http://www.warships1.com
Okun, Nathan, *Major Historical Naval Armor Penetration Formulae*, s1.com http://www.warships1.com

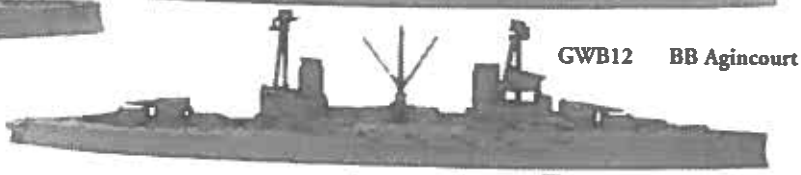
GHQ

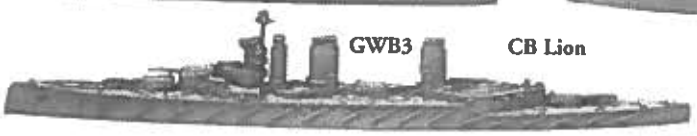
GreatWar MICRONAUTS®

1:2400 Scale Pewter Models

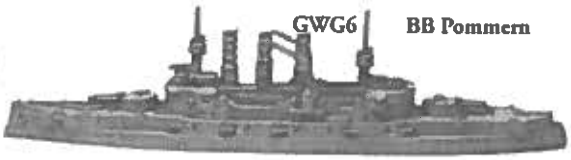
The finest line of World War I miniatures available in any scale!







GHQ offers all the ship classes at Jutland!



Only a few are shown here!

GHQ, 28100 Woodside Road, Shorewood, MN 55331 USA
(612) 374-2693 fax (952) 470-4428
www.ghqmodels.com